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Experimental Investigation of Flexural Behavior of Self Compacting Concrete Using Copper Slage

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Abstract

In recent years, self-compacting concrete (SCC) has gained wide use for placement in congested reinforced concrete structures with difficult casting conditions. In this experimental study M50 grade of concrete is adopted. The cement and fine aggregate is partially and fully replaced with fly ash and copper slag and it's compared with controlled specimens. Replacement of copper slag by weight of fine Aggregates in various percentages such as 10%, 20%, 30%, 40% up to 100% does not have any adverse effect on strength. Fly Ash of about 0.4% is replaced by weight of cement and strength properties of concrete is compared. The compressive strength and Flexural strength test, split tensile strength of hardened concrete with various replacements is to be investigated. This replacement would prove to have some environment benefits and would be an economical or a cost effective technique in concreting for the future. Environmental aspects move the research towards recycling industrial by-products, as Fly ash

Key Words: Self-compacting concrete, SCC Mix design, Flow ability, Workability, Testing methods, Copper slag, Fly Ash, and Compressive strength, split tensile strength, Flexural strength.

1. Introduction

Self-compacting concrete (SCC), a new kind of high performance concrete (HPC) with excellent deformability and segregation resistance, was first developed in Japan in1986. It is a special kind of concrete that can flow through and fill the gaps of reinforcement and corners of molds without any need for vibration and compaction during the placing process.

The application of concrete without vibration in construction is not new. For examples, placement of seal concrete underwater is done by the use of a tremie without vibration, mass concrete has been placed without vibration. These seal, mass and shaft concretes are generally of lower strength, less than 34.5 MPa and difficult to attain consistent quality. Modern application of self-compacting concrete (SCC) is focused on high performance better and more reliability, dense and uniform surface texture, improved durability, high strength and faster construction.

The performance required for concrete structures is more complicated and diversified. The concrete is required to have properties like high fluidity, self compactability, high strength, high durability, better serviceability and long service life of concrete structures. In order to address these requirements Self Compacting concrete (SCC) was developed.

It is relatively new product that sees the addition of High Range Water Reducing Admixture (HRWA) and Viscosity modifying admixture to the concrete mix to significantly increase the ease and rate of flow. By its very nature, SCC does not require vibration. It achieves compaction into every part of the mould or formwork simply by means of its own weight without any segregation of the coarse aggregate.

1.1 Self-Compacting Concrete

Self-compacting concrete (SCC) is defined as the concrete which can be placed and compacted into every corner of formwork, purely by means of its self-weight, by eliminating the need of either external energy input from vibrators or any type of compacting effort.

The intention behind developing this concrete was the concerns regarding the homogeneity and compaction of cast-in-place concrete with in intricate, of paste (i.e. highly reinforced structures and improvement of overall durability, quality of concrete due to lack of skilled labors.

This concrete is highly flow able and cohesive and enough to handle without segregation. It is also referred as Self levelling concrete, Super workable concrete, Self-consolidating concrete, High flow able concrete and Non-vibrating concrete.

1.2 Requirements of Self-Compacting Concrete

Increase of water-to-cementitious material increases the flow ability of cement paste at the cost of decrease in its viscosity and deformability the primary requirements of SCC. The SCC is flow able as well as deformable without segregation. Therefore in order to maintain deformability along with flow ability in paste, Super plasticizer is must in concrete. With Super plasticizers, the paste can be made more flow able with little decrease in viscosity. An optimum combination of W/C ratio and super plasticizers for achieving the self-compactibility can be derived for fixed aggregate content concrete.

1.3 Role of Mineral Admixtures in Self- Compacting Concrete

High flow ability requirement of SCC allows the use of mineral admixtures in its manufacturing, use of mineral admixtures results in reduction in the cost of concrete. The incorporation of one or more mineral admixtures/powdery materials having different morphology and grain size distribution can improve particle-packing density and reduce inter-particle friction and viscosity. Hence it improves deformability, Self-compactibility and stability of SCC.

1.4 Development of Self-Compacting Concrete

SCC mix should meet these key properties:

- Ability to flow into and completely fill intricate and complex form under its own weight.
- Ability to pass through and bond to congested reinforcement under its own weight.
- High resistance to aggregate segregation.

The SCC mixes are designed and tested to meet the demands of the projects. For examples, the mix for mass concrete is designed for pumping and depositing at a fairly high rate. SCC was mixed at a batch plant at the job site and pumping through a piping system to the location of the anchorage 200m away. The SCC was dropped from a height of as much as 5m without aggregate segregation. For mass concrete, the maximum size for coarse aggregates may be as large as 50mm. The SCC construction reduced the construction time for the anchorage from 2.5 years to 2 years. Similarly SCC mixed can be designed and placed successfully for concrete members with normal and congested reinforcement. The coarse aggregate size for reinforced concrete generally varies from 10mm to 20mm.

1.5 Merits of Self-Compacting Concrete

- Industrialized production of concrete.
- Promote the development of a more concrete production.
- Reduction in the construction time by accelerating the construction process.
- Improve working environment at a construction site by reducing noise pollution.
- Easily placed in thin walled on element with limited access.
- Ease of placement results in cost saving through reduced equipments and labor requirement.
- Increases the bond strength between the aggregates and reinforcement bars.

1.6 Applications of Self-Compacting Concrete

- SCC can be used in precast industries.
- In complicated reinforcement positions.
- Construction element in high rise buildings.
- Natural drought cooling tower tank bund areas.
- Marine structures. Reduced form work and equipment cost.
- Less man power.
- Improved durability and good structural performance.

1.7 Copper Slag

The use of industrial wastes in cement concrete is an economical and eco-friendly material. Copper slag is a glassy granular material with high specific gravity. Particle sizes are of the order of sand and have a potential for use as fine aggregate in concrete. The copper slag was brought from Sterlite Industries Ltd (SIL), Tuticorin, Tamil Nadu, India. SIL is producing copper slag during the manufacture of copper metal. Currently, about 2600 tons of copper slag is produced per day and a total accumulation of around 1.5 million tons. This slag is currently being used for many purposes ranging from land-filling to grit blasting. These applications used only about 15% to 20% and the remaining dumped as a waste material and this causes environmental pollution.

Fig 1: Copper Slag

Copper slag is widely used in the sand blasting industry and it has been used in the manufacture of abrasive tools. Since copper slag is glassy and granular in nature and has a similar particle size range to sand, indicating that it could be used as a replacement for the sand present in the cementitious mixes (CaijunShi, Christian Meyer, Ali Behnood).

1.8 Ingredients Used

- **Cement:** Ordinary Portland Cement 40 grade (OPC)
- **Fine Aggregate:** Natural River Sand

- **Coarse aggregate:** Maximum size of 10mm-12.5 mm is Used
- **Mineral admixtures:** Fly Ash

1.9 Developing SCC Mixes

SCC mixes must meet three key properties:

- Ability to flow into and completely fill intricate and complex forms under its own weight.
- Ability to pass through and bond to congested reinforcement under its own weight.
- High resistance to aggregate segregation.

1.10 Objective and Scope of Study

The objective of the present investigation in self-compacting concrete is to study its characteristics in fresh and hardened state.

In this project it is proposed to study:-

- Mix proportions for Self-Compacting Concrete and to obtain the optimum percentage of fly ash and Copper slag to be replaced in SCC.
- Study the workability characteristics of self-compacting concrete with partial replacement of cement by fly ash and copper slag using
    - Slump-flow test.
    - V-funnel test.
    - V-funnel at T- 5 minutes
    - L-box test.
- To study and compare the properties of hardened concrete and Self compacted concrete (SCC) using
    - Cube compressive strength
    - Split Tensile strength
    - Flexural strength.

1.11 Scope

The main scopes of this investigation are

- To varying the percentage replacement of cement by fly ash and copper slag from 0 to 100%
- The replacement of the cement by fly ash and copper slag in concrete applications would lead to considerable environmental benefits like dumping, exploiting natural resources and would be economical

2. Properties of Materials

2.1 Cement

Cement is a binding material. The history of cementing material is as old as the history of engineering construction. Ordinary Portland cement is far the most important type of cement. The OPC classified into three grades, namely 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested as per IS 4031-1988.If 28 day strength is not less than 33N/mm^2 it is called 33 grade cement, if the strength is not less than 43N/mm^2, it is called 43 grade cement, and the strength is not less than 53N/mm^2, it is called 53 grade cement. But the actual strength obtained by these cements at the factory is much higher than the BIS specification. The raw materials used for the manufacture of cement consist mainly of lime, silica, alumina and iron oxide. The basic constitutive elements are lime, silica, alumina, iron and gypsum, magnesia and alkalis

2.2 Fine Aggregate

Fine aggregate are material passing through an IS sieve that is less than 4.75mm Gauge Usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone is used as a fine aggregate. The sand used for the experimental works was locally procured and conformed to grading zone II. Sieve Analysis of the Fine Aggregate was carried out in the laboratory as per IS 383-1970. The fine aggregate was first sieved through 4.75mm sieve to remove any particle greater than 4.75 mm sieve and then was washed to remove the dust.

According to IS 383:1970 the fine aggregate is being classified in to four different zone, that is Zone-I, Zone-II, Zone-III, Zone-IV.

2.3 Coarse Aggregate

The materials which are retained on 4.75mm sieve are called coarse aggregate. The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in the present work. According to IS 383:1970, coarse aggregate maximum 20mm is suitable for concrete work. But where there is no restriction 40mm or large size may be permitted.

2.4 Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Potable water is generally considered satisfactory. In the present investigation, tap water was used for both mixing and curing purposes. A graph within a graph is an “inset,” not an “insert.” The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).

3. Test on Materials

Table :1 Cement

Testing Items	Test on values
Specific gravity	3.12
Fineness of Cement	5.1%
Standard consistency	32%
Initial setting time	30 minutes
Final setting time	11 hours

Table :2 Fly Ash

Testing Items	Test on values
Specific gravity	2.65

Table :3 Fine Aggregate

Testing Items	Test on values
Specific gravity	2.66
Fineness modulus	3.83
Water absorption test	0.5%
Bulk Density test	1560 Kg/m^3

Table : 4 Copper Slag

Testing Items	Test on values
Specific gravity	3.05
Fineness modulus	3.87
Water absorption test	0.3%

Table : 5 Coarse Aggregate

Testing Items	Test on values
Specific gravity	2.73
Bulk Density test	1450 Kg/m^3
Water absorption test	

4. Test on Fresh Concrete

4.1 Properties of Concrete

The properties of concrete is two types, they are fresh and hardened concrete properties. The performance of concrete properties are mainly depends upon the mix design, shape and strength of aggregates. Water-cement ratio is main factor of fresh concrete

properties. It may affect the durability of concrete. The strength and life time of the structure is mainly depending on properties of concrete only.

4.2 Fresh Concrete Properties

The fresh concrete property is depending up on properties like cement, grading of aggregate and water. The slump test, compaction factor test are used to find the workability of the concrete. The required quantity of water is calculated and added to the concrete to find the workability of concrete. The test was carried out according to IS 6461 (Part 7)-1973 - define the workability as that property of freshly mixed concrete.

4.3 Slump Flow

Slump flow and T_{500} time is a test to assess the flow ability and the flow rate of SCC in the absence of obstructions.it is based on the slump test described in EN 1253-2. The result is an indication of the filling ability of SCC, and the T_{500} time is a measure of the speed of flow and hence viscosity. The fresh concrete is poured into a cone to when the concrete has flowed to a diameter of 500mm is measured; this is the T_{500} time. The largest diameter of the slow spread of the concrete and the diameter of the spread at right angles to it are then measured and the mean is the slump flow.

4.4 L-box Test

L-box test is asses the passing ability of SCC to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking. L-box has arrangement and the dimensions as shown in Fig.

Fig 2: L-Box test

Test procedure is to support the L-box on a level horizontal base and close the gate between the vertical and horizontal sections. Pour the concrete from the container into the filling hopper of the box and allow to stand for (60±10)s. when movement has ceased, measure the vertical distance, at the end of the horizontal section of the box at three positions equally spaced across the width of the box. By difference with the height of the horizontal section of the box, these three measurements are used to calculate the depth of concrete immediately behind the gate as H1 mm. the passing ability is calculated from the following equations : PA = H2/H1.

4.5 V-Funnel

V-funnel test is used to assess the viscosity and filling ability of SCC, Procedure is to clean the funnel and bottom gate, then dampen all the inside surface including the gate, close the gate and pour the sample of concrete into the funnel, without any agitation or Roding, then strike off the top with the straight edges so that the concrete with the top of the funnel. Place the container under the funnel in order to retain the concrete to be passed. After a delay of (10±2) s from filling the funnel, open the gate and measure the time t_v, to 0.1s, from opening the gate to

when is possible to vertically through funnel into the container below for the first time. t_v is the v-funnel flow time.

4.6 U-Box Test

U-Box test apparatus consists of vessel that is divided by a middle wall into two compartments. Especially fluidity of SCC is measured by using this test. It range is in between (h2 – h1) = 0 and 30mm.

Fig: 4 U-Box Test

5. Results and Discussion

Table: 6 Fresh concrete test

Property measured	Test method	Test on values
Flow ability / Filling ability	Slump flow	680mm
	T_{500}	3-sec
	V – funnel	10-sec
Passing ability	U – box	H_2- H_1=15-15 =0 mm

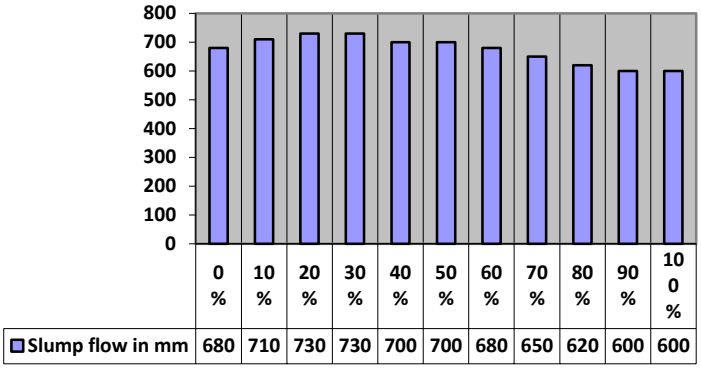

Figure: 5 Slump flow tests for various replacements of copper slag

5.2 Hardened Concrete Test

Compressive Strength

The cube size of 150mmX150mmX150mm as per the IS 10086-1982.moulds were cleaned thoroughly using a waste cloth and then properly oiled in the surfaces. Concrete is filled

in to mould and then compacted using a standard tamping rod of 60 cm length having a cross sectional area of 25mm^2.the control and various replacement percentages of sand and cement with copper slag and fly ash concrete cube specimens are casted and demoulded after 24 hours from the casting. Determine the compressive strength of the concrete for each sets of cubes after 7, 14 and 28 days of curing.

Table :7 Compressive test result with various replacement (%)

Replacement %	7 Days (N/mm^2)	14 Days(N/mm^2)
conventional	23.11	30.22
10%	20.88	28.10
20%	22.22	30.22
30%	23.34	31.11
40%	18.55	30.66
50%	15.23	26.44
60%	14.22	22.33
70%	12.44	20.44
80%	11.11	19.33
90%	09.33	15.55
100%	08.22	14.22

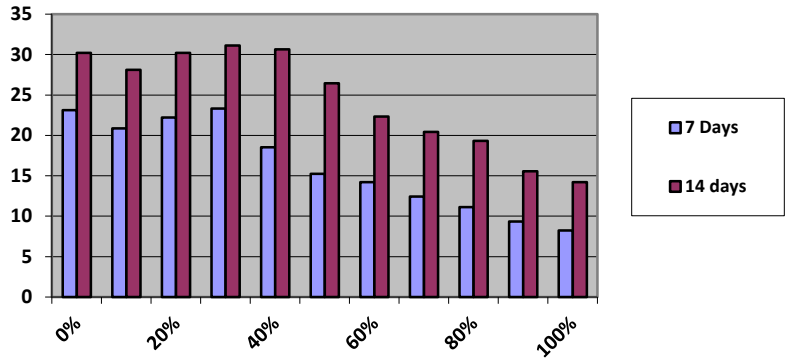

Fig: 6 Comparison of Compressive test result with various replacement (%)

Spilt Tensile Strength Test

The cylinder specimen is of size 150 mm x 300 mm, if the largest nominal size of the aggregate does not exceed 12.5 mm. The splitting test is simple to perform and gives more uniform results than other tension tests. Strength determined in the splitting test believed to be closer to the true tensile strength of concrete, than the modulus of rupture. Split tension gives about 5 to 12% higher than the direct tensile strength.

Table: 8 Split tensile strength test results with various replacement %

Replacement %	7 Days (N/mm^2)	14 Days(N/mm^2)
Conventional	1.37	1.87
10%	1.78	2.36
20%	1.89	2.61
30%	2.33	3.28

40%	2.58	3.76
50%	2.18	2.62
60%	2.13	2.56
70%	1.92	2.33
80%	1.78	2.12
90%	1.32	1.65
100%	1.15	1.34

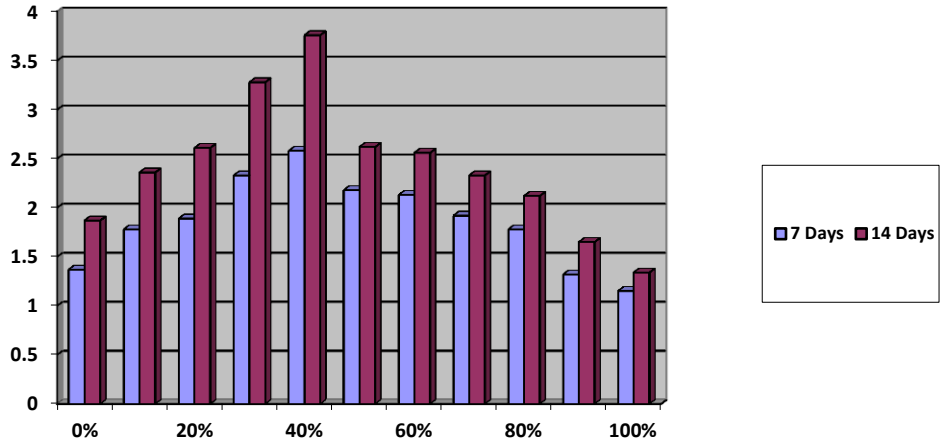

Fig:7 Comparison of split tensile strength results

Flexural Strength Test

The size of beam specimen is 500X100X100mm. The beam specimens were cast and tested with and without copper slag for normal conditions IS10086-1982.Moulds were cleaned thoroughly using waste cloth and then properly oiled the inner surfaces. Concrete is filled in to mould and then compacted using a standard tamping rod of 60cm length having a cross sectional area of 25mm^2. The specimens were immersed into water for curing up to 7 , 14 and 28days. Determine the flexural strength of concrete for each set of rectangle after 7th ,14thand 28th days of curing.

Table: 9 Flexural strength test results with various replacement %

Replacement %	7 Days (N/mm^2)	14 Days(N/mm^2)
Conventional	1.75	1.98
10%	1.97	2.12
20%	2.57	2.98
30%	2.65	3.12
40%	2.76	3.04
50%	2.18	2.62
60%	3.00	3.65
70%	2.80	3.13
80%	2.45	2.64
90%	2.27	2.45
100%	2.18	2.23

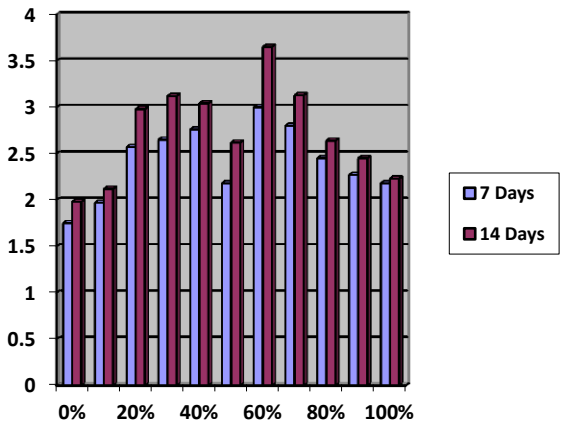

Fig:8 Comparison of flexural strength test results on various replacement.

6. Conclusion

- It shows that the water consumed by the copper slag during mixing is very less when compared with river sand.

- The blend of copper slag and river sand with slag upto 30% can be used as fine aggregate in pavement quality concrete as well as in dry clean concrete.
- Use of copper slag and fly ash in construction is possible to work and it is very cheap and gives good result.
- This study points out the beneficial aspects of using copper slag as a best replacement material of fine aggregate.
- The 30% replacement of sand with copper slag and 40% replacement of weight of cement with fly ash significantly increase the compressive strength of concrete mixtures.
- Results obtained from this study indicate the tremendous potential of copper slag as a mineral admixture.

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An Ample Appraisal of Phase Change Materials for Thermal Insulation

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Abstract

Energy is the evergreen topic which is having significant in all the stages & periods of Research. In the construction field, the consumption of energy is huge when compare to other engineering field. For the effective utilization and to conserve the energy resources, the implementation of new technique is the necessary one, to find the alter choice of formal materials and resources. This paper makes a complete review on the usage of phase change materials in building construction to consume less amount of energy by controlling the thermal effect in building envelope. Heat, Ventilation and Air-Conditioning is always a major concern in any of the building design to utilize less amount of conventional energy to make comfort environment. By considering the significance of HVAC, This paper also reviews the importance of HVAC implementation in buildings to make a thermal comfort building. Among the two types of PCM's the article recommends to use of organic PCM based on the benefits as mentioned in the reviewed papers. The prominent characteristics such as high thermal stability and non-corrosiveness are the major advantages of Organic PCM to recommend and utilize it in building environments when compared to Inorganic PCM.

Keywords: PCM, Energy Efficiency, Thermal Insulation, Comfort building zone

Introduction

Globally, buildings are responsible for 40% of the total world annual energy consumption which is responsible for one-third of greenhouse gas emissions around the world. A significant portion of this energy is used for lighting, heating, cooling, and air conditioning purposes in

buildings. Increasing awareness of the environmental impact of greenhouse gas emissions and CFCs triggered a renewed interest in environmentally friendly cooling, and heating technologies for buildings. Free cooling of buildings may be seen as an alternate to compressor based air conditioning systems used for the buildings. [7]

Residential buildings are mostly sensitive to climatic conditions, building envelopes work as the interface between indoor and outdoor environments, preventing heat gain in the summer ad heat loss in the winter. Proper use of energy storage technologies may reduce greatly the energy needs in residential dwellings while delivering better indoor environment quality. [1]

The importance of energy efficient buildings has assumed great urgency in light of fast depleting energy resources, energy scarcity and increasing environmental pollution. Innovative ways to cut down energy consumption are necessary. The construction industry is one of the largest energy consuming sectors. In modern buildings significant amount of energy is consumed to keep the building environment comfortable. In developing countries like India, rising population, increasing standards of living and rapid urbanization result in an increase in building construction activities. [2]

Approximately 30% of energy use in Canada is consumed in buildings. The largest component of this energy consumption in multifamily residential buildings is space heating. One of the primary functions of building enclosure is reducing space-heating energy. Although heat flow cannot be completely prevented, it can be controlled to reduce energy consumption, create a sustainable environment, and implement indoor human comfort. However, this can be achieved by constructing a thermally resistant building enclosure. [3]

Energy Efficiency

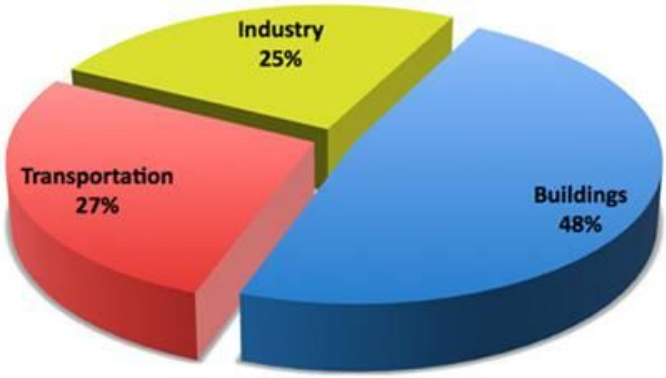

Fig.1. Energy Consumption in Canada

Energy Efficiency is nothing but an achieving the desired comfort with the least input of conventional energy. Architects and designers accomplish the task through solar passive design, use of renewable energy technology systems, and/or natural building materials. While designing such buildings, not only new building stock can be targeted but also existing buildings can be retrofitted with energy efficient and eco-friendly technologies, thereby substantially reducing energy consumption. All put together is Energy Efficient Housing. [2]

In residential sector, size and location are key factors for energy consumption. Small flats needs less energy as there is less conditioned and transfer area, and also less occupation. The amount and type of energy used in dwellings are mainly related to weather, architectural design, energy systems and economic level of occupants. By and large, dwellings in developed countries use more energy than those in emerging economies and it is expected to continue growing due to the installation of new appliances. In USA, dwellings consume 22% of the total final energy use, compared with 26% in the EU. The UK figure is 28%, well above the Spanish 15% mainly due to more severe climate and building type. For example: Predominance of independent houses over blocks. [14]

If we concentrate on energy efficiency, we can't omit the greenhouse gas emissions. The continuous increase in the level of greenhouse gas emissions and the climb in fuel prices are the main driving forces behind efforts to more effectively utilize various sources of renewable

energy. In many parts of the world, direct solar radiation is considered to be one of the most prospective sources of energy. However, the large-scale utilization of this form of energy is possible only if the effective technology for its storage can be developed with acceptable capital and running costs. One of prospective techniques of storing solar energy is the application of phase change materials (PCMs). This paper looks at the current state of research in this particular field, with the main focus being on the assessment of the thermal properties of various PCMs, methods of heat transfer enhancement and design configurations of heat storage facilities to be used as a part of solar passive and active space heating systems, greenhouses and solar cooking. [12]

Approximately 30% of energy use in Canada in consumed in buildings. The largest component of this energy consumption is in multifamily residential buildings in space heating. One of the primary functions of building enclosure is reducing space – heating energy. Although heat flow cannot be completely prevented, it can be controlled to reduce energy consumption, creates a sustainable environment and implement human comfort. However this can be achieved by constructing a thermally resistant building enclosure. [13]

Concrete and Brick walls are coated with Phase Change Materials to make a comfort building environment. Its aim is to study the influence of the integration of PCM on the thermal behavior of cells and on the thermal behavior of cells and on the improvement of thermal comfort in buildings under the Algerian climate. [6]

A building faces different kinds of problems due to thermal inefficiency such as condensation on window surfaces; some occur within our wall and roof systems. Condensation problems occur for several reasons like, elevated humidity and stagnation of air. Evaluations of thermal inefficiencies are done using visual observation, tracer smoke testing, infrared thermography and thermal analysis. Along with architectural features such as light shelves and sun shades, we have to consider about structural retrofits for stabilizing the thermal comfort.[15]

Phase Change Materials

The effect of phase change material (PCM) integration in buildings is investigated in mild climates for the entirely of the hot season. The incorporation of PCMs in building materials is particularly interesting because it allows for the thermal storage to become a part of the building structure while being completely passive. Simulations in a typical single-family home are carried out, and the effect of incorporating PCMs in different building components is analyzed. Results show an important reduction in cooling energy. [9]

In our work different kinds of materials were used as PCM. In principal materials should fulfill different criteria in order to be suitable to serve as a PCM.

- Suitable melting temperature
- High melting enthalpy per volume unit [kJ/m³]
- High specific heat [kJ/(kg.K)]
- Low volume change due to the phase change
- High thermal conductivity
- Nonflammable, Nonpoisonous, Non corrosive

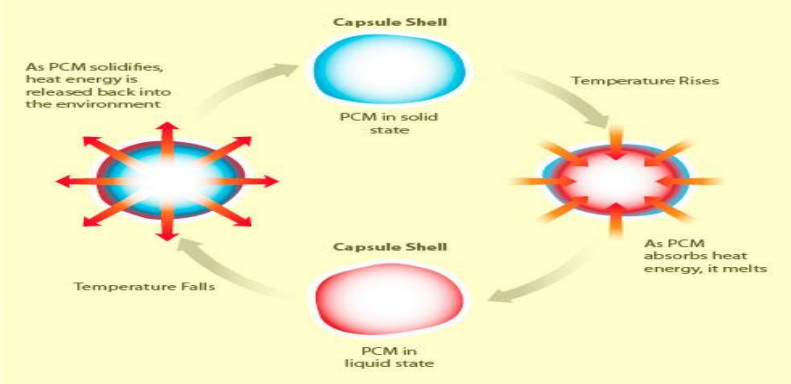

Fig.2 Phase Change Materials

Why PCM is Necessary for Energy Efficiency?

- The optimum concentration of PCM (30% PCM) wherein the composite material has a specific heat and mechanical properties well suited to the use of PCM in the building

- During the summer season, the PCM incorporated building components decrease of 2.5 C in the maximum indoor temperature and reduces the amplitude of the cells indoor temperature by 4C.
- The PCM improves the thermal comfort and increases the maximum wall temperature by 4 C in winter period. [6]

Organic PCM

These are generally stable compounds and free from super cooling, corrosion, having great latent heat of fusion. Commercial Paraffin waxes are inexpensive and have a reasonable thermal storage density of 120kJ/kg up to 210kJ/kg. Paraffin's are chemically inert and available in a wide range of melting temperatures from approximately 200C up to about 700C, of most interest in this group are the fatty acids palmitoleic acids. It is free from super cooling, volumetric change and has high latent heat of fusion. [8]

Table 1: Advantages and disadvantages of PCMs [10]

Description	**Organic PCM**	**Inorganic PCM**
Advantages	Not Corrosive	High Melting Enthalpy
	Chemically and Thermally Stable	High Density
	No or Little Subcooling	
Disadvantages	Lower Melting Enthalpy	Subcooling
	Lower Density	Corrosive
	Flammable	Cycling Stability

Overview on PCM Tasks

The Phase change materials are involved in various components of buildings to control the thermal effect and to make a comfort indoor temperature with minimal usage of energy.

Some of the tasks which are performed with the applications of PCM are studied to understand the mechanism and applications of PCM.

Some of the reviewed papers are compacted here as follows:

- The three cells are made and located in the Algiers region. Among the three cells two cells are made with PCM and by the analysis results show that the use of a gypsum plaster incorporating 30% PCM contributes to a reduction of the amplitude of indoor temperature of the cell by 4°C in the summer. The use of PCM has also improved thermal comfort and increased the maximum cell temperature by 2°C during winter. Tests of the flexural strength, compressive strength, bond strength, and hardness were performed at seven days of age on composite plaster/PCM materials. [6]
- In the present work, silica nanoparticles (30-70nm) were supplemented into cement paste to study their influence on degree of hydration, porosity and formation of different type of calcium-silicate-hydrate (C-S-H) gel. As the hydration time proceeds, the degree of hydration reach to 76% in nano-modified cement paste whereas plain cement achieve up to 63% at 28 days. An influence of degree of hydration on the porosity was also determined. In plain cement paste, the capillary porosity at 1hr is ~48%, whereas in silica nanoparticles added cement is ~35 % only, it revealed that silica nanoparticles refines the pore structure due to accelerated hydration mechanism leading to denser microstructure. Similarly, increasing gel porosity reveals the formation of more C-S-H gel. Furthermore, C-S-H gel of different Ca/Si ratio in hydrated cement paste was quantified using X-ray diffractometer and thermogravimetry. The results show that in presence of silica nanoparticles, ~24% C-S-H (Ca/Si<1.0) forms, leading to the formation of polymerized and compact C-S-H. In case of plain cement this type of C-S-H was completely absent at 28 days. These studies reveal that the hydration mechanism of the cement can be tuned with the incorporation of silica nanoparticles and thus, producing more durable cementitious materials.[11]

- In another project, thermal analysis was made by using of Finite Element Method in two dimensional analysis. The thermal efficiency was found out by comparing the wall system of with and Without PCM. The heat gain is significantly reduced when the PCM is incorporated into the brick, and increasing the quantity of PCM has a positive effect. The results show the best performance when compared to nominal wall. [4]
- The thermal properties and structural performance of variable density wall panels was investigated made with a range of Portland cement (PC) and inorganic polymer concrete mixes and using different light and heavyweight aggregates. Results from thus study found that inorganic polymer concrete produces lower thermal conductivity and volumetric heat capacity compared with PC concrete.[5]
- The usage of Phase Change Materials in residential building applications are studied by making modeling methods of PCM-embedded wall system and a new simulation program is developed to simulate the thermal performance of walls with and without PCM. Both technical and economic performances of the solution are explored. [1]

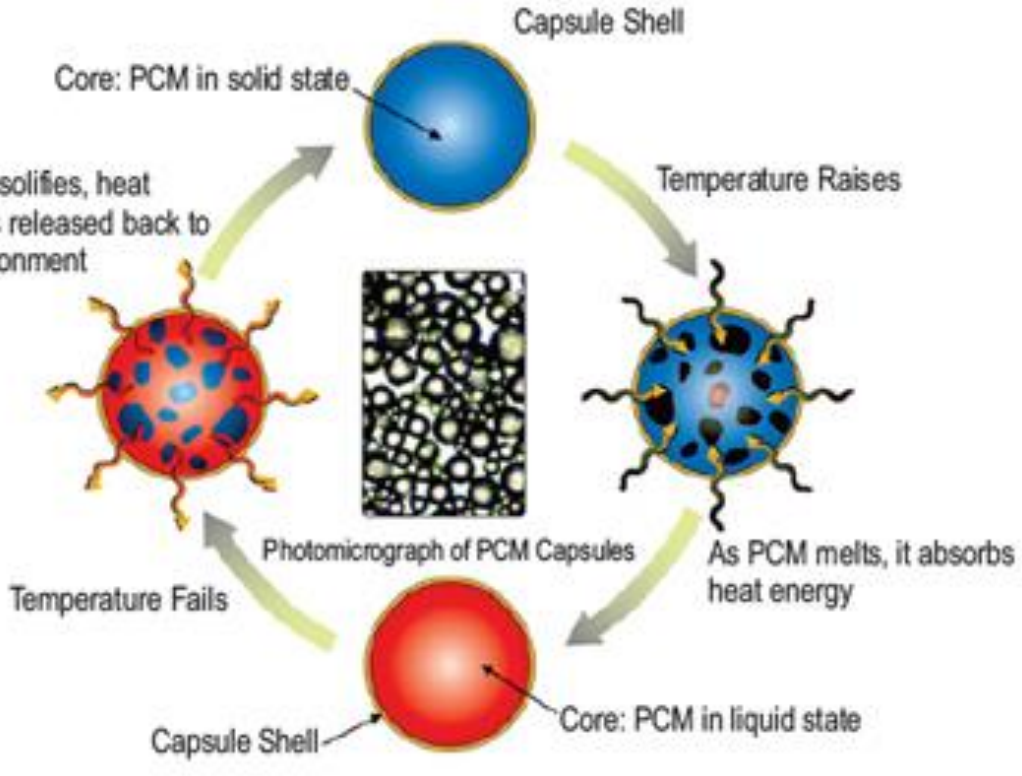

Fig.3.Photomicrograph of PCM

Conclusion

Thus the paper was concluded that the implementation of Phase Change Materials in building components will improve the thermal stability of the structure and it gives the comfort indoor temperature. The less consumption of energy and giving much benefit is the advantage of using PCM. Through the concept of HVAC we can make a comfort building envelope without causing pollution. More than that, each and every one has to aware about the Energy consumption and in every stage from planning to execution, we have to implement it by consuming optimal quantity of energy to make sustainable green environment. As compare to all other methods, PCM is the best choice for building energy efficient structures by providing comfort temperature with less amount of coolant agencies.

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A Study on Causes and Effects of Delays in Construction Projects At Dindigul and Madurai Districts

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Abstract

This paper focus on construction delays are common problems in private and government projects in Dindigul and Madurai District. This problem occurs frequently during life time leading to dispute and litigations. Therefore it is essential to study and investigate causes of construction delay. There are a number of definitions for delay: to make something happen later than expected; to cause something to be performed later than planned or to not act timely. Each of these definitions can describe a delay to an activity of work in a schedule. The construction industry is large, unpredictable and requires tremendous capital outlays. Delay of a project is a main factor and the major cause of construction claims. There is an acute necessity for detailed investigations to identify the delay factors and choose correct actions to minimize the adverse effect of delay on time, within cost and for high quality. This research paper present list of construction delays causes retrieved from literature. The feedback of construction experts was obtained through interviews. Subsequently a questionnaire survey was prepared .The questionnaire survey was distributed to Project Engineers from Dindigul and Madurai District. The Data Analysis has carried by Statistical Package for the Social Sciences (SPSS) (Programming with automatic calculation) and the top twenty delay causes of residential construction projects in Dindigul and Madurai District are find out. The number of recommendations ends the paper. The findings of this paper can be used as a reference by project owners, managers, and government agencies in developing their project management strategies.

Keywords: Delay, Causes of Delay, Effects of Delays, Construction Projects

1. Introduction

Project delay can be defined as an incident that causes extended time to complete all or part of a particular projects. Delay can also be defined as the time overrun, either ahead of the date for project completion specified by the contract or further than the extended contract period where an addition of time has been granted. The project delay in the construction industry is a universal or large-scale observable fact affecting not only the construction industry but the overall economy of a country as well. Delay is a pervasive phenomenon in construction project delivery. It is branded as the most common, costly and risky problem encountered in construction project with a debilitating effect on the parties to a contract. It creates adversarial relationships, distrust, litigation, cash-flow problems, project abandonment and general feeling of apprehension towards each other. Delays frequently occur in all phases of construction projects and have been seen as inevitable which consequently results in cost and time overruns. It is seen as the most prolific factor affecting project performance.

The demand of construction clients for the timely delivery of construction projects and the susceptibility of projects to delays and cost overruns has attracted the attention of researchers all over the world, most of who tried to identify the immediate as well as the root causes of project delay. However, despite the various study and investigation into the causes of delays, it has continued to be a deadly monster which plagues the construction industry. Project delay involves manifold multifaceted issues all of which are perpetually of decisive magnitude to the parties to the construction contract. These are issues concern right to recuperate costs of the project delay or the need to extend the project with the substantial right to recovery costs for adjustments to the contract schedules.

One of the main objectives and policies of any public or private sectors dealing with the implementation of project is to upgrade the projects performance process, through reduction of costs, completion of the construction project within their contract sum and time limit and improve quality. Private housing project delays are often caused by circumstances that create barriers to launch and further implementation of project activities. When project delays are unexpected, they are hardly manageable and have rather negative impacts on the project activities and outcomes. An unexpected delay will extends the overall duration of project activities and entails an increase in project costs. It produces time-associated cost effects that will increase the resource consumption and will require extra time upon reaching project success.

In construction, delay is defined as the time over-run either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer work period, higher material costs through inflation, and due to labor cost increases. Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources. These sources include the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations. However, it is rarely happen that a project is completed within the specified time.

Accordingly, the contributions of this research are (i) to determine the reasons of delay in the construction sector of Dindigul and Madurai District , (ii) to determine the probability of occurrence of the identified reasons of delay with a subjective and unbiased approach, (iii) to statistically test whether the delays and cost overruns are significant, (iv) to provide recommendations to organizations and companies who play a role in the construction sector of these two district on how to mitigate the delays and (v) and to facilitate the risk management efforts by developing regression models that allow the project managers to reassess the timelines and costs of the construction projects in Dindigul and Madurai district based on the current delay profiles. The successful execution of construction projects and keeping them within estimated cost and prescribed schedules depend on a methodology that requires sound engineering judgment. To the dislike of owners, contractors and consultants, however many projects experience extensive delays and thereby exceed initial time and cost estimates.

2. Review of Literature

Long Le-Hoai, Young Dai Lee, and Jun Yong Lee have examined; In-planned duration and cost at project closing are the two of criteria of successful project and successful project management. In Vietnam, regularly, construction projects have met delays and cost overruns. This research has employed a questionnaire survey to elicit the causes of this situation by interviewing 87 Vietnamese

construction experts. Twenty one causes of delay and cost overruns appropriate with building and industrial construction project were inferred and ranked with respect to frequency, severity and importance indices. Spearman's rank correlation tests showed that there are no differences in the viewpoints between three principal parties in the project. A comparison of causes of time and cost overruns was done with various selected construction industries in Asia and Africa. Factor analysis technique was applied to categorize the causes, which yielded 7 factors: Slowness and Lack of constraint; Incompetence; Design; Market and Estimate; Financial capability; Government; and Worker. These findings might encourage practitioners to focus on delay and cost overruns problem that might have existed in their present or future projects.

Kasimu A.M. and Usman M.D. have described; Delay is one of the biggest problems in Nigerian construction industry. Delay can lead to many negative effects such as disputes between the clients and contractors, increased costs, loss of productivity and revenue and termination of contract. However, comprehensive study on this delay is essential. Since the problems are rather contextual, the study focuses on specific causes of delay like insufficient coordination and ineffective communication between involved parties in construction projects. Literature review and a questionnaire survey were targeted at professionals in Nigerian construction industry and these questionnaires have been used as the tools to carry out this study. The study presents the findings of a survey aimed at identifying some of the most important causes of delay in construction projects in Nigeria. It is hoped that these findings will serve as a guide to enhance the performance of the construction Industry.

Greeshma B Sureshand Dr. S. Kanchanasuggest: A project is said to be successful when it is completed in desired time and cost. The Construction industry of India is an important indicator of the development, as it creates investment opportunities across various related sectors. Construction delays can be minimized only when the causes are identified. Time is one of the major considerations throughout project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. This research work attempts to identify, investigate, and rank factors perceived to affect delays in the construction projects with respect to their relative importance so as to proffer possible ways of coping with this phenomenon. The construction industry is the tool through which a society achieves its goal of urban and rural development. It is one of the sectors

that provides important ingredient for the development of an economy. It was through the analysis carried out, top 10 major causes of construction delays in construction industry are Shortage of construction materials, Effect of subsurface conditions and natural disaster, Delay in material delivery, Low productivity of labors, Rework due to errors, Late procurement of materials, Unqualified workforce, Low productivity and efficiency of equipment, Delay in quality control, Poor site management and supervision, Poor communication between parties & Lack of high technology.

M. E. Abd El-Razek, H. A. Bassioni, and A. M. Mobarak inform us: Delay in construction projects is considered one of the most common problems causing a multitude of negative effects on the project and its participating parties. This paper aims to identify the main causes of delay in construction projects in Egypt from the point of view of contractors, consultants, and owners. A literature review was conducted to compile a list of delay causes that was purged based on appropriateness to Egypt in seven semi structured interviews. The resulting list of delay causes was subjected to a questionnaire survey for quantitative confirmation and identification of the most important causes of delay. The overall results indicated that the most important causes are: financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction, and non-utilization of professional construction/contractual management.

The contractor and owner were found to have opposing views, mostly blaming one another for delays, while the consultant was seen as having a more intermediate view. Results' analyses suggest that in order to significantly reduce delay a joint effort based on teamwork is required. Furthermore, causes of project delay were discussed based on the type and size of the project.

Jeremy Lambert has explained: It is readily recognized that project planning is essential to identify what needs to be controlled and project monitoring and control is required to ensure projects finish on time and within budget. However; project performance in the Middle East in terms of timely delivery and within cost parameters remains poor. In Saudi Arabia, for example, Assaf and Al-Hejji 2006 concluded that 70% of projects surveyed experienced time overrun and found that 45 out of 76 projects considered were delayed.

Similar disturbing statistics can be found for Jordan2, Kuwait3, UAE4, and outside of the region in Hong Kong5, Malaysia6 and in international development projects7 in general. The consideration that poor project planning, monitoring and control plays a major role in the failure of projects is examined in the context of the five major causes of project failure and the reasons behind these causes. Potential mitigating control and monitoring actions are explored to examine whether by their implementation the prognosis for project outcomes can be improved.

3. Methodology

The methodology elements considered include the research design, population, sample size and sampling design, data collection methods as well as data analysis. In this paper the objectives and the aims of this research will be described and explained. The main focus of this study will be on questionnaire survey that was distributed among the selected Engineers from Dindigul and Madurai district in construction industry. The complete research methodology of this study has been shown in Fig.1.

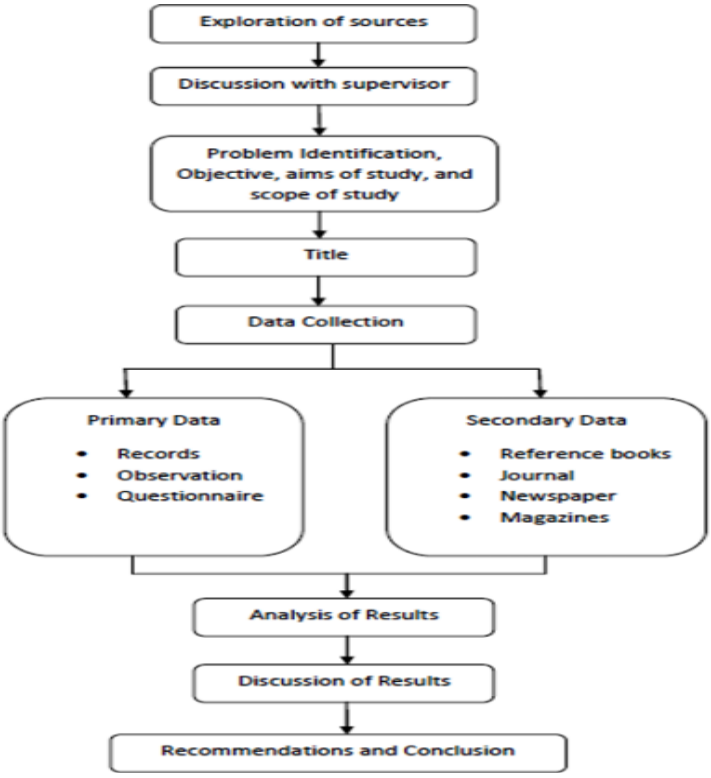

Fig.1 Complete research methodology of the proposed study

Furthermore, statistical package for the social sciences program would be used to analyze collected data. This chapter is divided into main following sections that will briefly be described in this chapter and with more detail in subsequent chapters.

(i) Questionnaire design,

(ii) Data collection,

(iii) Data analysis and

(iv) Conclusion

3.1 Questionnaire Design

In most of the studies, the questionnaire would be designed according to the objective of the research. In this research, as it was mentioned before, the main aim is causes of delays in construction industry from Dindigul and Madurai district. However, it would be impossible to eliminate all delays but when the reliable data was collected and the related party causing the delay was determined, it would be easier to control the delays of projects. This questionnaire survey was developed to get the opinion of large number of Engineers from different construction industry. Also selected companies help to classification the causes of delay based on Indian construction industry. The questionnaires were prepared in 6 different subcategories:

(i) Part A: Respondent information,

(ii) Part B: Contractor Related delay factors,

(iii) Part C: Consultant Related delay factors,

(iv) Part D: Owner Related Delay factors,

(v) Part E: Materials Related factors and

(vi) Part F: External and Other related Factors

3.2 Data Collection

This part of research refers to obtained data from the questionnaires and it will be used to analyze and determine the most critical parameters and project delivery methods. All the respondents in this research were Engineers and because of the different point of view in each civil engineering field, the final result would be closer to engineers' viewpoint. After collecting the data, the next step is analyzing the data and answer to main objectives of the study. But before analyzing the data, the

method of analyzing and the computer program that was used, should be determined. Totally 108 engineers are selected as sample from Dindigul and Madurai district. 60 Engineers from Dindigul and 48 Engineers from Madurai district are selected and questionnaires has distributed and collected.

3.3 Data Analysis

The main purpose of this part is determining relative importance of parameters that contribute to causes of construction delays in the selected project delivery method and also revealing the responsible party for each factor. This problem is usually been solved in two different ways:

(i) Statistical Package for the Social Sciences (SPSS) (Programming with automatic calculation)

(ii) Relative Importance Index (Handwork with manual calculation).

In this research only statistical package for the social sciences has been used.

3.4 Calculation Process of Raw Data

In this statistic part, all of raw data were collected from respondents. As mentioned before, by assisting of SPSS program, the calculation could be done easily and faster than other ways. Especially in this case, according to massive volume of calculations, it would have been unavoidable to use other methods. First of all in different views of SPSS program, the parameters and ranking method were entered. After that, the raw data should be put in correct order in data view tab. In this session of research, the mean, variance and standard deviation were needed to be calculated. So to understand a brief description of each parameter, the following parts are presented.

4. Result Analysis and Discussion

The main aim of conducting the analysis for second part of questionnaire is establishing all of one hundred and thirty factors under the identified groups. The ranking method was designed according to importance degree of each parameter. To achieve a better result, all factors were divided into different groups and each group was analyzed separately. With this method, the most influential factor of each group could be revealed easily.

4.1. Result Analysis

The interviews were conducted 108 project managers /site engineers. The project managers surveyed have an average experience of about 14 years, while site engineers have an average project management practical experience of approximately 9 years. During the interviews, the researcher asked the participants to provide an estimation of importance for each delay factor. The five ranking indices were used to rank delay causes from the viewpoints of the engineers (Project managers and site engineers). Table 1 shows the ranking of the delay causes in descending order of frequency. It presents the 20 most important delay factors according to project managers and site engineers. It can be observed that most commonly delays occur due to non-payment for completed work causes from the viewpoints of the engineers (Project managers and site engineers). Table 1 shows the ranking of the delay causes in descending order of frequency. It presents the 20 most important delay factors according to project managers and site engineers. It can be observed that most commonly delays occur due to non-payment for completed work

Table 1 Ranking of the delay causes in descending order delay

Columns	**Ranking of the Delay**
1st column	Strongly Disagreed
2nd column	Disagree
3rd column	Neither Agree nor Disagree
4th column	Agree
5th column	Strongly Agree

4.2 Explanation of the Guidelines

Depending on the previous analyses, on the recommendations given by the interviewees and on the techniques that were discovered in the literature review, the following explains the most important techniques that project managers can use to discover and reduce delays in construction projects. The ranking the delay factors is shown in Table 2. The following techniques can play the role of the guidelines aimed by this study.

Table 2 Ranking the delay factors from the highly important (Top 20 from 130 Factors)

[Total interviewees=108 (60 from Dindigul District and 48 from Madurai District)]

S.No	Delay Factors	Total Interviewees				
1	Finance and payments of completed work	0	2	6	32	68
2	Equipment availability and failure	0	0	23	49	36
3	Late revising and approving the design documents by the owner	1	0	50	35	22
4	Poor communication and coordination by owner and other parties	4	11	36	28	29
5	Shortage of equipment	0	2	23	46	37
6	Financial constraints faced by the owner	1	14	30	40	23
7	Too many change orders from owner	1	3	10	57	37
8	Slow decisions making from owner	2	6	15	64	21
9	Lack of coordination with contractor	4	8	28	53	15
10	Inference by the owner in the construction operations	2	6	15	64	21
11	Conflicts between consultant and design engineer	2	2	22	60	22
12	Late drawings and specifications delivery	1	6	29	44	28
13	Low level of equipment-operator's skill	4	4	48	39	13
14	Insufficient coordination among the parties by the contractor	1	26	22	39	20
15	Delay in contractor’s claims settlements	4	13	40	29	22
16	Insufficient coordination among the parties by the Owner	0	3	38	43	24
17	Financial problems (delayed payments, financial difficulties, economic problems)	4	8	26	47	23
18	Poor qualifications of consultant engineers staff assigned to the project	0	9	37	51	11
19	Slow responses by the consultant engineer to contractor inquiries	5	11	27	49	16
20	Shortage of construction materials in market	2	4	17	51	34

Project delays have been a topic of concern in the construction industry. Delays have become a universal phenomenon and are almost always accompanied by cost and time overruns. Construction project delays have a debilitating effect on parties (owner, contractor, consultant) to a contract in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow problems, and a general feeling of apprehension towards each other. Delays can be minimized only when their causes are identified. Knowing the cause of any particular delay in a construction project would help avoiding the same. This project was therefore, aimed at identifying the major causes of delays in construction projects in the Dindigul and Madurai region only Construction Industry through a survey, and quantifies the perceptions of different parties relating to causes, responsible party and types of delay.

Based on the results of the questionnaire survey and information gathered from the literature review, the following conclusions were drawn. Generally, whether a delay is determined to be excusable or non-excusable, a contractor is not entitled to an extension of time or to an upward adjustment in costs without understanding the full context of the contract.

Based on the overall results, we can conclude that the following is the ranking of responsibilities of the contractual from the most responsible (1) to the least (5):

(1) Contractor = 44%
(2) Owner = 24%
(3) Government = 14%
(4) Shared = 12%
(5) Consultant = 6%

5. Analysis of Cost Performance due to Construction Delays

Project delays have been a topic of concern in the construction industry. Delays have become a universal phenomenon and are almost always accompanied by cost and time overruns. Construction project delays have a debilitating effect on parties (owner, contractor, consultant) to a contract in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow problems, and a general feeling of apprehension towards each other. Delays can be minimized only when their causes are

identified. Knowing the cause of any particular delay in a construction project would help avoiding the same. This project was therefore, aimed at identifying the major causes of delays in construction projects in the Construction Industry in Dindigul and Madurai district through a survey, and quantifies the perceptions of different parties relating to causes, responsible party and types of delay.

This research project was limited to building projects in the Dindigul and Madurai region only. Based on the results of the questionnaire survey and information gathered from the literature review, the following conclusions were drawn. Generally, whether a delay is determined to be excusable or non-excusable, a contractor is not entitled to an extension of time or to an upward adjustment in costs without understanding the full context of the contract.

Code-Related Delay is ranked as the most critical category followed by Design-Related Delays, Construction-Related Delays, and so on, as shown below. In general, the ten (10) most critical causes (across the six sub-headings given above) of delays are:

Sl.No.	Description	--------
1	Building Permits Approval	3.83
2	Change order	3.81
3	Changes in Drawings	3.76
4	Incomplete Documents	3.63
5	Inspections	3.40
6	Changes in Specifications	3.37
7	Decision during Development Stage	3.35
8	Shop Drawings Approval	3.23
9	Material delivery	3.15
10	Severe weather conditions on job site	3.00

Based on the overall results, we can conclude that the following is the ranking of responsibilities of the contractual from the most responsible (1) to the least (5):

1	Contractor	46%
2	Owner	23%
3	Government	16%
4	Consultant	12%
5	others	3%

In most of the cases, it is found that when the contractor has the responsibility, the type of delay respectively is Non-Excusable when the responsibility is the owner's or the consultant's it is an Excusable Compensable Delay; and when the government is responsible, the delay is considered an Excusable Compensable. The consultants play a very important role in Design-Related Delays because as they are in charge of the design process in conjunction with the owner of the project. On the other hand, the government plays the most important role. The contractor has the major responsibility for delays in Construction-Related Delays. Delays due to Financial/Economical Causes as well as Management/Administrative Causes share an intermediate position of importance, just presenting one Key Delay – Delayed Payments. These categories do not have the same negative impact on project completion times as other factors considered in this study such as code, design and construction related issues.

Based on the findings of this study, the authors would like to recommend that the Buildings Permit Approval Process be streamlined as much as possible and changes in Laws and Regulations be made keeping in mind the negative impact it causes in terms of construction project cost and time. Design related issues such as changes in drawings, incomplete and faulty specifications and change orders have a very damaging effect on project completion times and invariably lead to cost escalations as well. These are issues that can be controlled with proper design process management and timely decision- making. It is a well-known fact that decisions made early in the life of a project have the most profound effect on the project's objectives of delivering a safe, quality project within the time and budget allocated.

6. Conclusion

The main objective of this research which has been determined at the beginning of study was identifying the major causes of delays in three different projects delivery methods. These objectives were performed through questionnaire survey which was designed with regard to the knowledge of Dindigul and Madurai district construction companies and their respond had a significant influence on this research. Also the oral interviews during the process of filling questionnaire helped in realizing the best answer for the main and also side objective of the study. In addition to those, after the data was analyzed, a few meetings had been arranged with Engineers from Dindigul and Madurai District final results were shared with those companies. During each session, they told their opinion about the result and tried to find a solution for how to decrease each critical parameter.

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Managing Structural Raw Materials by Replacement of Concrete Materials with Fly Ash, M-Sand, Coconut Shell & Bamboo

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Abstract

Conventional Structural elements such as beams, slabs and columns may require strengthening during their service life period. The need for strengthening and rehabilitation of existing structures is, in general, caused by the following main reasons increase of service load levels; material degradation; design construction defects; new code requirements. The objective of this work is a systematic assessment of the performance of the RC by replacing the materials of the concrete partially. The assessment is focused on prediction of the ultimate axial strain of the concrete. Bamboo is a versatile material because of its high strength-to-weight ratio, easy workability and availability. Bamboo needs to be chemically treated due to their low natural durability. It can be used as Bamboo Trusses, Bamboo Roofs Skeleton, Bamboo walling/ceiling, Bamboo Doors and Windows, Bamboo Flooring, Reed Boards, Scaffolding. Properties of concrete with bamboo as reinforcement replacement were studied. Control concrete and coconut shell concrete with 20% coarse aggregate replacement with coarse aggregate were made. Three mixes with Fly ash, coconut shell, M-sand were also made to investigate the effect on partial replacement of bamboo.

Key Words: Material Degradation, Green Structural Elements, Alternative Raw Materials, Concrete Raw Materials, Fly Ash, Bamboo, Coconut Shell.

Introduction

General

Structural elements such as beams, slabs and columns may require strengthening during their service life period. The need for strengthening and rehabilitation of existing structures is, in general, caused by the following main reasons increase of service load levels; material degradation; design construction defects; new code requirements.

Composite materials are engineered or naturally occurring materials made from two or more constituent materials with different physical or chemical properties which remain separate and distinct within the finished structure.

Objectives

- The objective of this work is a systematic assessment of the performance of the RC by replacing the materials of the concrete partially. The assessment is focused on prediction of the ultimate axial strain of the concrete.

The Proposed work is plan to achieve the following:

- To investigate strength of replaced materials as a retrofit for cubes, cylinders and beams.
- To determine the compressive strength, tensile strength and flexural strength of M_{20} grade normal concrete and replaced materials concrete

History

Through research it has been found that some species of bamboo have ultimate tensile strength same as that of mild steel at yield point. Experimentally it has been found that the ultimate tensile strength of some species of bamboo is comparable to that of mild steel and it varies from 140N/mm2- 280N/mm2. Bamboo is a versatile material because of its high strength-to-weight ratio, easy workability and availability. Bamboo needs to be chemically treated due to their low natural durability. It can be used as Bamboo Trusses, Bamboo Roofs Skeleton, Bamboo walling/ceiling, Bamboo Doors and Windows, Bamboo Flooring, Reed Boards, Scaffolding.

I. Strength Properties of Bamboo

It has also been found that bamboo acts very well in buckling but due to low stresses than compared to steel and due to it not being straight it may not be very good. Further, it has been established that in seismic zones the failure of bamboo is very less as the maximum absorption of the energy is at the joints. Cellulose is the main component present in bamboo which is the main source of mechanical properties of bamboo.

Some specific properties of Bamboo are as given below:

- Specific gravity - 0.575 to 0.655
- Average weight - 0.625kg/m
- Modulus of rupture - 610 to 1600kg/cm2
- Modulus of Elasticity - 1.5 to 2.0 x105kg/cm2

Replacement of Steel by Bamboo Reinforcement

- Ultimate compressive stress- 794 to 864kg/cm2
- Safe working stress in compression - 105kg/cm2

Safe working stress in tension It has also been found that bamboo acts very well in buckling but due to low stresses than compared to steel and due to it not being straight it may not be very good. Further, it has been established that in seismic zones the failure of bamboo is very less as the maximum absorption of the energy is at the joints. Cellulose is the main component present in bamboo which is the main source of mechanical properties of bamboo.

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- Ultimate compressive stress- 794 to 864kg/cm2

- Safe working stress in compression - 105kg/cm2
- Safe working stress in tension - 160 to 350 kg/cm2
- Safe working stress in shear- 115 to 180 kg/cm2
- Bond stress - 5.6kg/cm2

II. Selection and Preparation of Bamboo Selection

The following factors should be considered in the selection of bamboo culms (whole plants) for use as reinforcement in concrete structures:

- Use only bamboo showing a pronounced brown colour. This will insure that the plant is at least three years old.
- Select the longest large diameter culms available.
- Do not use whole culms of green, unseasoned bamboo.
- Avoid bamboo cut in spring or early summer. These culms are generally weaker due to increased fibre moisture content.
- Preparation
- Sizing- Splints are generally more desirable than whole culms as reinforcement. Larger culms should be split into splints approximately 3/4 inch wide. Whole culms less than 3/4 inch in diameter can be used without splitting. Splitting the bamboo can he done by separating the base with a sharp knife and then pulling a dulled blade through the stem. The dull blade will force the stem to split open; this is more desirable than cutting the bamboo since splitting will result in continuous fibres and a nearly straight section
- Seasoning- When possible, the bamboo should be cut and allowed to dry and season for three to four weeks before using. The culms must be supported at regular spacing‟s to reduce warping.
- Waterproof Coatings- When seasoned bamboo, either split or whole is used as reinforcement; it should receive a waterproof coating to reduce swelling when in contact with concrete. Without some type of coating, bamboo will swell before the concrete has developed sufficient strength to prevent cracking and the member may be damaged, especially if more than 4 percent bamboo is used.

Classifications of Fly Ash

Two classes of fly ash are defined by ASTM c618: class F fly ash. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash. The chemical properties of the fly ash are largely influenced by the chemical content of the coal burned.

Class F Fly Ash

The burning of harder, older anthracite and bituminous coal typically produces class F fly ash. This fly ash is pozzolanic in nature, and contains less than 7% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime mixed with water to react and produce cementitious compounds. Alternatively, adding a chemical activator such as sodium silicate (water glass) to a class F ash can from a geopolymer.

Class C Fly Ash

Fly ash produced from the burning of younger lignite or sub-bituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, class C fly ash hardens and gets stronger over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike class F, self-cementing class C fly ash dose not require an activator. Alkali and sulfate (SO_4) contents are generally higher in class C fly ashes.

At least one US manufacturer has announced a fly ash brick containing up to 50% class C fly ash.

Experimental Work

General

A total number of 12cylinders and 12 cubes, 6 cylinders and 6 cubes are made by normal mix concrete and 6 cylinders and 6 cubes are made by GFRP wrapping. Here the thickness of wrapping is kept constant and to be tested to study the confining effect.

Material Properties

M_{20} grade of concrete is used for casting the test specimen with the following details.

- Cement - PPC 53 grade is used through out the thesis.
- Fine aggregate - natural sand (river sand) passing through IS sieve no 7(1.18).
- Coarse aggregate - crushed gravel (angular) maximum size of 20mm.
- Water - portable quantity.
- Fly ash
- Manufacture sand
- Coconut shell
- Bamboo

Mould

(i) Cylinder size : Asbestos cement pipeof diameter 100mmand length 200mm.

Fig 1

(ii) Cube size : 10mm x 150mm x 150mm.

(iii)

Fig 2

(iii) Beam size :150mm x 150mm x 700mm.

Fig 3

Experimental Work

General

A total number of 6 cylinders, 6 cubes& 2 beams, 3 cylinders, 3 cubes & a beam are made by normal mix concrete and 3 cylinders, 3 cubes& a beam are made by replacing materials. Here the percent of replacing materials are kept constant and to be tested to study the confining effect.

Details of Test Specimen

- Cylinders of diameter 100mm and length 200mm, cubes of 150mm x 150mm x 150mm and beams of.
- M_{20} grade concrete with 20mm and 60mm maximum size aggregate were used.

Test Setup and Test Procedure

Compressive Strength

Axial loading from the device are applied to the specimens (6 cube specimen), where the specimen should be placed at the center of the machine. Compressive from the machine is applied until fracture occurs at the ultimate strength of the specimen. The machine indicator indicates the compressive force of fracture, and from that the compressive strength of the specimen is calculated from the formula:

$$\textbf{Compressive strength} = P/A$$

Where,

P = Compressive load

A = Area of specimen

Tensile Strength

This test is held on the cylindrical specimens (6 cylindrical specimens), where the cylinder is placed in the same machine that is used in the compressive test but this time the cylinder is placed with its axis horizontal. Two pieces of wood are placed between the machine plates and the specimen so that the applied force is uniformly distributed.

The reading of the maximum load from the machine is taken at the fracture of the specimen, and from that the tensile strength of the specimen is calculated using the formula:

$$\textbf{Tensile strength} = 2P/(\pi LD)$$

Where,

P = Tensile load

L = Length of cylinder

D = Diameter of cylinder

Flexural Strength

Flexural strength also known as modulus of rupture, bend strength or fracture strength is a material property, defined as the stress in a material just before it yield in a flexure test. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross section is bent until fracture or yielding using a 3 point flexural test technique. The flexural strength represent the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress, here given the symbol σ

Conclusion

Fly Ash, Coconut Scalp and Bamboo needs to be chemically treated due to their low natural durability. It can be used as Bamboo Trusses, Bamboo Roofs Skeleton, Bamboo walling/ceiling, Bamboo Doors and Windows, Bamboo Flooring, Reed Boards, Scaffolding. Properties of concrete with bamboo as reinforcement replacement were studied. Similar alternative raw materials for conventional methods will develop a better green environment for sure in the future for the betterment of the Human community and Society.

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Architectural Layout and Beauty of Madurai Meenakshi Temple

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Abstract

Madurai is a very old city of India**,** more than 2,500 years old. It was built by the Pandian king, Kulashekarar in the 6th century B.C. and also is believed to be the home for the classical language of Tamil. The best-looking buildings in the city are its most famous landmark, the **Meenakshi Sundareswarar Temple.** Introduction to Acoustics, rudiments of Wave theory and definition of elementary Acoustics terminology are explained in this paper. The Ponthamarai Kulam (Golden Lotus Pond) is located inside the temple. The pillars along the three corridors of the Ponthamarai Kulam do not have any big statues. The reason for this is also explained in this paper.

Key words: Madurai Meenakshi temple, *nada brahman*, Golden Lotus Pond, ancient traditions.

Introduction: Madurai Meenakshi Sundareswarar Temple

Temples, monuments and ancient cultural wonders abound in Madurai. The City is even called ‘The Athens of the East’. Madurai city is also referred to by various names like "Madurai", "Koodal", "Malligai Maanagar", "Naanmadakoodal" and "Thirualavai". The word *Madurai* is derived from Madhura arising out of the divine nectar showered on the city by the Hindu god Shiva from his matted hair. Another theory is that *Madurai* is the derivative of the word *Marutham*, which refers to the type of landscape of the Sangam age, which surrounds the City of Madurai.

Madurai Meenakshi Temple Architecture

Meenakshi temple is situated in the heart of the city of Madurai. The Meenakshi temple is dedicated to goddess Meenaksh**i**, the Consort of Lord Siva. It has long been the focus of both Indian and international tourist attraction as well as one of the most important places of Hindu pilgrimage. For the people of Madurai, the temple is the very center of their cultural and spiritual life. The sculpted pillars are adorned with the exquisite murals that celebrate the ethereal beauty of Princess Meenak**s**hi and the scenes of her wedding with Lord Siva. At the Sundareswarar Temple across the courtyard, Lord Siva is represented as a *lingam*. The pillars depict scenes from the wedding of Meenakshi and Sundareswarar. Present are 985 richly carved pillars here, and every one surpasses the other in beauty. The cute looking temple was believed to have been sacked by the infamous Muslim invader Malik Kafur in the 1310 and all the ancient elements were destroyed completely and no sculptural elements of the ancient temple remain today.

The Pandyas started construction of Sri Meenakshi Temple in the early 13th century. The **East Tower (***gopuram)* was built first (13th century) and then the **West Tower (***gopuram)* in A.D. 1323 by the Pandyas. **South Tower (***gopuram)* was built by one Sevvandi Chettiar in1478 A.D. **North Tower** was built by Nayak rulers during A.D. 1564-72, but left unfinished, though the temple was commissioned with the east tower as the main entrance. One individual from Sivaganga completed North Tower in 1878. Thus it took about **650 years** to complete the present temple as we see today. East Tower height is 161'3”., South Tower height 170'6".,. West Tower height 163'3".. North Tower height 160'6"., all towers have 9 storeys each. You can find **MSL + 400 Ft stone** fixed atop **South Tower** by GTS of India.

From the very beginning the East Tower served as the main entrance to the Temple leading to the sanctum of Lord Siva, since Siva (Sundareshwarar Swami) was the main deity of this temple. As per one version, a man dissatisfied with the irregularities of the Nayak regime, jumped down from the top of the East Tower and committed suicide. People refused to use the East Tower. People used other inlets including the present Amman Sannathi door way, which was so far the outlet but it became the inlet during Thirumalai Nayak (Ruled: 1623-

1659).Thirumalai Nayak built the vaulted Ashta Sakthi Mandapam with a small tower over it. Since then Sri Meenakshi, the goddess, gained importance.

The temple has **14 gopurams** including two magnificent Thanga (golden) Gopurams. The gopurams have exquisite sculptures with elaborate detailing. The tallest south temple tower is 51.9 metres (170 ft.) in height. **Fig.1. Shows the South Tower of Madurai Meenakshi Temple.**

Fig.1. South Tower of Madurai Meenakshi Temple

Laws of Acoustics

A few terms and Laws of Acoustics are explained below**.** Echoes and excessive Reverberation are bad boys of Acoustics. Flat surfaces create standing waves which produce flutter echoes. Concave surfaces produce focused echoes. Convex surfaces diffuse reflections, i.e., it breaks up and distributes sound. The concepts of white noise, pink noise, etc. and the space noise generated by the space bodies are also explained here. Space noise and all noise of nature are **White Noise** only, which masks other noises and has a soothing effect. All the stone pillars have sharp non-filleted edges, which are also good sound diffusers. All the statues have convex surfaces which diffuse sound. According to the Mass Law, "Transmission Loss (TL) or Noise Reduction (NR) of airborne sound across a solid wall is proportional to the Logarithm of the Mass". Hence ideal acoustic environment with good aesthetic charm is established by the statues.

Porthamarai Kulam *(Golden Lotus Pond)*

It is the sacred pond inside the temple, a very holy site for devotees. The name means the Pond with **the Golden Lotus** and people have to go around the tank to enter the main shrine. According to legend, Lord Siva promised a stork that no fish or other marine life would grow here and thus, none are found here. The space around the **Pon Thamarai Kulam** even before and after Sri Meenakshi gained importance, is a crowded area. **Fig.2. Shows the Photo Graphical View of Porthamarai Kulam**.

If you walk along the corridors, the pitch of the noise made by people come running from the opposite direction will be amplified by Doppler Effect. The space noise (infra sound) from the **Pon Thamarai Kulam,** being an white noise will mask the background noise. You can talk to your friends or family with intelligibility. If there is rain, in the water in the tank the white noise effect is accentuated. All acoustic energy is degraded into some form of heat energy. By viscous attenuation of a plane wave the above heat energy can be absorbed. If statues are provided on the pillars of the corridors around **Pon Thamarai Kulam** air space will be reduced and the passages will be heated up by the acoustic energy. Hence big statues are avoided. Sharp edges of pillars serve as diffusers. If water is retained in **the Pon Thamarai Kulam** viscous

attenuation of acoustic heat energy is possible. That is why the **Pon Thamarai Kulam** is situated inside the temple to collect rain water from terrace and to get space noise to overcome the Doppler Shift and for viscous attenuation of acoustic heat energy. **Fig.3. Fibonacci Spiral profusely used.** All statues are designed and fixed not as an accident.

'Every statue is in its place, and a place for everything'. The placement of the statue is coherent, i.e., logically or aesthetically ordered or integrated. **Fig. 4. All statues with convex surfaces.**

Parallel walls or parallelism produces standing waves, which in turn creates echoes. Hence the statues on the pillars in any hall have random distribution to avoid symmetry and parallelism. All parts of the statues are proportioned to the **Golden Ratio 1.618** and the Fibonacci Spiral is profusely used in the statues. Fibonacci learnt number theory from India and also through the Arabs. **Fig.5. The axes of the north and south and the east and west gopurams intersect at the place where the shrine of the principal deity (Siva) is located.**

Fig.2. Porthamarai Kulam of Meenakshi Temple

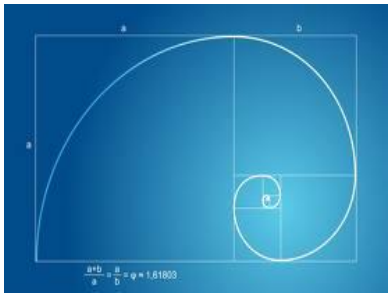
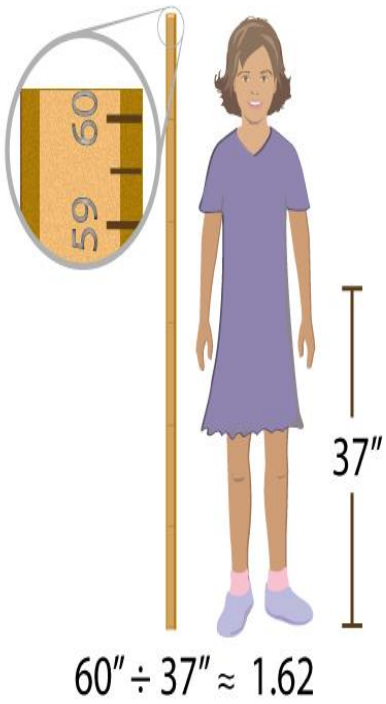


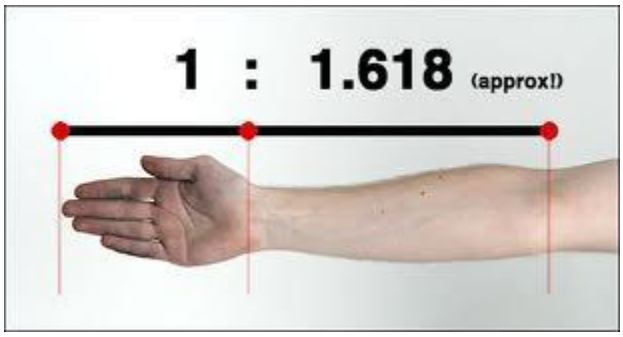
Fig.3. Fibonacci Spiral profusely used

Golden Ratio $\varphi = 1.618$

$$\varphi + 1 = \varphi^2$$

$$\varphi - 1 = 1/\varphi$$





All Statues are proportioned to satisfy the Golden Ratio

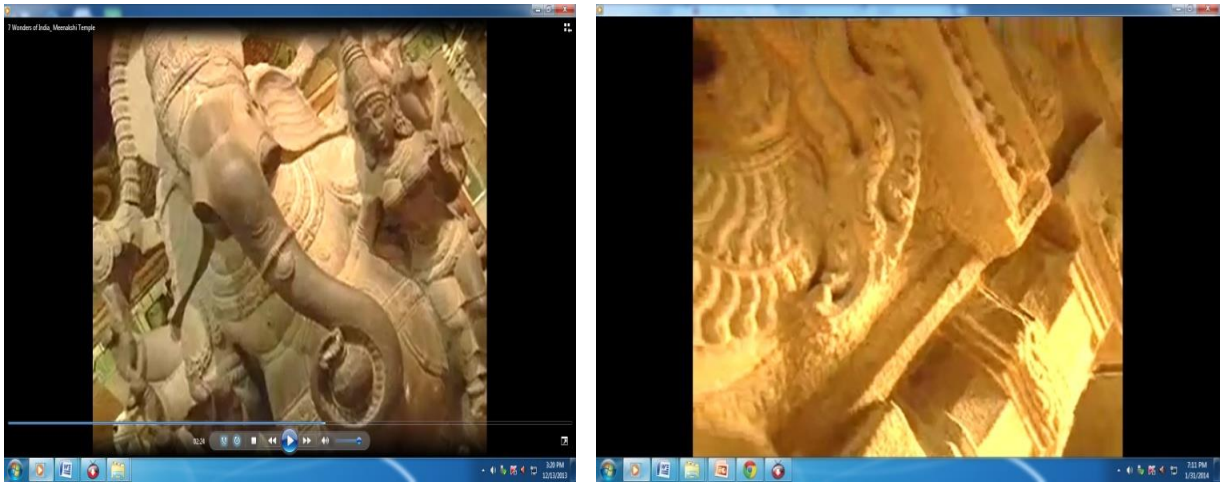


Fig.4. All statues with convex surfaces

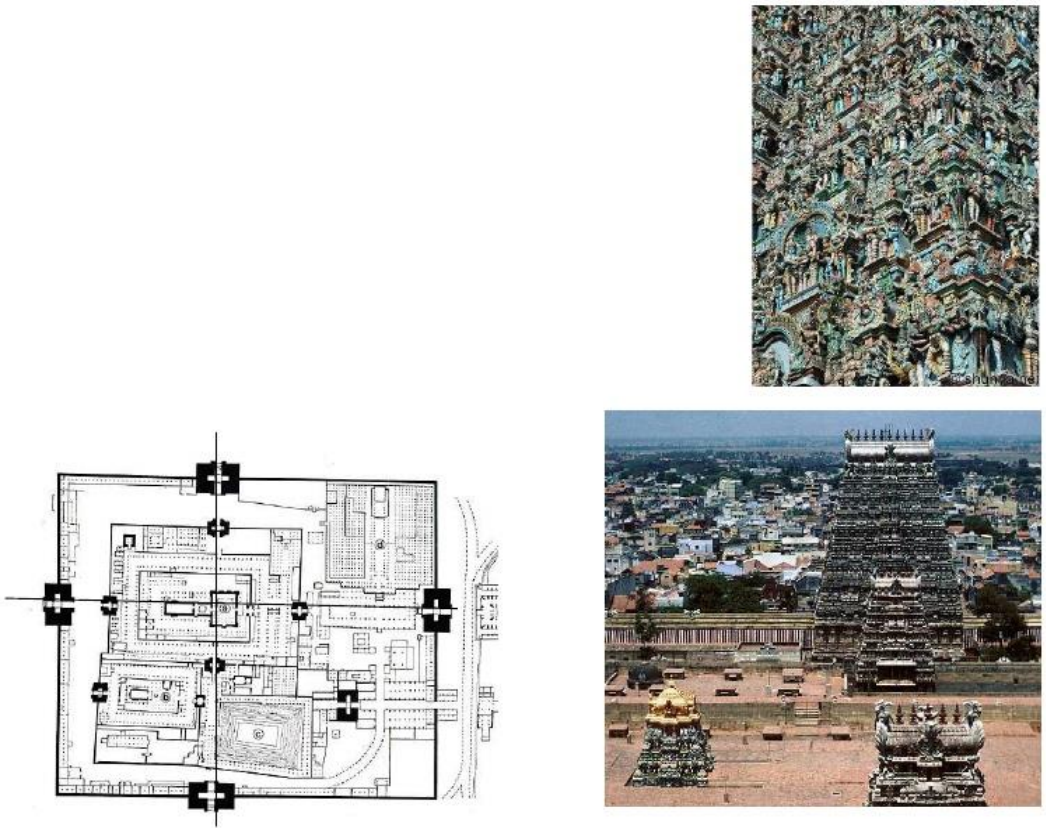


Fig.5. The axes of the north and south and the east and west gopuras intersect at the place where the shrine of the principal deity(Siva) is located

Mukkuruni Pillaiyar

The Mukkuruni Pillaiyar is placed on the cross road because of the convex nature of Pillaiyar's belly which will diffuse noise and prevent formation of echoes. The decorative works around the statue should be removed for good results. The temple bell produces white noise and has a soothing effect on those who meditate inside the temple. The bell must be rung with a delay time. Siva's cosmic dance represents the origin of the cosmos and augments the big bang theory. The drum on his upper right hand represents the origin of the cosmos with a big bang and the trident on his left hand marks the destruction of the cosmos. His dance represents the cyclic happening of this creation and destruction. The **Navagrahas** are called cosmic influencers,

because they are essential for our existence. There are only four kinds of musical instruments: String instrument, Percussion instrument, Wind Instrument and Brass instrument, each having many varieties. All these instruments with or without combinations can be played anywhere in the temple with balanced acoustics. The musical pillars are not hollow and are quite solid. Top and bottom have fixed ends. When struck, noise is produced by the pillars by Flexural Mode of vibration. The temple is built to a master Vedic Architect's blue print. The large space, the temple bell and the statues are ornaments to the temple and are curative pills to your wavering mind.

During the 7th and the 8th centuries, the *mandapams* have flat roofs usually covered with massive stone Slabs, while in the South India the *mandapams* are provided with flatter pyramidal covering with waterproofing and surrounded by a parapet. The Madapam in the South Indian temples are often large in size. (Hundred-pillar mandapam, thousand-pillar mandapam, etc.). Pillars are most times well ornamented and display carvings of gods and goddesses, various characters and mythical animals.

The Thousand Pillar hall of Madurai Meenakshi Amman Temple (Fig.6.) was built using the older *Nellaiappar Temple*, Tirunelveli as a model. The *Aayiram Kaal Mandapam* or Thousand Pillar Hall contains 985 (instead of 1000) carved pillars. It is considered culturally important and is maintained by the Archaeological Survey of India. At the entrance of the Mandapam, there is an idol of a man majestically seated on a beautiful horse. Legend has it that this is an idol of *Ariyanatha Mudaliyar* who built the mandapam.

Fig.6. Thousand Hall Pillars at Madurai Meenakshi Temple

Madurai Meenakshi Architectures were destroyed in 1310 A.D.

The original temple was built by Kulasekara Pandian in 6th century. At first it was a temple of art and architectural elements. Lord Siva was worshiped there. At Madurai Lord Siva performed one of the **seven dances of Sandhya Tandava** by lifting left foot for the balance of creation whereas Lord Siva performed his dance of **Ananda Tandava** by lifting right leg at **Chidambaram.** The temple was believed to have been sacked by the infamous Muslim invader Malik Kafur in AD 1310 and all the ancient elements were destroyed.

Restoration of Meenakshi Temple by King Thirumalai Nayakkar

The temple in its present form was constructed in the 1600s. The initiative to rebuild the structure was taken by first Nayak King of Madurai, Viswanatha Nayak (1559-1600 A.D.). The restoration was carried out under the supervision of Ariyanatha Mudaliar, the Prime Minister of the Nayak Dynasty and the founder of the Poligar System. King Thirumalai Nayakkar (circa 1623-1659) played an important role in the temple's construction. He built various complexes

inside and outside the temple and he built Vasantha Mandapa to celebrate Vasanthotsavam. Kilikoottu Mandapam and the corridors of Teppakulam were built by Rani Mangammal. Meenakshi Nayakar Mandapam was built by Rani Meenakshi.

Ashta Sakthi Mandapam

The visitors who enter the temple through eastern gateway, first enter through the Ashta Sakthi Mandapam.(Fig.10). Visitors are not entering through eastern gopuram. During the construction of eastern gopuram, the gopuram had collapsed and afew workers died. So the visitors started avoiding entering through this gopuram and they started entering through Ashta Sakthi Mandapam. This Ashta Sakthi Mandapam was built by Thirumalai Nayakkar wives Rudrapathi Ammal and Tholimamai. Ashta Sakthi Mandapam is an impressive structure with a hemispherical ceiling. It is 14m long and 5.5m wide. There are bas-reliefs all over the place.

One School of Thought

It was built with the help of Roman (Italian) Architect. But the citation was not there in history. But we have to believe that only Greek and Romans were good in this architecture. (Refer above architectural view).

Another School of Thought

Thirumalai Nayakkar Mahal was built with the help of Roman Architects. By seeing the Arches, Rudrapadi Ammal wanted to construct a hemispherical structure. Therefore this Ashta Sakthi Mandapam was built by our architect in order to prove that we can also construct an arch type of Mandapam. That is why this was constructed by our Indian architects.

Fig.7. Ashta Sakthi Mandapam for Eastern Entrance

Madurai Meenakshi Temple Tower Height is the Vasthu for House Construction

There are 14 gopurams (Towers) in the Meenakshi Temple. The outer 4 Towers are the landmarks of Madurai. The height of 4 Towers are given below:

South Tower Height: 170'6"

West Tower Height: 163'3"

East Tower Height: 161'3"

North Tower Height: 160'6"

These towers; height are the basic source for the Vasthu Construction of our house. When we construct our south wall, it should be always higher than the other walls.

Conclusion

Madurai Meenakshi Sundareswarar Temple is a symbol for the beauty of art and architecture. The symbol stands for the immortal world of art and architectural.

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A Study about Green Environment

T. Ravisankar, II Year ME (Structural Engineering)

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Abstract

In India, due to increase in population and rise in living standard and material standard of living we are placing a grate strain on the environment and its ability to support us. Action at the local level is needed to help to tackle global environment problems. Consumption of non-renewable resources, pollution of air, water and land and also damaging the wild life habitats are of increasing importance as planning consideration point of view. Those developments which have impacts on the environment may be irreversible (not able to reform) or which are difficult to undo must be treated with particular care.

Keywords: Green Belt, Landscape Quality, Nature Conservation, Water Resources, Pollution Control And Energy Resources, CDM

Introduction

This paper aims to reconcile the need for development with conservation of the Green Environment. This paper cover issues such as green belt, landscape quality, nature conservation, water resources, pollution control and energy resources. Green Environment is the range of habitats that supports plants and animals and which reflect geology, land reforms, climate and land use.

Green Belt

The Green belt is a country side and large open spaces where there is a general restriction against inappropriate development.

Development with Green Belt

In the Green Belt development will not be permitted except in very special circumstances like;

1. Leads to unrestricted Growth of the buildup area.
2. Contribute towards merging of existing settlements.
3. Lead to encroachment of urban development into the country side.
4. To comprise urban regeneration thus the Green Environment is maintained in the Green Belt area.

Nature Conservation and Development

The natural environment will be protected and enhanced. The design, siting and landscaping of development should respect and promote nature conservation and include measures to reduce any potentially harmful effects of development on natural features of value.

Development which would damage sites of special scientific interest or local nature resources will not be permitted.

Rural Economy and Agriculture

The development will not be permitted in the green environment region, otherwise it will result in:

a) Permanent loss of the best and most versatile agricultural land or
b) Seriously harming agricultural activities or the viability of a firm.

Effects over Utilization of Water on Green Environment

Due to the increased usage of ground water the ground water level decreases. When the ground water withdrawal is more than its recharge rate the sediments with aquifer get compacted which results in sinking of overlaying land surface which is called as ground subsidence. In coastal areas over-exploitation of ground water leads to rapid intrusion of salt water from the sea. Over-utilization of ground water leads to decrease in water level which causes earthquake and

landslides. When the ground water level near the agricultural land decreases, the water containing nitrogen (nitrate fertilizer) percolates rapidly into the ground and pollutes the ground water.

Role of an Individual in Conservation of Natural Resources for Green Environment

Since resources may be exhausted, it is the duty of every individual on this earth to conserve the natural resources in such a way that they must be available for future generations also. Each individual should understand the importance of preserving the green environment which should be done by up-gradation of natural resources as well as afforestation of affected green belt forest area.

Effects of Environmental Pollution in the Green Environment

- The green environment pollution may be defined as the unfavorable alteration of our surroundings, which changes the quality of air water, and which interferes with the health of humans and other life on earth.
- The types of pollutants are biodegradable pollutants and non-degradable pollutants.
- The classification of green environment pollution includes air pollution, water resources pollition, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards.

Role of Central and State Pollution Control Boards in Preserving the Green Environment

- The control board advises the central government regarding the prevention of pollution and it plans for the prevention and control of pollution.
- It lays down standards for the well water and air.
- It identifies areas or industries causing air pollution to protect green environment.
- The state board advises the state government or any matter concerning the prevention and control of pollution for maintaining the green environment. It encourages research and investigations regarding pollution in controlling the green environment conditions.

Clean Development Mechanism (CDM) in Protecting the Green Environment

CDM is an arrangement under the Kyoto protocol allowing industrialized countries with a greenhouse gas reduction commitment to invest in projects that reduce emissions in developing countries for maintaining the green environment.

The control measures to prevent acid rain, ozone layer depletion (ozone hole), nuclear accidents and holocaust to be properly taken as per regular check to preserve the green environment.

Conclusion

- The green environment should be created through formal and informal education to all sections of the society.
- The environmental awareness in school and collages should be imparted to the students.
- The environmental awareness should be implemented through media like radio, TV, cinema and cable network and newspaper.
- The voluntary organization like rotary club, NCC and NSS should be effectively utilized for green environment awareness.
- The political leaders, cine actors and popular social reformers can make an appeal to the public about the green environment issues.

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Construction Waste in Benzene Removal by Column Study in Ground Water – A Pragmatic Approach

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Abstract

Benzene (colorless liquid) is an additive for petrol to increase the octane number. Due to its combustion as fuel in vehicles, the ambient air quality gets deteriorated, and as a consequence the groundwater contamination is resulted. The present research work explored the concentration of benzene in 90 groundwater samples at the proximity of petrol bunks and residential places at Madurai District for a stretch of about 20 kms. The variation in the benzene concentration was observed for the groundwater samples taken during January 2011, February 2011 and March 2011 and they sample were determined for benzene in 2016 April. The attribution of these benzene level fluctuations may be accounted with respect to varying vehicular emissions and evaporation of hydrocarbons from petrol stations, leaking petrol tanks and automobile industries in the City. Most of these samples found to exceed the prescribed level for benzene recommended by WHO, EPA, CCME and USNDS. The concentration levels are interpreted using Arc GIS and box – whisker plots. An immediate monitoring and attention may be the need of the hour in order to curtail the concentration of benzene in the groundwater.

Key Words: Benzene, groundwater, Madurai, GIS

1. Introduction

1.1. Water Source

In the world, 50 percent of people using groundwater for drinking purpose, live in rural areas. The major use of groundwater is to irrigate crops. Groundwater supplies are replenished or revitalized by precipitation and snow liquefies. In some areas of the world, people face serious

water shortages because groundwater is used faster than it recharge. In other areas groundwater is polluted by human activities. In areas where substance above the aquifer is porous, pollutants can readily sink into groundwater supplies. Landfills, septic tanks, underground leakage of gas tanks and from overeat of fertilizers and pesticides is the major source of groundwater pollution, If groundwater becomes impure, it will no longer be secure to drink.

Guarantee of drinking-water security is a basis for the preclusion and control of waterborne diseases. World Health Organization (WHO) constructs global norms on water quality in the form of guidelines that are used as the basis for regulation and standard locale worldwide (WHO Report, 2013)

1.2 Sources of Benzene

The molecular formula C6H6 of Benzene is an organic chemical compound. It is shortened as Ph–H. Benzene is a colourless and enormously flammable liquid with a syrupy smell and a comparatively high melting point. Because it is predictable as a carcinogen, its use as an preservative in gasoline, but it is a most important industrial solvent and precursor in the drugs production, plastics, synthetic rubber, and dyes. Benzene is a natural ingredient of crude oil, and may be synthesized from other composite in petroleum. Benzene is an aromatic hydrocarbon), a repetitive hydrocarbon with a unbroken pi bond. It is also related to the functional group arene which is a generalized structure of benzene.

In groundwater, the concentration of benzene based on the geological, physico - chemical inimitability of an aquifer, the porous and sharpness of the soil and rocks, the temperature, the accomplishment of other chemicals, and the depth of wells.

1.3 Exposure of Benzene

Outdoor environmental levels of benzene series from 0.2 μg/m3 (0.06 ppb) in remote rural areas to 349 μg/m3 (107ppb) in industrial centres with a high bulk of motor vehicle traffic. The percentage of benzene in unleaded petrol is roughly 1–2%. Driving a motor vehicle one hour per day is estimated to add 40 μg of benzene to a person's every day intake. Levels up to 10,000

µg/m3 (3,000 ppb) have been measured in air at petrol stations. Paying a slight under 2 min/week to refill a car at the petrol station is the reason to an extra predictable daily intake of 10 µg. Benzene has been detected at levels as high as 500 µg/m3 (154 ppb) in indoor residential air.

Cigarette smoke contribute considerable quantities of benzene to the levels accounted in indoor air, with smokers inhaling approximately 1,800 µg benzene/d compared to50 µg/d by non-smokers. Benzene can also occur in foods and drinks as a product of reaction between benzoate and ascorbic acid, and has been found in soft drinks. Most important sources of benzene in water are stated in the environment, spills of petrol and other petroleum products, and chemical plant seepages. Ranges of up to 179 µg/litre have been accounted in chemical plant effluents (2). In seawater, levels were accounted to be in the level of 5–20 ng/litre (coastal area) and 5 ng/litre (central part) (4). Levels between 0.2 and 0.8 µg/litre were reported in the Rhine in 1976) (7). Levels of 0.03–0.3 mg/litre were found in groundwater contaminated by max out emissions (8). Benzene was detected in 50–60% of potable water samples taken at 30 treatment amenities across Canada; significant concentrations varies from 1 to 3 µg/litre (highest range 48 µg/litre) (9). Federal drinking-water investigations in the USA calculate approximately that 1.3% of all groundwater structures contained benzene at concentrations superior than 0.5 µg/litre (highest level reported 80 µg/litre) (5).

1.4 Adverse of Benzene

Benzene is a health hazard compound, the undersized health effects of experience above the maximum contaminant level is anemia, impermanent nervous system disorders and immune system dejection. The long term effect of exposure above the maximum contaminant level of Benzene is cancer and chromosome aberrations. Consuming water with high levels of benzene in excess of a long time is a source of health effects such as Central nervous system dysfunction, wide-ranging hemorrhaging, Pancytopenia, augment risk of cancer.

2. Objective and Scope

It is necessary to estimate the extent of petroleum product contamination in groundwater because of the above serious health effects. HPLC-Methodology and Gas Chromatography are used successfully in many recent studies for this estimation. The quantitative results help to arrive with the proper remediation methodology and awareness scenario.

The overall objective of the works is to quantitatively estimate the benzene concentration and thereby determining the quality of the water. The study objective is to estimate Benzene in groundwater samples collected in commercial, residential and surface water bodies in and around Madurai. The identification of vulnerable areas with maximum risk of consuming low quality groundwater is also our objective. The remediation process is executed by the column technique in batch process technique and providing recommendations for preventing future contaminations.

2.1 Details of the Study Area

Madurai city, which is more than 2500 years old is situated at $9^{o}58'$ N latitude and 78°10' E longitude and engage an area of about 140 km^2 .The metropolitan city, located on the banks of the River Vaigai, it is the 24th major city in India (population wise) and Madurai is the third largest in the state of Tamil Nadu. The population stress on the city is always rising. The population of Madurai is 11, 94,665 it based upon 2001 survey.

3. Methodology

Sampling and Analysis

One hundred and twenty groundwater samples from bore well resources were collected in pre – cleaned bottles in the months of Jan – 11, Feb – 11 and Mar – 11 and thirty six samples collected in April – 16 to identify the ranges from corporate and residential locations of six corporate, thirteen residential location and three surface water bodies of Madurai District. The collected samples were stored in the refrigerator (8 - 10°C) before the estimation of Benzene. At the time of estimation, the chilled water samples were equilibrated to room temperature followed

by vacuum filtration using 0.4 µm filter paper. The estimation of benzene is done by High Pressure Liquid Chromatography (HPLC) and Gas Chromatography (GC-FID).

High Pressure Liquid Chromatography (HPLC)

High Performance Liquid Chromatography (**HPLC**) is a form of column chromatography that pumps a sample mixture or analyte in a solvent (known as the mobile phase) at high pressure through a column with chromatographic packing material (stationary phase). The stationary phase is nonpolar (hydrophobic) in nature, while the mobile phase is a polar liquid, such as mixtures of water and methanol or acetonitrile. It works on the **principle** of hydrophobic interactions hence the more nonpolar the material is, the longer it will be retained.

Gas Chromatography (GC-FID)

Chromatography is the separation of a mixture of compounds (solutes) into separate components. By separating the sample into individual components, it is easier to identify (qualitate) and measure the amount (quantitate) of the various sample components. It is estimated that 10-20% of the known compounds can be analyzed by GC. One or more high purity gases are supplied to the GC. One of the gases (called the carrier gas) flows into the injector, through the column and then into the detector. A sample is introduced into the injector usually with a syringe or an exterior sampling device. The injector is usually heated to 150-250°C which causes the volatile sample solutes to vaporize. The vaporized solutes are transported into the column by the carrier gas. The column is maintained in a temperature controlled oven.

Benzene Standard for HPLC & GC-FID Grade

Benzene was estimated using High Pressure Liquid Chromatography (HPLC) and Gas chromatography (GC-FID),Standard solutions of benzene of 2000 mg $^{-1}$ was prepared and diluted to 500 mg L^{-1} (primary dilution standard) in acetonitrile (as per the certified standard mixture 1:4) and stored in amber colored bottle at 4°C. Fresh aqueous working standard solutions were prepared daily by diluting the primary dilution standard solution in water of HPLC and GC -FID grade. After the zero correction was done, 20 µl of the standard was injected using a micro

syringe (pre cleaned with isopropyl alcohol) with initially set run time of 20 min. From the knowledge of retention time (RT), the samples in triplicates were injected and the corresponding chromatograms were saved in the data path. The Benzene concentration was estimated using the formula as follows.

$$\text{Benzene Concentration} = \frac{\text{Area of the peak in sample x Concentration of standard solution}}{\text{Area of the peak in standard solution}}$$

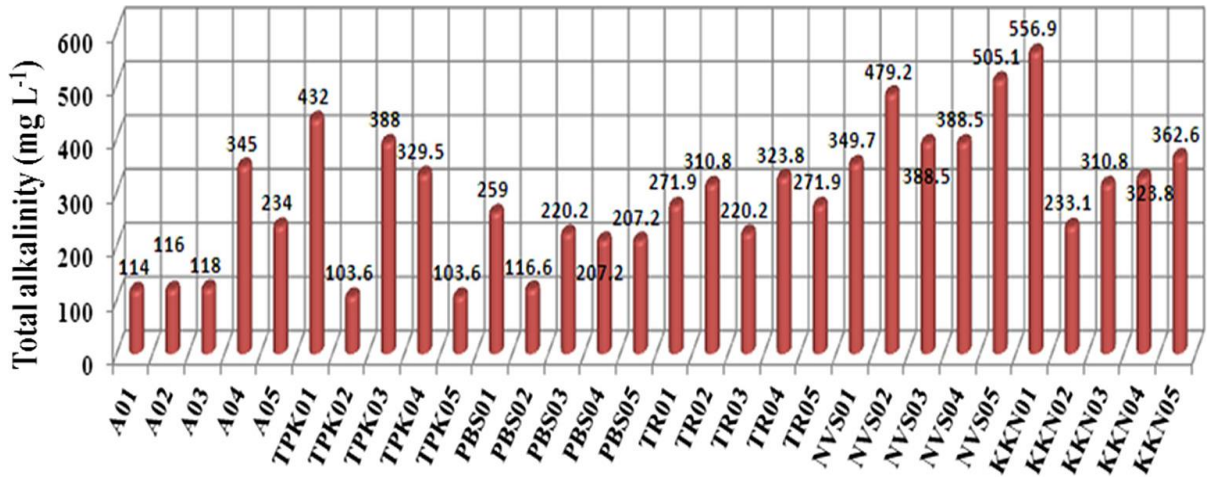

Fig1. Alkalinity range of groundwater sample

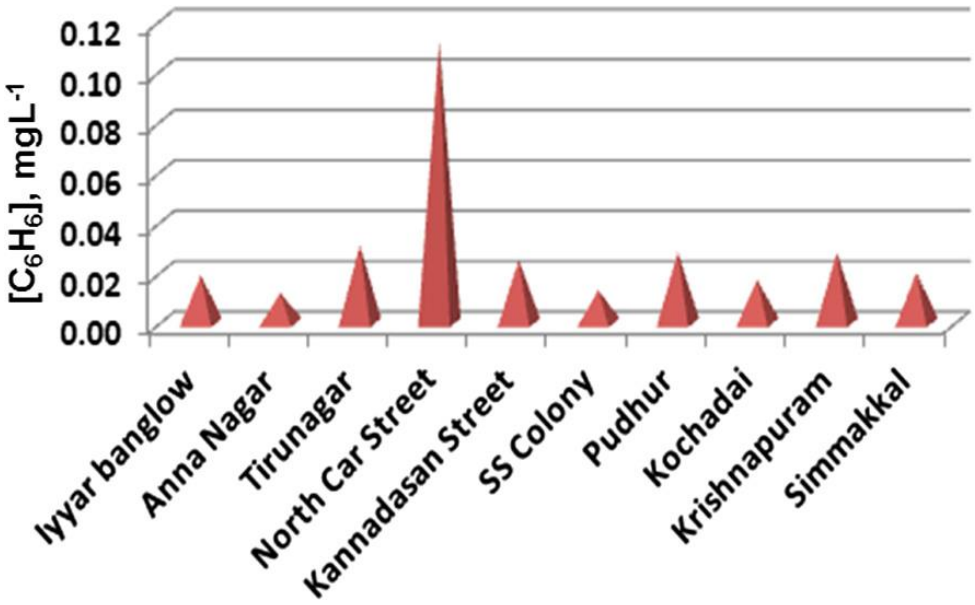

Fig 2. Benzene Concentration level in Madurai

Risk Analysis

Risk assessment process is defined by a model which may use different mathematical and empirical models in arriving at the estimate of risk. A conceptual exposure model is derived by tracing the chemical from its source to the receptor. The life time risk for adults and children can be calculated using the formula given below. Chronic Daily Intake (CDI) was calculated for 70 years life time (mg kg^{-1} day^{-1}).

CDI (for adults) = [Total Dose (mg) / Body Weight (70 kg) × life time (days)] …….(1)

CDI (for children) = [Total Dose (mg) / Body Weight (10 kg) × life time (days)] ……..(2)

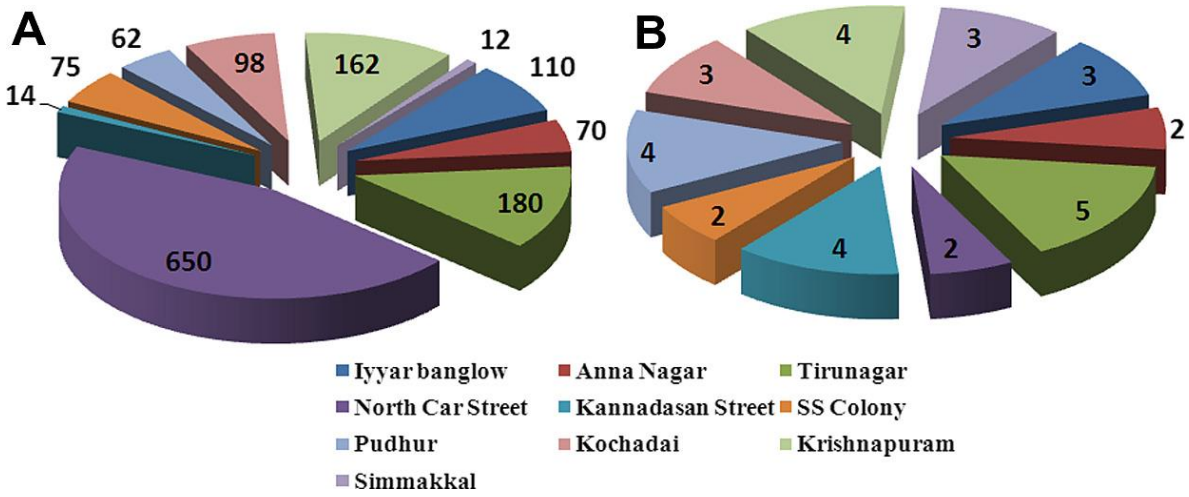

Fig 3. Risk changes level in all area of Madurai

Interpretation through GIS tools

Geographic Information Systems (GIS) provide platforms for managing the data, computing spatial relationships such as distance and connectivity. It is based on the analysis of spatiotemporal behaviour of the benzene level in groundwater in the study area was done using the spatial analyst module of Arc GIS 9.3 powerful spatial analysis is feasible once the database is established. The interpolation technique used in the analysis is inverse distance weighted (IDW) method. IDW is an algorithm for spatially interpolating or estimating values between measurements. Each value estimated in an IDW interpolation is a weighted average of the surrounding sample points. Weights are computed by taking the inverse of the distance from an observations location to the location of the point being estimated (Burrough and MC Donnell 1998).

The inverse distance can be raised to a power (e.g. linear, squared, and cubed) to model different geometries (e.g. line, area, volume) (Guan et al., 1999). In a comparison of several different deterministic interpolation procedures, Burrough and Mc Donnell (1998) and Mathes et al., (2006) found that using IDW with a squared distance term yielded results most consistent with original input data. This method is suitable for datasets where the maximum and minimum values in the interpolated surface commonly occur at sample points (ESRI 2002).

Topo sheets were used to prepare the base map and to understand the general nature of the study area. GPS is used to map the location of each sampling well and finally the results were taken to GIS for further analysis.

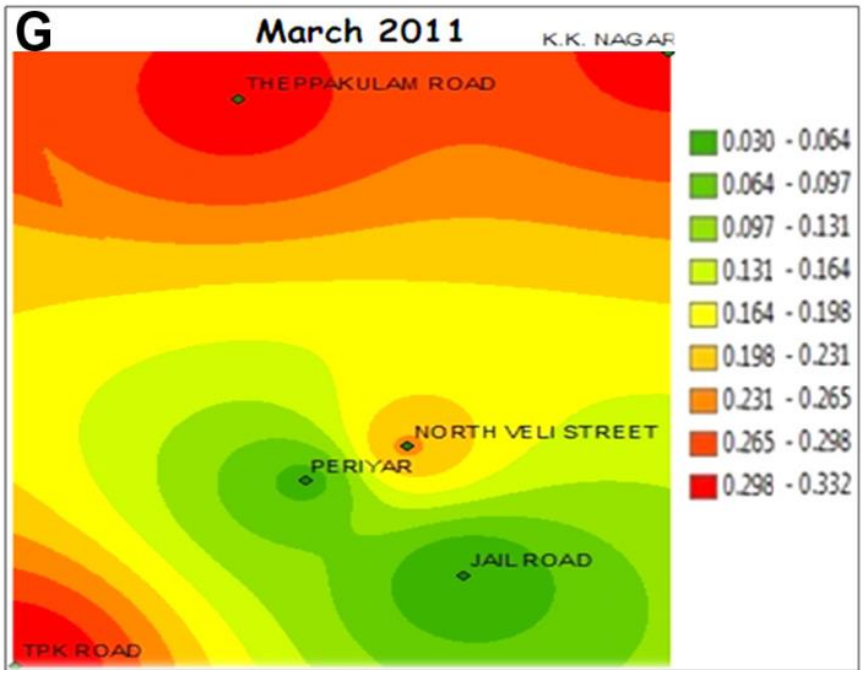

Fig 4. Pollution load interpretation on GIS

Benzene Removal Technique

Excess benzene in drinking water has to be removed before they are supplied to the community. There are various methods for benzene removal *viz*. using GAC, natural attenuation, anaerobic bio remediation, *in situ* bio remediation and intrinsic bio remediation. Due to factors like high operational costs these technologies are found to have limited access. Among the existing methods, adsorption is one of the most extensively used methods for the removal of benzene because of its ease of operation and cost effectiveness. In adsorption techniques, biomaterials are employed, activated and chemically modified forms.

The present study is concentrated on the removal of benzene in water by using adsorption technique by batch experiments. The zeolite materials were prepared from the brick. The sodium chloride solutions were used to remove microbial particles. Then the materials are washed by

distilled water to produce plain adsorption material. It is sewed to produce uniform materials to produce consistent bed. All adsorbing materials were characterized before and after the benzene removal process. The benzene removal efficiency of all the adsorbing materials was explored by using the synthetic benzene removal solution. The benzene removal efficiency was studied as a function of contact time, pH, dose, initial benzene concentration and interfering anions. The reusability of adsorbing materials was decided by the benzene desorption from the exhausted adsorbing materials. The validity of different kinetic models (*viz*, pseudo-first order, pseudo-second order, intra particle diffusion and Elovich) and isotherm models (Freundlich and Langmuir) was corroborated. The practical applicability of all adsorbing materials was also ascertained from the results obtained after benzene removal experiments using ground water samples.

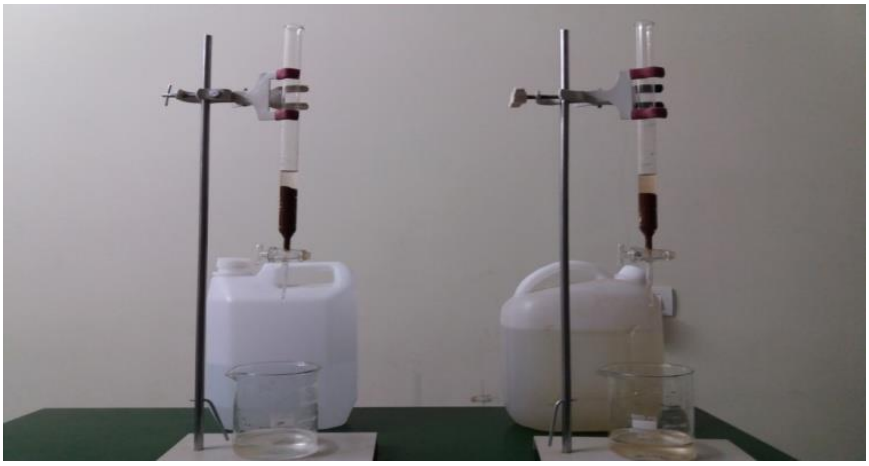

Fig 4. Column study for benzene removal

4. Conclusion

Contamination of benzene in the groundwater at six commercial and ten residential locations has been identified. The possible routes include leakage of hydrocarbon from petrol bunks and stations, tobacco smokes and vehicular emissions. Very less percentage of groundwater samples corroborated within the WHO limit. Based on the cancer risk analysis in the commercial locations, children were at a greater risk than adults. Conversely, at the residential locations, adults were at a greater risk than children. Student's t-test approved the significant variation of benzene between February and March 2011. Hierarchical Cluster and

GIS based analyses were done interpreting the distribution of benzene in groundwater sources at corporate locations. The possible hydrocarbons in the other water sources in the study area for future investigation are also envisaged. The remediation of benzene is done by column technique in batch process mode. The removal efficiency is determined in different sized column. It conclude that the removal efficiency is high when the bed height in increased. At the same time the detention time also increased when the bed height in raised.

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Big Data in Disaster Management

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Abstract

Big Data is a frame work to use in particularly disaster prone areas of the globe. It investigates the nature of social media generated during disaster and defines a list of content categories taking into consideration for the information in disaster phases. Smart cities governance can leverage on this Big Data to plan effective disaster management. Disaster management is a crucial and urgent research issue. Emergency Communication Networks (ECNs) provide fundamental functions for disaster management, because communication service is generally unavailable due to large-scale damage and restrictions in communication services .Big data analytics in the disaster area provides possible solutions to understand the situations happening in disaster areas, so that limited resources can be optimally deployed based on the analysis results. In this paper, we study big data in disaster management and its characteristics, challenges, and uses.

Key Words: Disaster Management, Big Data, Volume, Velocity, Emergency Communication Networks.

1. Introduction

Big Data is the name given to our ever-increasing ability to collect more data from a multitude of sources, and analyze it for insights using advanced computer algorithms. Humans can't provide a better understanding of situations and solutions to problems. Disasters are big, messy and noisy situations, and exactly the sort of conditions in which Big Data can help to make sense of the chaos. The massive amounts of data that we are generating with mobile

phones, satellites and social media can all play a part in providing clues to the best way to respond to a situation in four phases of disaster management: (Neal,1997) Prevention, Preparedness, Response, Recovery. The DM Act 2005 uses the following definition for disaster: "Disaster" means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."

The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources. The Red Cross and Red Crescent societies define disaster management as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters.

The UNISDR defines disaster risk management as the systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to diminish the impacts of natural hazards and related environmental and technological disasters. This comprises of all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards. UNISDR3 has proposed the following definition for the term Disaster Management (UNISDR 2015b): "The organization, planning and application of measures preparing for, responding to and, initial recovery from disasters." As per this definition, 'Disaster Management' focuses on creating and implementing preparedness and others plans to decrease the impact of disasters and build back better. Failure to create/apply a plan could result in damage to life, assets and lost revenue. However, it may not completely avert or eliminate the threats. The term Disaster Management as used in the NPDM

2009 and the DM Act 2005 document is comprehensive covering all aspects – disaster risk reduction, disaster risk management, disaster preparedness, disaster response, and post-disaster recovery. This document uses the term with the same meaning as defined in the DM Act 2005: "A continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient" for the following: 1) Prevention of danger or threat of any disaster, 2) Mitigation or reduction of risk of any disaster or its severity or consequences, 3) Capacity-building, 4) Preparedness to deal with any disaster, 5) Prompt response to any threatening disaster situation or disaster, 6) Assessing the severity or magnitude of effects of any disaster 7) Evacuation, rescue and relief, and 8) Rehabilitation and reconstruction."

1.1 Types of Disasters

There is no country that is immune from disaster, though vulnerability to disaster varies. There are four main types of disaster.

- Natural disasters: including floods, hurricanes, earthquakes and volcano eruptions that have immediate impacts on human health and secondary impacts causing further death and suffering from (for example) floods, landslides, fires, tsunamis.
- Environmental emergencies: including technological or industrial accidents, usually involving the production, use or transportation of hazardous material, and occur where these materials are produced, used or transported, and forest fires caused by humans.
- Complex emergencies: involving a break-down of authority, looting and attacks on strategic installations, including conflict situations and war.
- Pandemic emergencies: involving a sudden onset of contagious disease that affects health, disrupts services and businesses, and brings economic and social costs.

Any disaster can interrupt essential services, such as health care, electricity, water, sewage/garbage removal, transportation and communications. The interruption can seriously affect the health, social and economic networks of local communities and countries. Disasters have a major and long-lasting impact on people long after the immediate effect has been mitigated. Poorly planned relief activities can have a significant negative impact not only on the

disaster victims but also on donors and relief agencies. So it is important that physical therapists join established programmes rather than attempting individual efforts.

Local, regional, national and international organizations are all involved in mounting a humanitarian response to disasters. Each will have a prepared disaster management plan. These plans cover prevention, preparedness, relief and recovery.

1.2 Levels of Disasters

The disaster management and its planning at various tiers must take into account the vulnerability of disaster-affected area, and the capacity of the authorities to deal with the situation. Using this approach, the High Power Committee on Disaster Management5, in its report of 2001, categorized disaster situations into three 'levels': L1, L2, and L3. The period of normalcy, L0, should be utilized for disaster risk reduction. Level-L1: The level of disaster that can be managed within the capabilities and resources at the District level. However, the state authorities will remain in readiness to provide assistance if needed. Level-L2: This signifies the disaster situations that require assistance and active mobilization of resources at the state level and deployment of state level agencies for disaster management. The central agencies must remain vigilant for immediate deployment if required by the state. Level-L3: This corresponds to a nearly catastrophic situation or a very large-scale disaster that overwhelms the State and District authorities. The categorization of disaster situations into levels L0 to L3 finds no mention in DM Act 2005. Further, the DM Act does not have any provision for notifying any disaster as a ‘national calamity’ or a ‘national disaster’.

1.3 Big Data

The concept of Big Data project is fundamentally related to computer science since the beginning of computing. The term Big Data describes amounts of data obtained with technological means that are normally unusable by humans due to volume and which with appropriate automated processing will extract actionable information. [1]

1.4 Big Data Characteristics

Big Data may be characterized as having four dimensions: Data Volume, measuring the amount of data available, with typical data sets occupying many terabytes. Data velocity is a measure of the rate of data creation, streaming and aggregation. Data variety is a measure of the richness of data representation – text, images, videos etc. Data value, measures the usefulness of data in making decisions. [2]. A further characteristic has recently appeared, namely Variability, which represents the number of changes in the structure of the data their interpretation. Gartner [3] summarizes this in the definition of Big Data as high volume, velocity and variety information assets that demand cost effective processing.

2. Big Data Research Challenges In Disaster Management

The first common challenge reported was the insufficient levels of implementation for each monitored activity. For example, although DRM plans or risk sensitive building codes exist they are not enforced because of a lack of government capacity or public awareness or because so much development takes place in the informal sector. Risk information acquired through assessments is often not translated into policy partly because policy makers are not aware of how to use such information. Staging public awareness raising campaigns, while useful, run the risk of being a one-time event and may not bring any real change in people's behaviour or actions. In other words, it is not sufficient to have risk assessment data and institutional arrangements in place; it is important to consider how these elements actually lead to changes in behavior at all levels in a way that leads to an improved management of risks. A second common challenge highlighted by many countries is the need to strengthen local capacities to implement disaster risk management, including through establishing local level mechanisms and risk assessments. Weak capacity at the local level undermines the implementation of building codes and land use plans. National policies also need to be adapted to the local context (e.g. the national school curricula on DRR that can be tailored to local risks and needs). Small-scale events that many countries struggle with are local in scope.

A third challenge refers to how climate change issues are integrated into DRM (e.g. risk assessment, research, building codes, and land use planning) given that climate change will lead to shifts in risk patterns. Some countries have already combined DRM and climate change adaptation policies and created a common platform to discuss how both need to be mainstreamed into national and local-level policies. While steps have been taken, there is still long way to go before effective policy coordination on climate change and DRM is the norm. Fourth, DRM policymakers have difficulty in obtaining political and economic commitment due to other competing needs and priorities. While many agree that reducing disaster risks is important for saving lives and property, few countries have appropriate measures in place because other issues (e.g. poverty reduction, economic growth, social welfare and education) require greater attention and funding. This has resulted in the insufficient earmarking of financial resources for DRM policies. Land use planners also face difficulty in balancing DRR needs with economic ones. DRM policy makers are in need of clear evidence, including cost-benefit analysis, to convince public and politicians that commitment to DRM is as practical and necessary as any other priority. Another common challenge refers to poor coordination between stakeholders, and a lack of information sharing, including with respect to risk assessment, monitoring and evaluation, early warning, disaster response and other DRM activities.

Mainstreaming DRR in all policy areas and ensuring the commitment of sector agencies is important in preventing new risks from arising and also helps stakeholders address existing risks and strengthen the resiliency of society. Finally, while many countries are still engaged in moving from a response based emergency management paradigm towards the disaster risk reduction paradigm embodied by the HFA, yet others are already pushing the boundaries beyond the HFA towards a new paradigm in which disaster risk management becomes a hallmark of good development

2.1 Quality of Service and Quality of Information in Big Data

For using big data analysis to achieve effective disaster management, the underlying infrastructure must provide high quality of service (QoS). While the QoS requirements may

differ for various disaster situations, we outline some examples here as illustration. Given the urgency of the response actions when dealing with most disasters, it is imperative for the infrastructure to provide real-time performance. This includes real-time data analysis to accurately predict the impact of an approaching hazard as well as the best way of effectively responding to the disaster. It also includes real-time communication to ensure that correct data are gathered about the environment, such as the location of people who need help, the best routes for going to a disaster site and for helping people move away from disaster sites. Real-time communication is also needed to ensure that various emergency response teams can coordinate their actions in optimally responding to a disaster.

Given the criticality of disaster response situations, it is also important to ensure that the service will be highly reliable and available in spite of the adverse environmental conditions during such situations, including physical damages, power outages, floods, etc. Hence, the big data storage, analysis, and transmission services must be able to operate in spite of such adverse conditions. Redundancy alone is not adequate since one type of hazard may impact all the redundant units. Hence, this requires the use of diversity in addition to redundancy to ensure high reliability and availability. For example, computing and sensor resources can be deployed at different geographical locations and different communication methods can be used to ensure continuous access to the data.

Given the evolving nature of disasters and disaster response strategies, it is also important to ensure that the big data supporting infrastructure is sufficiently maintainable. This includes methods of ensuring that the infrastructure can be easily upgraded and also to be able to rapidly repair or replace damaged units. Given the sensitivity of some types of data that can substantially help disaster response, such as the location of people and their medical conditions, it is also important to ensure that the service meets high levels of security. This includes high levels of privacy and confidentiality as well as assurance that the information used to guide the response to a disaster are correct and not corrupted. For tele-operation, tele-health, and other remote actions, it is also important to ensure high levels of cyber security. In particular, the

infrastructure must ensure that only authorized emergency response personnel can control remote units. Cloud computing platform resources can be leveraged to support big data storage and analysis. Multiple cloud computing platforms at geographically diverse locations can be used to tolerate different hazards. This natural combination of redundancy and diversity can be leveraged to achieve high performance real time big data analysis. This diversification can also be used to achieve highly secure storage and computing by splitting confidential data across multiple sites and using big data analysis methods that can work directly on encrypted data without needing to decrypt the data.

Dependable communication methods are needed that can operate under severe operational conditions, including power outages, damaged communication lines, disruption of wireless signals, damaged communication signal transmission units, etc. Also, it must be ensured that emergency response personnel will be able to access the big data platform and coordinate their actions with other teams. This must be done in spite of areas that may have communication dead-spots, such as underground tunnels, etc. For example, it can require the deployment of sonar, light, and other communication methods in addition to the usual electrical signals for communication. Usually, when we consider the usage of infrastructures, its efficiency, reliability and dependability are key parts. In general, big sensing data are stored in the cloud. However, in disaster situations, it might not be able to access to the cloud from disaster areas. Thus, it is important to consider the efficiency, reliability and dependability for not only the cloud side but also the sensing edges. In order to design and develop mission-critical services, we definitely need to consider failures of communication lines.

A kind of autonomous recovery from such failures should be equipped. Also, data security and privacy are both important. Dissemination of incorrect information and false rumor might make the society confusion. Given the large volume of data and the real-time constraints for performing the analysis for prediction as well as the analysis for appropriate response and recovery operations, it is imperative to ensure that the computations can be done in real-time. A variety of methods may have to be integrated together to achieve this, including the use of

parallel processing based on cloud computing and local resources, reduction of large data sets into equivalent correct rules, distributed pipeline processing, etc. It is also important to ensure that the data acquisition and analysis procedures are highly dependable in spite of the failures of various processing and communication units.

Given the distributed nature of such computing, it can be difficult to identify which units have failed. Hence, the processing and communication infrastructure may need to be augmented with dependable on-line system health monitoring capabilities to enable the rapid identification of faulty components and the activation of redundant standby units to ensure correct and timely completion of the big data analysis under emergency situations. Assessment of the big data analysis algorithms is needed to determine the confidence in the correctness of the results of the analysis, including predictions and recommendations for optimal response and recovery actions. Simulation and emulation platforms can be used for evaluating and certifying new algorithms and procedures. Different algorithms can be evaluated and compared by applying them to a suite of benchmark scenarios and test-beds for which the correct results are known. It is important to quantify the confidence in the accuracy of the results of big data analysis since failure to predict a disaster in a timely way can be harmful to society. Similarly, false alarms should also be avoided since these can reduce the likelihood that the public will react appropriately to a real disaster.

2.2 Volume and Velocity

In many cases, data generated by sensors need to be processed in real-time for immediate action (e.g., Twitter and Facebook). However, the development and validation of models using real-time data is a challenging task. Archive of datasets collected during historical events that can be shared among researchers would be helpful in enabling quantitative analysis between different models – i.e., the use of a common dataset for evaluations and validations of models would help researchers in developing models with improved quality. Open access datasets collected during real events are known to be very useful to test and validate new ideas: for example, the 1998 World Cup web access trace [6] has been used by many research to advance web server/services technology.

Research on cloud-based approach can potentially lead to a viable solution to accommodate the high volume of data and the multiple formats of data generated by different sensors of various types, While cloud systems have the necessary components, namely compute, storage, and network, to the development of a repository of disaster-related datasets, models, and applications, research is needed to integrate components and design interfaces that make it easy for domain scientists – which are not necessarily cloud computing experts. The big data gathered through sensor and social networks will become useful once they are turned into actionable information that helps decision-making. There is multi-scale timeliness to decision making during disaster response. Some information should be available on the order of seconds, minutes, and other can be a matter of hours. Faster is better, but, high error rate could aggravate the situation. For example, inaccurate information could result in the distribution of rescuers and supplies to wrong places, wasting limited resources. False information could also misguide the public, increasing their stress level.

2. 3 Variety

Integration of Many Heterogeneous Data Sources The integration of many heterogeneous data sources and software tools when applying big data to disaster management is a significant challenge. At a limited scale, this heterogeneity is a challenge that has risen in big data scientific research, for example, in the construction of Global Climate Model (GCM) for global weather modeling. To achieve global weather prediction, a GCM needs to integrate a variety of atmospheric and ocean models. Given the relatively small number of component models (less than a hundred), it has been feasible to connect them manually. In contrast, the number and variety of data sources in disaster management, as well as their rate of change, far exceeds what is feasible by manual integration.

Consequently, research on automated development and maintenance of data integration tools is necessary and its success very important. Big data analytics for disaster management and response requires a large variety of heterogeneous data sets that are related with each other and

show different aspects of the changes caused by a disaster. We need the integration of such heterogeneous datasets for big data analytics. We need to handle many kinds of sensors outputting different types of data ranging from time series data to semi-structured data and textual data. These data inherently include noise and misinformation. We need to improve the trust and reliability of these data despite some noise and misinformation in them. For example, by combining information from multiple, potentially unreliable, but independent sources, we may statistically improve the trust and reliability. We also need to take into account that there may be some dependency within and among many resources. Re-tweets, for example, are not mutually independent.

2.4 Metadata Management Issues

For an appropriate interpretation of heterogeneous big data, detailed metadata is required. Some of the reports contain some metadata, but many more details (e.g., about the specific sensor used in data collection) are needed for research purposes. The collection of metadata and data provenance is a significant challenge when the data are collected under duress and stressful situations.

Furthermore, the sensors are operated by a large number of different government agencies for different purposes. At the national level in Japan, the agencies include: Ministry of Internal Affairs and Communications (Fire and Disaster Management Agency); Ministry of Agriculture, Forestry and Fisheries (e.g., radioactivity in fish); Ministry of Land, Infrastructure, Transport and Tourism (Land and Water Bureau); Ministry of Environment; Ministry of Health, Labor and Welfare (Pharmaceutical and Food Safety Bureau). Many more sensors are operated by prefectures, universities, and other agencies. Consequently, the main challenge has shifted from sensor insertion for a relatively small amount of data collection to the management of large but varied data from many sensors.

2. 5 How Emergency Managers Can Benefit from Big Data

During a disaster, life-saving decisions are often made based on the most current information of a situation and past experiences in similar circumstances. While that's a tried-and-true approach, the availability of complex, computer-generated data streams is changing the ball game for some emergency managers. Large volumes of data sets — commonly referred to as big data — derived from sophisticated sensors and social media feeds are increasingly being used by government agencies to improve citizen services through visualization and GIS mapping. In addition, big data is enabling responders to react to disasters more efficiently.

Volunteers at Splunk, an operational intelligence software provider, are involved in a project that culls data from Twitter feeds. By analyzing keywords along with time and place information, a pattern of activity in a particular area can be unearthed. The idea was used during Superstorm Sandy. FEMA created an innovation team composed of public agencies and private companies. One of the participants was Geeks Without Bounds, a nonprofit humanitarian project accelerator, which partnered with Splunk's charity arm, Splunk4Good, to apply the social media analysis. Team members working on the project looked at hashtags and words in Twitter feeds as well as Instagram photos related to Sandy, evacuation rates in specific areas and other keywords about resources, such as power, food, fuel and water. Using that data, the team plotted out locations where supplies might be most needed and got a finger on the pulse of a community's sentiment about available resources.

"You can imagine the ways it can be used in real time for response during an emergency," said Stephanie Davidson, director of federal civilian sales for Splunk. "It's really helpful for where to allocate those resources to the places that need them most."Government agencies have been using social media data for sentiment analysis and public relations for a while. But according to Art Botterell — associate director of the Disaster Management Initiative at Carnegie Mellon University, Silicon Valley — practical use by emergency management agencies for response, recovery and preparation activities is fairly new. Botterell called current

efforts of emergency managers using social media a period of rich experimentation, where decision-makers must determine whether big data derived from Twitter and Facebook should be further incorporated into practical emergency situations, or used simply as a communication tool. "This is an area that has been technology- and concept-driven, which is how most innovation happens, but now we're getting to the point where it all falls under the big data tent [and] how do we know what is more useful and less useful," Botterell said. "This is a conversation that I haven't heard emergency managers having."

3. Big Data in Disaster Management

Effective Big Data Disaster Management

Below are some key points to consider when setting up big data disaster recovery and management:

1. Regulatory Requirement

Your big data disaster management plan needs to comply government and relevant regulatory body mandates. Some companies like knowledge and information aggregators, who look at long term trends, may keep even decades-old data, while this is not necessary for other type of companies. Blend in your critical time period for retaining data, with regulatory compliance essentials. This detail will help you to correctly determine how many years back you need to go, when preserving data.

2. Recovery Point

Big data is a culmination of various well thought out processes. First, the use of a web data extractor collects relevant and targeted data from diverse sources. This is then stored in a data warehouse in a planned manner. From here, it is passed through an ETL engine (extracted, transformed, and loaded) to be used by BI and big data analytics tools for uncovering insights. Now, coming back to big data disaster recovery, you need to be sure what will be your recovery point in case of an outage or data issue. Will it be the initial raw format that data comes in from various sources? Or will it be a more refined form of data that has passed through the

ETL process? A larger proportion of corporate entities involved in big data disaster management will choose the second option. It is worth noting that this is just like transactional data – where the point of recovery will be nearest to when the stoppage or trouble happened in the transaction. However with big data, it is also necessary to determine the 'form' in which you need the data to be recovered.

3. Speed of Data Recovery

In order to derive its full potential, management rightly needs big data analytics to be carried out in near real time. This calls for quick fire recovery in case of any trouble. IT heads might look at cloud storage options to enable this. They can also look to bolster their on-site storage choices. This can be done either with a slower media such as tape drive that has time consuming recovery, or go for continuous replication on in-memory storage on more than one data server.

4. Priority vs. Non Priority

Big data is humongous. You need to be absolutely clear on what data takes priority for recovery, in case of an unforeseen disaster. It's unnecessary and expensive to try and recover ALL the data at once. Mission critical, time critical, or rapidly changing data needs to be on top of your priority list, followed by other data constituents that change or get updated less rapidly. Classifying various clusters into these two types of data on priority needs to be a consensual affair. This way the top management, operations heads, IT admins, and other stakeholders can mutually decide on what should be recovered first and what can wait for a bit longer.

5. Enforce Data Governance

The classic quip of 'Prevention is better than cure' becomes very applicable for big data disaster recovery. While we may have strong process oriented approach for related activities such as data crawling, we lag behind when it comes to implementing strong protocols for big data. Having this in place will help with data disaster management to a great extent. Important components worth considering are assessing the data provenance (source and metadata about the

data) and then deciding on how to use the data in your analytics. This is not something that you can simply plug and play. It has to be ingrained into the way a web data extractor works. This helps make certain that you consider this crucial pointer from the very outset of data collection and later on, its analysis.

6. Practice Makes It Perfect

All the initial brainstorming and devising of big data disaster management plans will bear fruit only with its successful long term implementation across the organization. All stakeholders (both, internal and external) and IT executives need to be taken through the plan and told of their roles and responsibilities in context of the larger picture. It needs several rounds of testing and coordination with end users (individual as well as department level) and external vendors.

The involvement and adoption will be hesitant from them initially, but don't lose hope, because this is the foundation to your disaster management initiative success. You will see that they will eventually support this planning and preparation process when they witness the immense value provided by a properly planned big data disaster management process. These pointers will help you ensure that your big data continues to denote integrity, accuracy, and relevance to help management with insight-based decision making. Do write in to us and let us know what consideration have you factored in for ensuring the safety of your hard earned big data insights.

4. Motivation and Overview of Big Data Analytics

Although many issues for ECNs have been studied, some research problems are still open. [4] It is hard to understand global situations, e.g., a group of people with similar movement patterns. Such kinds of information are important in ECNs when considering the limited communication resources and dynamic changing environments. This information can possibly be grasped by using big data analytics. Efficient deployment and adjustment of different types of

ECNs requires understanding the global situations in disaster areas. ECNs are different from general cellular communication systems:

1) Disaster context awareness,
2) Infrastructure free systems,
3) Distributed style,
4) Limited communication resources,
5) Requirement of optimal deployments and adjustments based on situations as they occur, etc.

Possible data analysis techniques, e.g., stochastic modeling and data mining, were briefly reviewed for wireless communication. However, they neither address the new challenges from the unique characteristics of ECN from both content and spatial points of view. Also, case studies are not sufficient and detailed enough. Therefore, in this paper, we perform a systematic survey and an attempt study on big data analytics for ECNs, through discussing analysis methods and their applications from both content and spatial points of view, and several detailed case studies. From a content point of view, an analysis focuses on the content of the data, e.g., personal opinions, topics, and sentiments. From the spatial point of view, both content and its spatial information are used together in an analysis to explore the distribution patterns of the data in space.

Analyzing such data can prompt a better understanding of the situations when disasters take place. However, both kinds of big data analytics follow similar procedures, shown below:

Collection

The first step is to universally collect the data. The analysis process cannot be conducted without data, and the appropriate data are especially important.

Storage

The second step is to maintain large-scale data storage servers. The size is not a problem with the current mature technology, but a real challenge will be efficient processing of the

distributed data which also covers a wide spectrum of issues such as scheduling problems on single computers or open clusters, communication guarantee or failure recovery, and data transmission between vertices.

Management

The third step is to correctly categorize the data. Since big data are often from heterogeneous resources, applying flexible data management offers a more reliable and instant storage plan for heterogeneous information at different levels, compared to general data management solutions. It also mass data operations suited for further analytics and statistics.

Processing

The fourth step is to process and analyze the data in an efficient way. To achieve instant large scale data processing, it is necessary to use distributed computing resources.

Prediction

The last step is to make a prediction. which makes a meaningful connection among separate datasets for a specific purpose, based on the results obtained from the raw data. This step also requires the participation of domain experts and users, who are expected to observe and explain the meanings of the data and determine the solutions (as well as an action plan).

5. Big Data: A Natural Solution for Disaster Relief

With big data as common in science as it is everywhere else, could we have used better tools to see this coming? What's the role of big data in natural disasters today?

The answer is a work in progress. NASA, for one, admits to currently having a big data problem. "(D)ata is continually streaming from spacecraft on Earth and in space, faster than we can store, manage, and interpret it," writes NASA Project Manager Nick Skytland. "In our current missions, data is transferred with radio frequency, which is relatively slow. In the future, NASA will employ technology such as optical (laser) communication to increase the download and mean a 1000x increase in the volume of data. This is much more then we can handle today and this is what we are starting to prepare for now. We are planning missions today that will easily stream more then 24TB's a day. That's roughly 2.4 times the entire Library of Congress – EVERY DAY. For one mission."

NASA still needs to catch up with its data load. Other government agencies are looking for ways to collaborate more effectively. For example, the Department of Defence has secret satellites located around the world for reconnaissance. Those satellites also happen to have the capability to detect large and small meteors. The DoD, however, is nervous about sharing any information that it deems classified, so efforts are still underway to find a way to incorporate that data into the bigger scientific schema.

6. Real-Time Disaster Maps

Terrestrial challenges, on the other hand, are currently more amenable to big data. One of big data's true strengths lies in crisis mapping, the process of using visualizations, footage, analysis and apps to get an overview of a disaster as it evolves. Google's Super storm Sandy Crisis Map tracked the course of last winter's storm, with video footage, evacuation routes and emergency aid centres. The UN commissioned the Digital Humanitarian Network to track the real-time effects of Typhoon Pablo in the Philippines. Among other efforts, social data was analyzed to provide a detailed, real-time map of displaced people, fatalities, crop damage, broken bridges and more.

7. Using Big Data In A Crisis: Nepal Earthquake

There were hundreds of emergency services, charities, disaster relief agencies and volunteers have done their best to help people affected by the terrible Nepalese earthquake which struck during the weekend. And Big Data is playing its part, too – with crowd sourced, data-driven efforts to connect people outside the country with their missing loved ones, and assist in getting aid to where it is needed.

Much of the work on developing Big Data systems to help with disaster relief began in the wake of the 2010 Haiti earthquake and the 2011 Tohuku, Japan earthquake and tsunami. Japan and the US instigated a joint research program to find workable methods of using data to ease the toll of natural disasters which kill thousands each year, and cost the global economy billions. Last year, the US National Science Foundation and Japanese Science and Technology Agency offered $2 million in funding to groups working on data-driven solutions to disaster management problems. At the other end of the scale, crowd sourced, data-led initiatives have also started off at a grassroots level, with community members coming together to collate data to assist others. This happened following Hurricane Sandy in the US, when high school students collaborated to create an online map of the New York and New Jersey area showing where gas was available. Following Typhoon Haiyan in the Philippines, the international Red Cross collaborated with volunteers around the world to map the effects on the region and its people.

The four key elements of disaster management are prevention, preparation, response and recovery. Big Data has potential to help with all of them.

While not much can be done to prevent natural disasters, sophisticated Big Data systems such as those developed by Palantirare being used to crack down on man-made disasters such as those caused by terrorism. But when it comes to "acts of God", of course the focus will be on preparation, response and recovery.

8. Adoption Issues for Big Data Approaches in Disaster Management

One of the key questions in disaster management research is the acceptance and adoption of technologically advanced solutions by the public. To illustrate improved emergency response, let us consider the idea of "call in emergency" list, which has been implemented by many institutions. For example, large institutions such as University of Florida and Georgia Tech offer an opt-in emergency notification service to send critical information to employees and students when emergencies arise. The notifications modes supported currently include phone calls, emails, and SMS to smart phones.

9. Practical Questions on Technology Adoption

Another emergency response scenario being suggested (and debated) is the use of smartphone location information to notify every phone in a danger zone during an emergency. (For the following discussion we will assume that the legal rules about opt-in and opt-out can be satisfied.) Although the idea of emergency notification is a relatively simple concept, there are many opportunities that arise beyond a hardwired message. Let us consider its application to the 3-11 scenario, where the tsunami arrived the Tohoku coast a few minutes after the earthquake. A quick notification (e.g., SMS) could be sent immediately to the coastal areas after an earthquake has been confirmed. As more information becomes available, e.g., the epicenter of earthquake is determined, phones are classified by their distance to the epicenter and their risks assessed accordingly (e.g., their distance to the seashore. Additional emergency response information is

then sent to phones according to the risk level due to their location. This additional information can be customized for each location as well as other available information such as whether the phone has been used or moved since the start of earthquake. For phones with active users, appropriate escape routes could be sent to each phone, using facilities such as Google Crisis Response. Each refinement step requires significant knowledge of the environment (provided by big data sources) plus an accurate knowledge of the disaster for accurate risk assessment and appropriate response. To increase the adoption of technologies developed for disaster prevention, preparation, response, and recovery, it is essential to consider the integration of the new infrastructure with tools currently in use and offer familiarization of new tools before a disaster takes place. For example, geographical replication is a known solution to recover IT from a devastating disaster.

However, these incur costs that prevent many small businesses from implementing it. Given that electronic businesses are increasingly adopting cloud computing and virtualization, [7] proposed the use of migration to mitigate the impact of disasters to an IT infrastructure when a disaster is predictable, while [8] increases the possibility of adoption for those taking advantage of advanced I/O technologies in virtualized environments. Studies that consider the barriers for adoption such as incompatibilities between solutions, cost/benefit of a solution, cultural differences, and amount of training are expected to accelerate adoption by providing accurate assessments. It is important to have opportunities for public training. However, there are so many people who are not familiar with ICT devices. Thus, we should develop ICT devices with simple and understandable user interfaces so that many people can recognize emergency alerts.

To increase public awareness in disaster prevention, preparation, response and recovery, it is critical to create effective training environments and programs that help prepare the public for future disasters. This can be achieved through appropriate education programs, such as ones that teach the public about potential disasters and how they progress, how should one response in such disaster situations, what tools, services and help are available, how one can effectively assist others during actual disasters and post-disasters. In addition, conducting regular testing of

the services and public responses under simulated disaster settings is important not only to increase public knowledge and awareness but also to evaluate the services and infrastructure. Collaborations between various government and industry stakeholders and scientists of various fields (e.g., engineering, psychology, healthcare) to construct such training environments and programs are needed to effectively educate the public.

10. Conclusion

Disaster Management is an important global problem. Disasters affect every country on Earth and effective disaster management is a global challenge. This is particularly the case of large-scale disasters that affect many countries (e.g., the 2004 Indian Ocean earthquake and tsunami) and multi-hazards such as the Tohoku Earthquake and landslides. Big Data is a great global opportunity for disaster management. Big data has already demonstrated its usefulness for both dedicated sensor networks (e.g., earthquake detection during the Tohoku Earthquake) and multi-purpose sensor networks (e.g., social media such as Twitter). However, significant research challenges remain, particularly in the areas of Variety of data sources and Veracity of data content. We call this the Big Noise in Big Data challenge. From the disaster management view, we need the technology push from big data researchers to tackle the challenges mentioned above (e.g., Big Noise) so big data tools can effectively address disaster management issues. From the big data view, we need the application pull of disaster management researchers to apply big data techniques and tools to solve real world problems.

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A Waste and E-Waste Management – An Overview

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Abstract

Waste is a significant environmental issue across communities and industries alike. Efforts in reducing, reusing and recycling waste are increasing in order to promote a sustainable natural environment. Effective waste management starts with knowledge; knowledge is gained through the understanding of information and information through the collection and analysis of sound data. The waste management sector is rapidly expanding but not without technology solutions that enable this transformation of data into knowledge. This paper focuses on the issue of the waste management and the role of IT to support management activities and specifically portrays about E – Waste Management and its strategies.

Keywords: Waste, EWaste, IT, Cloud, SaaS, PaaS, Iaas, ICT, 3 Rs, RFID, EPR.

1. Introduction

Waste management is all the activities and actions required to manage waste from its inception to its final disposal. This includes collection, transport, treatment and disposal of waste together with monitoring and regulation. It also covers the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc. The role of technologies in waste management towards the sustainable development presents the most significant IT technologies that have contributed to the identification and implementation of new forms of economic and social development that takes into account the evaluation of the environmental impact of products throughout their life cycle. Technologies such as decision support systems (DSS), remote sensing and geographical information systems (GIS), online web services,

virtualization and cloud computing are analyzed in terms of the innovator role and of the impact on the sustainable development of society.

At ISWA's 2015 World Congress in the City of Antwerp, UNEP and ISWA presented "Global Waste Management Outlook (GWMO)". David C.Wilson reported the global challenges of the waste management sector for the next decade and presented various shocking facts after two years of his study. They are 2 billion people on our planet, do not have currently access to solid waste collection at all. That is 27% of the world population. Solid waste management is accounted for 3% of the global greenhouse gas (GHG) emissions. He also stated that ICT solutions and 'big data' are a key driver to take global waste management to the next level. The potential positive impact of improved waste management on reducing GHG emissions across the economy will be around 15-20%.A major focus of the GWMO is on the 'governance' factor required to make waste management happen in practice. A 'toolkit' has been developed to help select a suitable set of actions. A "data revolution" is an essential gear wheel of the 'toolkit' that was developed to facilitate taking the next appropriate steps in developing specific waste management system at the national or local level. On a global scale, the industry is currently lacking the availability and reliability of waste and resource management data. And the cliché "You cannot manage what you cannot measure" has never been more applicable to the waste industry. David Newman, President of the International Solid Waste Association, said that bringing advanced technologies, such as Waste to Energy plants, to the developing countries, is not the real challenge. The real challenge is how to finance those projects. Economy of scale is necessary to lower the costs for technologies and funding opportunities may be an enabler to help develop the waste management industry on a global scale. Data and performance indicators are vital to drive the change towards a more sustainable waste management industry. Therefore, the industry must work towards a system where a city's municipal solid waste management system can be benchmarked against other city's using indicators and highlight areas for improvement. And this information must be publically accessible, online, to drive the awareness around waste disposal behaviour.

ICT industry is focusing on solutions for the waste industry for almost 20 years now, this raised the question about how to make ICT systems for waste collection and treatment affordable and available to all countries including the underdeveloped countries and emerging economies. Waste managers and policy makers are working hard on defining and implementing policies including a governance structure to improve the waste management systems locally. Having a cloud solution for waste collection, recycling and material resource trading, we have a system that can collect the data and present the performance indicators that are necessary to drive the waste revolution. It is not so hard to make our systems available to any country provided that it has access to the internet.

In this paper, we firstly reviewed about the Global Waste Management outlook. The rest of the paper is as follows: Section II delineates central principles of waste management including waste hierarchy, resource efficiency, polluter pays principle, World Wide Waste handling practices and Disposal solutions. Section III discusses about E waste management and its strategies. Section IV is about Technologies for E-Waste management and Section V concludes the paper.

2. Central Principles of Waste Management

There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:

2.1 Waste Hierarchy

The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which categorize waste management strategies in terms of waste minimization. The aim of the waste hierarchy is to pull out the maximum practical benefits from products and to generate the minimum amount of waste. The waste hierarchy is depicted as a pyramid because the basic premise is for policy to take action first and prevent the generation of waste. The next step is to reduce the generation of waste i.e. by re-use. The next is recycling which would include composting. Following this step is material recovery and waste-to-energy. Energy can be recovered from processes i.e. landfill

and combustion, at this level of the hierarchy. The final action is disposal, in landfills or through incineration without energy recovery. This last step is the final resort for waste which has not been prevented, diverted or recovered. The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management.

Figure 1 – Waste Management Hierarchy

2.2 Resource Efficiency

Resource efficiency reflects the understanding that current, global, economic growth and development cannot be sustained with the current production and consumption patterns. Globally, we are extracting more resources to produce goods than the planet can replenish. Resource efficiency is the reduction of the environmental impact from the production and consumption of these goods, from final raw material extraction to last use and disposal. This process of resource efficiency can address sustainability.

2.3 Polluter Pays Principle

The Polluter pays principle is a principle where the polluting party pays for the impact caused to the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the unrecoverable material.

Throughout most of history, the amount of waste generated by humans was insignificant due to low population density and low societal levels of the exploitation of natural resources. Common waste produced during pre-modern times was mainly ashes and human biodegradable waste, and these were released back into the ground locally, with minimum environmental impact. Tools made out of wood or metal were generally reused or passed down through the generations.

However, some civilizations do seem to have been more profligate in their waste output than others. In particular, the Maya of Central America had a fixed monthly ritual, in which the people of the village would gather together and burn their rubbish in large dumps.

2.4 World Wide Waste Handling Practices

Curb-side collection is the most common method of disposal in which waste is collected at regular intervals by specialized trucks. This is often associated with curb-side waste segregation. In rural areas waste may need to be taken to a transfer station. Waste collected is then transported to an appropriate disposal facility. In some areas, vacuum collection is used in which waste is transported from the home or commercial premises by vacuum along small bore tubes. Systems are in use in Europe and North America.

Pyrolysis is used to dispose of some wastes including tires, a process that can produce recovered fuels, steel and heat. In some cases tires can provide the feedstock for cement manufacture. Such systems are used in USA, California, Australia, Greece, Mexico, the United Kingdom and in Israel. The RESEM pyrolysis plant that has been operational at Texas USA

since December 2011, and processes up to 60 tons per day. In some jurisdictions unsegregated waste is collected at the curb-side or from waste transfer stations and then sorted into recyclables and unusable waste. Such systems are capable of sorting large volumes of solid waste, salvaging recyclables, and turning the rest into bio-gas and soil conditioner.

In San Francisco, the local government established its Mandatory Recycling and Composting Ordinance in support of its goal of zero waste by 2020, requiring everyone in the city to keep recyclables and compostables out of the landfill. The three streams are collected with the curbside "Fantastic 3" bin system - blue for recyclables, green for compostables, and black for landfill-bound materials - provided to residents and businesses and serviced by San Francisco's sole refuse hauler, Ecology. The City's "Pay-As-You-Throw" system charges customers by the volume of landfill-bound materials, which provides a financial incentive to separate recyclables and compostables from other discards. The City's Department of the Environment's Zero Waste Program has led the City to achieve 80% diversion, the highest diversion rate in North America.

2.5 Financial Models

In most developed countries, domestic waste disposal is funded from a national or local tax which may be related to income, or notional house value. Commercial and industrial waste disposal is typically charged for as a commercial service, often as an integrated charge which includes disposal costs. This practice may encourage disposal contractors to opt for the cheapest disposal option such as landfill rather than the environmentally best solution such as re-use and recycling. In some areas such as Taipei, the city government charges its households and industries for the volume of rubbish they produce. Waste will only be collected by the city council if waste is disposed in government issued rubbish bags. This policy has successfully reduced the amount of waste the city produces and increased the recycling rate.

2.6 Disposal Solutions

2.6.1 Incineration

Incineration is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This method is useful for disposal of residue of both solid waste management and solid residue from waste water management. This process reduces the volumes of solid waste to 20 to 30 percent of the original volume. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash.

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.

Incineration is common in countries such as Japan where land is more scarce, as these facilities generally do not require as much area as landfills. Waste-to-energy (WtE) or energy-from-waste (EfW) are broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam or electricity. Combustion in an incinerator is not always perfect and there have been concerns about pollutants in gaseous emissions from incinerator stacks. Particular concern has focused on some very persistent organic compounds such as dioxins, furans, and PAHs, which may be created and which may have serious environmental consequences.

2.6.2 Recycling

Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, a procedure called kerbside

collection. In some communities, the owner of the waste is required to separate the materials into different bins (e.g. for paper, plastics, metals) prior to its collection. In other communities, all recyclable materials are placed in a single bin for collection, and the sorting is handled later at a central facility. The latter method is known as "single-stream recycling."

The most common consumer products recycled include aluminium such as beverages cans, copper such as wire, steel from food and aerosol cans, old steel furnishings or equipment, rubber tiers, polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes.

PVC, LDPE, PP, and PS are also recyclable. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required. The type of material accepted for recycling varies by city and country. Each city and country has different recycling programs in place that can handle the various types of recyclable materials. However, certain variation in acceptance is reflected in the resale value of the material once it is reprocessed.

2.6.3 Reuse Recoverable materials that are organic in nature, such as plant material, food scraps, and paper products, can be recovered through composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity and heat (CHP/cogeneration) maximizing efficiencies. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

2.6.4 Energy Recovery

Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolyzation, anaerobic digestion, and landfill gas recovery. This process is often called waste-

to-energy. Energy recovery from waste is part of the non-hazardous waste management hierarchy. Using energy recovery to convert non-recyclable waste materials into electricity and heat, generates a renewable energy source and can reduce carbon emissions by offsetting the need for energy from fossil sources as well as reduce methane generation from landfills. Globally, waste-to-energy accounts for 16% of waste management.

The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Thermal treatment ranges from using waste as a fuel source for cooking or heating and the use of the gas fuel to fuel for boilers to generate steam and electricity in a turbine.

2.6.5 Pyrolysis

Pyrolysis is a process of thermo-chemically decomposition of organic materials by heat in the absence of oxygen which produces various hydrocarbon gases. During pyrolysis, the molecules of object are subjected to very high temperatures leading to very high vibrations. Therefore, every molecule in the object is stretched and shaken to an extent that molecules starts breaking down. The rate of pyrolysis increases with temperature. In industrial applications, temperatures are above 430 °C (800 °F). Fast pyrolysis produces liquid fuel for feedstocks like wood. Slow pyrolysis produces gases and solid charcoal. Pyrolysis holds promise for conversion of waste biomass into useful liquid fuel. Pyrolysis of waste plastics can produce millions of litres of fuel. Solid products of this process contain metals, glass, sand and pyrolysis coke which cannot be converted to gas in the process.

2.6.6 Resource Recovery

Resource recovery is the systematic diversion of waste, which was intended for disposal, for a specific next use. It is the processing of recyclables to extract or recover materials and resources, or convert to energy. These activities are performed at a resource recovery facility. Resource recovery is not only environmentally important, but it is also cost effective. It

decreases the amount of waste for disposal, saves space in landfills, and conserves natural resources.

Resource recover uses LCA (life cycle analysis) attempts to offer alternatives to waste management. For mixed MSW (Municipal Solid Waste) a number of broad studies have indicated that administration, source separation and collection followed by reuse and recycling of the non-organic fraction and energy and compost/fertilizer production of the organic material via anaerobic digestion to be the favoured path.

As an example of how resource recycling can be beneficial, many of the items thrown away contain precious metals which can be recycled to create a profit, such as the components in circuit boards. Other industries can also benefit from resource recycling with the wood chippings in pallets and other packaging materials being passed onto sectors such as the horticultural profession. In this instance, workers can use the recycled chips to create paths, walkways, or arena surfaces.

2.6.7 Sustainability

The management of waste is a key component in a business' ability to maintaining ISO14001 accreditation. Companies are encouraged to improve their environmental efficiencies each year by eliminating waste through resource recovery practices, which are sustainability-related activities. One way to do this is by shifting away from waste management to resource recovery practices like recycling materials such as glass, food scraps, paper and cardboard, plastic bottles and metal.

2.7 Avoidance and Reduction Methods

An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using

disposable products (such as disposable cutlery), removing any food/liquid remains from cans and packaging, and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans)

2.8 Benefits

Waste is not something that should be discarded or disposed of with no regard for future use. It can be a valuable resource if addressed correctly, through policy and practice. With rational and consistent waste management practices there is an opportunity to reap a range of benefits. Those benefits include:

1. **Economic** - Improving economic efficiency through the means of resource use, treatment and disposal and creating markets for recycles can lead to efficient practices in the production and consumption of products and materials resulting in valuable materials being recovered for reuse and the potential for new jobs and new business opportunities.
2. **Social** - By reducing adverse impacts on health by proper waste management practices, the resulting consequences are more appealing settlements. Better social advantages can lead to new sources of employment and potentially lifting communities out of poverty especially in some of the developing poorer countries and cities.
3. **Environmental** - Reducing or eliminating adverse impacts on the environmental through reducing, reusing and recycling, and minimizing resource extraction can provide improved air and water quality and help in the reduction of greenhouse gas emissions.

3. E-Waste

Urbanization and economic growth over the past few years have increased the consumption of resources and caused the menace of excess waste generation. With rapid technological advances, large number of electronic products has become obsolete and their replacement has led to increase in generation of electronic waste (E-Waste). The rising volume of E-Waste around the world is an unavoidable by - product of this growth and has to be managed properly. Improper management of such highly toxic waste can pose serious threat to environment and its people. To overcome such Problems, every country has laid down certain set

of goals, which are representative of present and future needs of the society or nation, and deploys its available resources for the attainment of such set goals. Waste of Electrical and Electronic Equipment (WEEE) or E-Waste management is one such goal. In Developed countries, E-Waste is handled by more of a mechanized and systematic way, whereas, in developing countries, like India, approach is more manual and labour intensive.

This approach indicates a strong interrelationship between human beings and E-Waste handling in terms of livelihood and health hazards. Thus, a more human oriented approach is required towards the management of E-Waste in developing countries. The E-Waste menace is largely recognized a major area of environmental concern. The major strategies that have led to the formulation of E-Waste management plans around the world are

• Reduction in amount of E-Waste generated through effective resource utilization, reuse and recycling;

• Environmentally sound management (ESM) of E-Waste for protection of human health and environment from the hazardous fractions present in it; and

• Recovery of scarce and precious materials as a step towards sustainable development.

Several nations have implemented E-Waste management plans according to their areas of need and concern. The European Union is considered as a stern legislation provider and focuses on most of the aspects of E-Waste handling, Japan is considered as they mainly focus on Reduction of E-Waste generated by reuse and recycling. India, as a new entrant in both legislative and management fields and as a representative of developing countries, is analyzed to assess the challenges and opportunities that exist in the field of E-Waste management.

The advance in technology improves the capabilities of the computer devices, while reduces its cost, size and weight, but the technology did not lengthen the useful age of the computer devices. Most of the computer devices have an average lifespan of less than two years; moreover, today, it is always cheaper and more convenient to buy a new machine than upgrading

the existing unit. Electronic waste (E-Waste) or Waste Electronic and Electrical Equipment (WEEE) refer to electronic products. Without proper management and control on the disposal of E-Waste, most of these discarded electronic devices eventually end up at the landfill.

As commented by Hamilton in her paper "There are 130,000 computers are trashed in United State each day and these discarded stuffs mainly go to landfill". In the earlier days, the disposal of electronic devices are mainly due to damages, but in today technology boom, damages is no longer the only reason for disposing of electronic devices, where technical worn out, better cost of ownership, new product features, better aesthetic outlook and emotional value are having strong influences to the disposal of the devices. Due to the uncontrolled disposal of electronic devices, E-Waste had became a global dilemma where E-Waste had populating ever-growth landfill area and the United Nation had warned that the E-Waste problem at the developing countries like China, Africa and India could be a double or even quadruple with the next decade .Acceptable forms of E-Waste include Computers, Monitors, Printers, Toner Cartridges, Mobile Phones, iPods/MP3 Players, Televisions, DVD Players, Telephones, Cables/Wires etc.

3.1 E-Waste Rules (2011), India

In order to reduce and manage the growing menace of E-Waste, Ministry of Environment and Forests (MoEF) has proposed the E-Waste (management and handling) rules, 2011 framed under the Environment Protection, Act 1986 for ESM of E-Waste. ESM is defined as taking all steps to ensure proper management of E-Waste to protect health and environment from hazardous substances present in EEE by E-Waste rules. The status of India as per the quantification process is not well defined. It was estimated that 19000 tons of E-Waste was recycled out of 144,143 tons available for recycling out of 382,979 tons of E-Waste generated in 2007 in India. It was estimated 482,000 tons of E-Waste generation in 2011 as per 6% compound annual growth rate .Presently, E-Waste generation is mounting at the rate of 15% since 2005 and expected to reach 1.2Million tones by 2020 . E-Waste is largely controlled by the unorganized

sector. This informal sector causes damage to the environment with the emission of toxic fractions from E-Waste due to the use of primitive methods for resource recovery.

3.2 E-Waste Management Strategies

Management of waste has been a critical concern for ensuring sustainability in organizations. There are a number of documented studies out there in the published literature which are highlighting this concern to an extent. For example, consumer behaviour on waste mobile recycling ;management of old electronic waste ; green software development model; decisive factors in green supply chain practices under uncertainty ; a literature and practice review to develop sustainable business model archetypes ; sustainability and business to business marketing; creating small business sustainability awareness ; a strategic approach to develop green supply chains ; review of sustainability terms and definitions; a European case study of business sustainability model are few to highlight.

However, it is an open question to explore the ways in which software companies manage their waste to maintain zero waste in their day to day business activities. Thus, this research focuses on exploring the following research questions by analyzing the sustainability reports of software development companies.

1. What types of wastes are generated by software development businesses?
2. How waste could be managed in a software development business?
3. Which waste management strategies and best practices multinational world class software development firms could learn from large scale Indian software businesses?

The type of wastes which are generated by the software businesses has to be identified and documented in order for it to be treated in an effective and environmentally friendly manner by the software development organizations. For example, E-Waste is a major type of waste generated by the used electronic items by the companies that has to be sorted in a manner which will not harm the environment .Likewise; there could be a number of waste types which has to be

handled by the software companies in order for them to generate effective waste management strategies. Therefore, our first question looks at identifying the types of wastes that has to be tackled by the software companies.

The know-how of managing waste in a software development environment is tackled as the second question in the research documented in this paper. The ways in which companies manage waste could well be analyzed through looking at the existing best practices on waste management companies are adapting. For example, reuse and recycling is one of the widely used strategies for waste management according to the published literature.

4. Information Technologies

4.1 RFID (Radio Frequency Identification)

Traditionally the waste management industry has been a late adopter of new technologies such as RFID (Radio Frequency Identification) tags, GPS and integrated software packages which enable better quality data to be collected without the use of estimation or manual data entry.

Real time monitoring of status of bins, estimation of amount of waste in and around bins, surveillance for monitoring the movement of vehicles, optimization of routes and reallocation of bins according to the estimated waste, availability of management information system (MIS) reports for effective planning of resources schedule, and providing transparency in civic administration are the functions of this technology. The figure shows the garbage truck

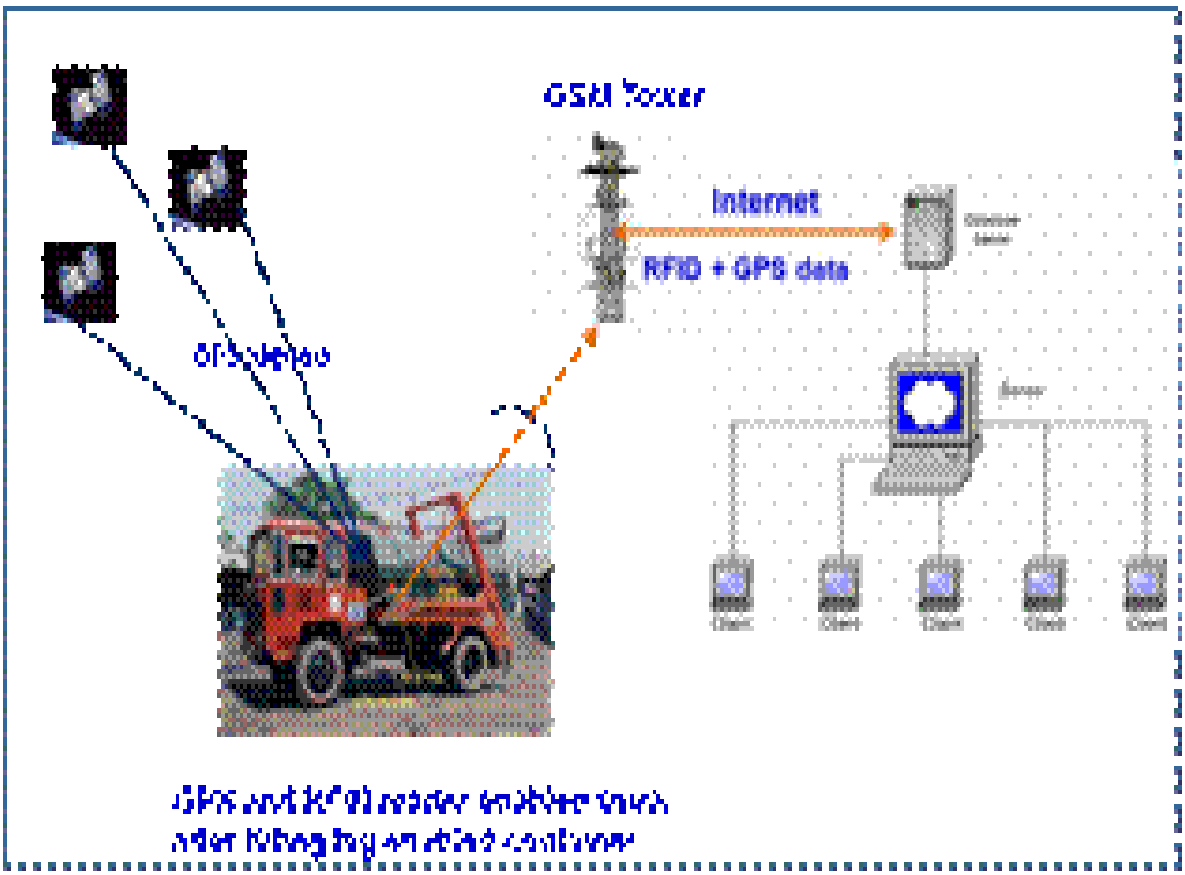

Figure 2: Technical architecture of the RFID system

4.2 EPR (Electronic Pollutants Recycling) system in the electronics recycling market at home and abroad

Lee et al. (1998) reported about how to apply the EPR pairs of Taiwan containers, packaging materials and other 10 categories of items for recycling process; Fishbeni (2000) describes the EPR system in the United States would apply to the recovery of the carpet achieved great success story; Yamaguehi (2002) the EPR system in Japan, the specific application, as well as for the OECD to the EPR system, the interpretation of the relevant provisions of the different views put forward their own; Thomas (2003) elaborated Sweden will EPR system used in waste electrical and electronic products (WEEE) recycling; Gonzalez a Torre et al. (2004) introduced the European waste bottles and packaging materials such as environmental policies and reverse logistics initiatives; Mr Tong Ka-Fu, Zhang Zhiqiang (2003)

discussed the EPR system in waste management in the specific application; Teng Yan, Feng-Chun Lin (2004) to the international countries and regions, the implementation of E-Waste legislation and its effects were compared. The literature suggests that here are already many countries have begun to respond positively to the EPR system used in waste management in the specific practice.

4.3 Cloud based information platform for e-waste recycling

Cloud computing is one of the new information technologies, which enables web based information. The cloud based information platform consists of three level services: 1) web-based information platform for all the stakeholders, which share information on the platform; 2) SaaS (Software as a Service) based ERP (Enterprise Resource Planning) management system for recyclers, who can lease the application from the platform operator, without having to invest in the software license or infrastructure; 3) expansion of the platform to collection platform and transaction platform for the recovered material. The above mentioned three platforms are considered as three sub-clouds, which are integrated in the E-Waste recycling cloud.

4.3.1 New Technologies Used in the Platform

With the rapid development of information and telecommunication technologies, IT based service as become more sophisticated and integrated with business and organization, which further drives the service innovation. IT service itself has been undergoing transformation. The old IT service mode is based on license, while new IT service focuses on SaaS (Software as a Service) paradigm, which relies on web-based service .Cloud computing, as an innovative distributed computing, can provide dynamic resource buffer, virtualization and highly usable next generation of enterprise data centre. Cloud image is used to represent the Internet or some large networked environment, the cloud is a virtualization of resources that maintains and manages itself. One major kind of cloud computing is SaaS (Software as a Service), through which users can get software service from internet, without having to invest massively in software or infrastructure. They can lease the web-based software from service provider, which is responsible for the operation, upgrading and maintenance of the software related technology.

4.3.2 Functions of the Platform

The proposed E-Waste recycling platform includes three levels of information:

1) Web based information & management platform, on which all the stakeholders (such as ecyclers, management authorities, producers etc.) are integrated in the platform. Through internet browser the stakeholders can access the platform to input information and extract information from the platform. All the data are stored in the central database server.
2) SaaS based platform for ERP system for recyclers and major collectors. To meet the requirement of information reporting to the municipal environmental protection bureau or the E-Waste fund centre, recyclers need to construct information system (ERP) system for inbound and outbound operation. SaaS mechanism is a suitable way for E-Waste recyclers. The information system is run online, which allows the recyclers to save the investment for the infrastructure. The system is run in the cloud, which is here 2 Cloud Computing includes three types of services: 1) IaaS (Infrastructure as a Service); 2) PaaS (Platform as a Service); 3) SaaS (Software as a Service), called "E-Waste recycling cloud" or E-Waste recycling platform
3) Extended platform with collection platform and transaction platform integrated. The collection platform integrates all the collectors and their operation, while transaction platform provides an electronic market for the recycled material for the buyers and sellers. Figure 5 shows the structure of the cloud based E-Waste recycling platform. Fig 5. Structure of the Cloud based E-Waste Recycling Platform.

4.3.3 Advantages of the Information Platform

This integrated platform can ensure quick and consistent information delivery. The stakeholders can communicate easily, without problem of system heterogeneity. Information can be easily updated and delivered to the parties involved. Producer: provide information of their product, especially about the toxic material contained in the product, and instruction of the collection & treatment. Management authorities, including local environmental protection authority, provincial management authorities and state council level authorities, share the

management responsibility to control and monitor the operation of the E-Waste recycling operation. Recyclers: exchange information with producer, collectors, management authorities, third party service providers etc. Other stakeholders can access the platform to contribute and to share the information.

Third party service providers, which claim the producer service responsibility, can also access the corresponding information on the platform. This platform allows simultaneous information sharing among stakeholders. Each stakeholder has its own power to access specific types of information. Especially for the recyclers, they cannot have access to other recyclers' data. The data security issue is currently the major obstacle to push forward the SaaS mechanism, because the recyclers are concerned about the information leaking to competitors. The innovative web (cloud) based service, such as IT service, logistics service and quality inspection service; etc., are part of the "producer services" In principle, these services can be hosted as web-delivered services, which can help improve the efficiency of the total service system. .Thus the companies are left with their core recycling business and their competitiveness can be enhanced. Furthermore, in the cloud based E-Waste recycling network, financial flow and material flow can be integrated in the information management platform.

4.3.4 Operation of the Cloud based Information Platform

Operator of the integrated platform can be the central E-Waste fund management center or a third party IT service provider. Because Cloud computing and SaaS mechanism is new to customers who needs time to develop trust in them, the investment and operation cost at the beginning stage should be covered by the government. Both the information platform and the ERP system for recyclers are free for all the stakeholders. The government should support the system until the system becomes mature.

5. Conclusion

As one of the major resource regulation industries, Waste and E-Waste recycling can help solve resource shortage and environmental pollution problem, ensuring sustainable development.

The information technologies such as RFID, GPRS, EPR , Cloud based platform etc can support the waste management practices efficiently. The government regulations pertaining to waste and E-Waste management would further enhance the waste management strategies of software development firms.

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The Value of Mathematical Creativity and Innovation in Entrepreneurship

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Abstract

All innovation begins with mathematical creative ideas. Creativity is the starting point for innovation. It has been traditionally attributed to art and Literature but now- a- days doing science has also been considered as a creative act. Mathematical Creativity is however necessary but not sufficient condition for innovation. Innovation is the implantation of creative inspiration. The main focus of this paper is to provide an overview of definitions and characteristics of mathematical creativity based on innovation in entrepreneurship. This paper will discuss and describe the essence of mathematical creativity and innovation in entrepreneurship.

Key Words: Innovation, Creativity, Inspiration, Mathematical.

Introduction

Drucker (1985) argued that innovation is the tool of entrepreneurship. In addition, both innovation and entrepreneurship demand mathematical creativity. Mathematical Creativity is the ability to make or otherwise bring into existences something new, whether a new solution to a problem, a new method or device, or a new artistic object or form. Wyckoff (1991) defines creativity as new and useful. Creativity is the act of seeing things that everyone around us sees while making connections that no one else has made. Mathematical Creativity is moving from the known to the unknown.

No entrepreneur or enterprise, however successful and big, can continue to hold a place of leadership unless it recognizes that modern business operates in a world of galloping change

which creates new problems, risk and opportunities and for which they have to mobilize the enterprise's resources before changes make their impact felt. To do successfully, the entrepreneur and enterprise should know where this firm is going and how the firm will get there. Here, we need mathematical creativity. This is turn requires a clear definition of the company's business which will enable it to continually adopt operations to the realities of the market place, 'the very corner stone of survival and growth" Innovation is nothing but adding something new to an existing product or process. The product or process has already been created from scratch and has worked reasonably well. When it is changed so that it works better or fulfils a different need, then there is innovation on what already exists. Hence Mathematical creativity Innovation are the successful exploitation of new ideas.

Creative Thinking

Creative thinking has various definitions (Okpara 2000). However, it is the art of generating solution to problems by the force of imagination and reasoning. It is an activity of the mind seeking to find answer to some of life's questions. In a dynamic and changing world, the challenges of man are also not static. They take on new forms and require a deep creative thinking approach. Creative Thinking can be considered as a dynamic mental process including convergent and divergent thinking.

Every idea is a product of thinking and every product is the manifestation of idea naked in a thinker's mind. These are people who see problems as opportunities to improve and do something new or something better, people who keep these two vital questions on their mind. "What can I do to make things better, or what can I do to make better things? This is the product of thinking.

In making things better, the goals are usually to improve productivity and efficiency, achieve speed, enhanced comfort and convenience, influence returns positively, and so much more. While in making better things, thinking can produce various alternative leading making better things, thinking can produce various alterative leading to the evolution of a completely

new idea, new production processes, or a total departure from the conventional. Whatever the goal, thinking is an indispensable tool in the life of all successful entrepreneurs.

The celebrated discoveries of man are not accidents. The minds of men/women were engaged in creative thinking to deliver the visible products we enjoy today. Name them: Bill Gate and the computer, Graham Bell and the telephone, Michael Faraday and electricity, Isaac Newton and physical law of science, the Wright brothers and Aeroplane, Adenuga and Consolidated oil, Atedo peterside and Investment Banking and Trust Company, Raymond Depokesi and Dear Communications. The list is endless. You too can join them as you begin to "ponder the path of your feet, that all your ways may be established."

Thinking begins with engaging yourself in a conversation with yourself by yourself, in yourself. That is to reach a conviction and conclusion as to what steps to take and what strategies to employ in a situation. The place of asking the right and relevant questions in thinking process cannot be overemphasized. Questions remain the string tool to provoke the mind to respond to issues and discover new things. Creative thinking must, therefore, lead to the articulation of a strategy. It is a common knowledge that successful entrepreneurs emerge not by strength or force but by superior strategy through creative thinking.

There are great business opportunities in applying creative thinking to solving mankind's crying need for basic products and basic support services –better homes, better jobs, and a better way of life. However, being able to adapt ideas is what makes an entrepreneur successful. There is nothing wrong with learning from others ideas. Creativity comes in when you expand upon it, when you take an idea and make it move.

Mathematical Creativity

Mathematical creativity is the ability to generate new ideas by combining, changing, or reapplying existing ideas. Some creative ideas are astonishing and brilliant, while others are just simple, good practical ideas that no one seems to have thought, of yet. (Harris,

1998).Creativity in mathematics helps us make sense of the world. However, in typical classrooms, we are taught as mathematics is all about rules and procedures. We should see how mathematics was developed and realize that creative individuals shaped the body of mathematical knowledge. More emphasis should be placed on creative ways of expressing ideas.

In this information and communication technology age, creative and skilled manpower are needed to support the vision of our nation. An emerging technological society and economy makes mathematical knowledge and creativity both essential and advantageous for us to join the workforce.

Mathematics relies on logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. The essence of mathematics lies in its beauty and its intellectual challenge. Learning to know our creativity ability is one of the most significant aspects of our life, for everything we do, is affected by our thinking abilities.

A product is creative when it is “novel” and “appropriate”. A novel product is original, not predicable. The bigger the concept, and the more the product stimulates further work ideals, the more the product is creative (Stermbering and Lubart). Mathematical Creativity requires passion and commitment. Out of the creative is born symbols and myths. It brings to our awareness what was previously hidden and points to new life.

The Principles of Mathematical Creativity

Ervynck (1991) described mathematical creativity in terms of three stages. The first stage (Stage 0) is referred to as the *preliminary technical stage*, which consists of "some kind of technical or practical application of mathematical rules and procedures, without the user having any awareness of the theoretical foundation" (p. 42). The second stage (Stage 1) is that of *algorithmic activity*, which consists primarily of performing mathematical techniques, such as explicitly applying an algorithm repeatedly. The third stage (Stage 2) is referred to as *creative* (*conceptual, constructive*) *activity*. This is the stage in which true mathematical creativity occurs and consists of non-algorithmic decision making.

"The decisions that have to be taken may be of a widely divergent nature and always involve a choice" (p. 43). Although Ervynck (1991) tries to describe the process by which a mathematician arrives at the questions through his characterizations of Stage 0 and Stage 1, his description of mathematical creativity is very similar to those of Poincaré and Hadamard. In particular his use of the term "non-algorithmic decision making" is analogous to Poincaré's use of the "choice" metaphor. In looking for conspicuous patterns, mathematicians use such heuristics as (1) verifying consequences, (2) successively verifying several consequences, (3) verifying an improbable consequence, (4) inferring from analogy, and (5) deepening the analogy.

The Notion of Creativity in Mathematics

As stated earlier, research on creativity has been on the fringes of psychology and mathematics. It is only in the last twenty-five years that there has been a renewed interest in the phenomenon of creativity in mathematics. The Handbook of creativity (Sternberg, 2000), which contains a comprehensive review of all research then available in the field of creativity, suggests that most of the approaches used in mathematical creativity can be subsumed under five categories: mystical, pragmatic, psychodynamic, psychometric and social-personality.

Functions of Mathematical Creativity

Within every individual, mathematical creativity is a function of three components:

1. Expertise
2. Creative thinking skills
3. Motivation.

Expertise encompasses everything that a person knows and can do in the broad domain of his or her work- knowledge and technical ability. Creative thinking refers to how you approach problems and solutions - the capacity to put existing ideas together in new combinations. The skill itself depends quite a bit on personality as well as on how a person thinks and works. Expertise and creative thinking are the entrepreneur's raw materials or natural resources.

Motivation is the drive and desire to do something, an inner passion and interest. When people are intrinsically motivated, they engage in their work for the challenge and enjoyment of it. The work itself is motivating. People will be most creative when they feel motivated primarily by the interest, satisfaction and the challenge of the work itself-"the labour of love", love of the work-"the enjoyment of seeing and searching for an outstanding solution – a break through.

The entrepreneur is primarily concerned with developing new products, processes or markets, the ability to bring something new, product, processes or markets, the ability to bring something new into the market. The entrepreneur indulges in mathematical thinking more than any other person thinks and he is able to produce solutions that fly in the face of established knowledge. Entrepreneurs are inclined to be more adaptable and are prepared to consider a range of alternative approaches.

Creative outcomes seldom emerge in an instant: a recognized mathematical process is involved, even if it appears to be rather chaotic. It begins with recognition of a problem or anticipation of an opportunity, and then, through understanding the situation and reflecting on the issues, new linkages are contemplated and possible new combinations of components are aired: From this emerge visible solutions or possibilities that are subjected to valuation, which may be continuous with judgment being suspended while the search process is prolonged in pursuit of genuine newness.

Entrepreneurs take bold creative steps but situations encourage creativity. Mathematical Creativity is, however, enhanced when people have some freedom, but not too much; high internal commitment to the task; but not too high a commitment; high proportion of intense rewards, but some extrinsic rewards as well; some competition but not winner-take-all competition.

Innovation

Innovation is the process of bringing the best ideas into reality, which triggers a creative

idea, which generates a series of innovative events. Innovation is the creation of new value. Innovation is the process that transforms new ideas into new value- turning an idea into value. You cannot innovate without creativity. Innovation is the process that combines ideas and knowledge into new value. Without innovation an enterprise and what it provides quickly become obsolete.

Innovation is the implementation of creative inspiration. The National Innovation Initiative (NII) defines innovation as "the inter-section of invention and insight, leading to the creative of social and economic value" Innovation is "value" – the creation of value adding value to customer's satisfaction- "delighting the customers". Innovation is the basis of all competition advantages, the means of anticipating and meeting customer's needs and the method of utilization of technology.

Innovation requires a fresh way of looking at things, an understanding of people, and an entrepreneurial willingness to take risks and to work hard. An idea doesn't become an innovation until it is widely adopted and incorporated into people's daily lives. Most people resist change, so a key part of innovating is convincing other people that your idea is a good one – by enlisting their help, and, in doing so, by helping them see the usefulness of the idea.

Enterprises throughout the world are experiencing what can be legitimately described as a revolution: rising energy and material costs, fierce international competition, new technologies, increasing use of automation and computers. All these are major challenges, which demand a positive response from the entrepreneur and management if the enterprise is to survive and prosper.

Joseph Schumpeter (1934) believes that the concept of innovation, described as the use of an invention to create a new commercial product or service, is the key force in creating new demand and thus new wealth. Innovation creates new demand and entrepreneurs bring the innovations to the market. This destroys the existing markets and creates new ones, which will in

turn be destroyed by even newer products or services. Schumpeter calls this process "creative destructions."

The Entrepreneur and Entrepreneurship

What are entrepreneurs like? What distinguishes them from other business people? An entrepreneur is the man or woman who is able to actualize his/her innate potentials and develop a character that is not dependent but independent. He/she is that person who undertakes the voyage of creating value by pulling together a unique package of resources to exploit an opportunity. He or She has the capacity and capability to build something from practically nothing – initiating, daring, doing, achieving, and building an enterprise. They genuinely believe they have something new and special to offer, either a product or a service. To them, life will remain a fantasy unless their dreams are actualized.

Entrepreneurs have been described as people who have the ability to see and evaluate business opportunities, gather the necessary resources to take advantage of them and initiate appropriate action to ensure success. They are achievement- oriented, like to take responsibility for decisions and dislike repetitive and routine work. Entrepreneurs having mathematical creativity possess high levels of energy and great degrees of perseverance and inauguration, which combined with a willingness to take moderate, calculated risk, enable them to transform what began as a very simple ill- defined idea or hobby into something concrete.

Most importantly, entrepreneurs are the driving force of any nation; they are value-adders and represent the wealth of a nation and its potentials to generate employment. The entrepreneur may be a highly educated, trained, and skilled person or he/she may be an illiterate person possessing high business acumen, which others might be lacking. The mix of creativity and irrationality is what makes entrepreneurs tick and accounts for many of their positive contributions. Their visionary abilities and leadership qualities stand them out as human colossus.

Entrepreneurship denotes the whole process whereby individuals become aware of the opportunities that exist to empower themselves, develop ideas, and take personal responsibility and initiative. In a broader sense, entrepreneurship helps young men and women develop new skills and experiences that can be applied to many other challenges in life. Entrepreneurship is therefore a key priority area with the potential to stimulate job and wealth creation in an innovative and independent way.

Entrepreneurship provides young people across the nation with valuable life skills and tools to empower them to build sustainable and prosperous futures for themselves and their communities. The concept of entrepreneurship has been associated with several activities concerned with the establishment and operations of business enterprises. Stevenson (1985) defines entrepreneurship as the process of creating value by putting together a unique package of resources to exploit an opportunity.

Entrepreneurship instills the enterprise culture into the individuals. Enterprise here is defined as resourcefulness, initiative, drive, imagination, enthusiasm, zest, dash, ambition, energy, vitality, boldness, daring, audacity, courage, get up, and go. Entrepreneurship, therefore, encompasses all the productive functions that are not rewarded immediately by regular wages, interest and rent and non- routine human labour. It is also not investing capital funds along. It is actually, the functions of seeking investment, production opportunity, organizing an enterprise to undertake new production process, raising capital, hiring labour, allocating resources, and creating new enterprises.

Challenge for Innovation

The place of innovation in commercial success is the development or adoption of new concepts or idea that leads to any form of increased organizational or social benefit. Innovation is vitally concerned with novel approaches, new ideas, and originality, and it the means by which ideas are exploited for competitive advantage.

To succeeds in business today demand constant innovation. Generating fresh solutions to problems and the ability to inherit new products or services for a changing market are part of the intellectual capital market that gives an enterprise its competitive edge. In a dynamic environment, success comes from looking for the next opportunity and having the ability to find hidden connections and insights into new products or services, desired by the customer.

While brain-power is the most valuable resource, great ideas are in short supply. Successful entrepreneurs place high premium on attracting and keeping talent because wealth flows directly from innovation. Creativity is the root of innovation. It is a process and a skill which can be developed and managed throughout the entire enterprise.

Creative ideas are not enough for your business to survive. You need a process organization and culture that will help you maximize your creative assets. This is innovation capability that helps your pull together the best thinking within your business, enabling you to connect the organization dots.

Shapiro argues that perpetual and pervasive innovation is the key to long –term sustainable success in the relentless competition for customers. To survive any competition, you must rapidly and repeatedly re-invent yourself. The road map to re-invention starts by applying the seven R's.

1. Rethink your underlying assumptions.
2. Reconfigure how you carry out work.
3. Resequence when work takes place
4. Relocate where work is done to cut down on handoffs and delays.
5. Reduce the frequency of carrying our specific activities.
6. Reassign who does the work by asking if anyone else could achieve the same result more effectively and efficiently.
7. Retool the technology that supports getting the work done. Could new software and automated equipment transform our ways of working?

Mathematical Creativity and Innovation in an Entrepreneurial Organization

Growth and development cannot be sustained without additional innovations (usually in the product or services or in its marketing) with additional innovations, firms become "glamorous" Introducing new products is usually seen as part of the process of innovation, which is itself seen as the engine driving continued growth and development.

The "winning performance" of the entrepreneur and the organization focuses on.

1. Competing on quality not prices
2. Domination of a market niche
3. Competing in an area of strength
4. Having tight financial and operating controls

To grow and prosper, most enterprises need to constantly improve their existing products and services through continuously innovating needed changes: and for survival of the enterprise, must also need to create new products and services to meet yet unfulfilled needs. Enterprises that rely exclusively on innovation will prosper until their products and services "ran out of gases and become obsolete and non-competitive. On the other hand, enterprise that are totally creative will have their new products and services ready to launch, but often too few current products sufficiently up-to-date and competitive to generate the cash needed to fund their creativity.

Changes are that the very successful leaders of the future will be more likely to make creativity and innovation a strategic priority in their organization. In today's environment where competition requires business enterprises to be distinct and meet customer needs with better or never products and organization becomes in critical necessity.

Joseph Schumpeter views innovation as the source of success in the market economy, a view that is reinforced by today's changing and competitive environment. The organization that is not creative and innovative cannot survive in the market place. Thus, entrepreneurs and enterprises are continuously creative and innovative to remain relevant to the customers, which is

the purpose of every business.

Conclusion

Successful entrepreneurs require an edge derived from some combination of a mathematical based creative idea and a superior capacity for execution. The entrepreneur's mathematical creativity may involve an innovation product or a process that changes the existing order. Entrepreneur may have a unique insight about the course or consequence of an external change. Entrepreneurship is the vehicle that drives mathematical creativity and innovation.

No doubt, the current economic environment is a volatile and violent one. The new environment demands renewed dynamism of approach. Mathematical Creativity and innovation is the new name of the game. Only the discerning organizations can manage the changes inherent in the new environment. It is the duty of an entrepreneur to keep his/her organization lean, young, flexible, and eager for new things to continuously delight the customers, which is the purpose of every business.

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Physical and Chemical characteristics of Dolomite for Partial Replacement of Cement in M_{20} Concrete

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Abstract

Concrete is a construction material consisting of cementitious material, fine aggregate, coarse aggregate and water. Now a days the cost of these materials are increased so, we need to look at a way to reduce the cost of building materials especially cement. One of the recent advancement in construction industry is replacement of materials in concrete. The replacement of materials offers cost reduction, energy savings and protection of environment. To achieve the above objective we are partially replacing the cement with Dolomite. The present investigation is aimed to study the fresh and hardened properties of concrete when cement is partially replaced by Dolomite powder. The work is focused on M_{20} grades of concrete. The percentage of Dolomite powder that replaced cement in this investigation are 0%,5%,10%, 15% and 20% .The fresh property is workability and hardened properties are compressive strength, flexural strength, split tensile strength have been carried out with the evidence of FTIR, SEM, EDAX.

Keywords: Dolomite, compressive strength, split tensile strength, flexural strength, cement.

Introduction

Cement is one of the most important constituents of concrete. The manufacture of cement is calcining argillaceous and calcareous materials at a high temperature. During this process, large amount of CO_2 is released in to the atmosphere. It is estimated that the production of one ton of cement results in the emission of 0.8 ton of CO_2. The lowering of carbon dioxide and nitrogen oxides emission, due to the partial clinker replacement and the reduction of electric energy consumption, resulting from the better grindability of soft limestone component should

are discussed as ecological reasons. The possibility of waste materials by-products disposal as additives to cement has been an important challenge improving the sustainable development of cement and concrete technology, as it has been pointed out by many researchers are reported Lothenbach [1], Giergiczny [2], Nocuń-Wczelik and Łój et al. [3].

The various report use of replacement materials such as fly ash and limestone in Portland cement has been gaining much attention in recent years [4–8]. The utilization of fly ash is one of the popular methods proposed to reduce expansion due to alkali–silica reactivity. Kamal M.M, et al [9] evaluated the bond strength of self compacting concrete mixes containing dolomite powder. Deepa Balakrishnan, et al [10] carried out an investigation on the workability and strength characteristics of self compacting concrete containing fly ash and dolomite powder. Bhavin K., et al [11] presented the details of the investigation carried out on paver blocks made with cement, dolomite block and different percentages of polypropylene fibres. Salim Barbhuiya [12] carried out an investigation to explore the possibilities of using dolomite powder for the production of SCC.

Dolomite is a carbonate material composed of calcium magnesium carbonate **CaMg $(CO_3)_2$.** Dolomite is a rock forming mineral which is noted for its remarkable wettability and dispersibility. Dolomite has a good weathering resistance. Dolomite is a preferred for construction material due to its higher surface hardness and density. Asphalt and concrete applications prefer dolomite as a filler material due to its higher strength and hardness. By the effective utilization of dolomite powder, the objective of reduction of cost of construction can be met. An attempt has been made to explore the possibility of using dolomite as a replacement material for cement. M_{20} grade concrete specimens were made by replacing 5, 10, 15, 20 and 25% of cement with dolomite powder. The Compressive, Split tensile and Flexural strength of the specimens were found on the 7^{th} and 28^{th} days. Optimal replacement percentage of dolomite was determined.

Experimental Method

Materials Used

Cement:

Ultra tech super grade cement confirming IS 8112:1989 was used thought the work. The cement used was dry and free from lump. All possible content was avoided while storing cement. Properties of this cement were tested and shown in table-1.

Table-1physical properties of cement

Properties	Results
Fineness	7%
Specific gravity	3.16
Standard consistency	31.6
Initial setting	150min
Final setting	270min

Fine Aggregate

The fine aggregate used in this work was clean river sand, whose maximum size is 4.75 mm, was used. The result of sieve analysis confirms to zone-II (according to IS: 383-1970). The other properties of fine aggregate are determined and shown in table -2.

Coarse Aggregate

Machine crushed aggregate of 20mm size is brought from quarry. Aggregates of more than 20mm size are separated by sieving. Tests are carried out in order to find out properties of it. The test results are presented in table- 2.

Table-2 Properties of fine aggregate & coarse aggregate

Properties	Fine Aggregate	Coarse Aggregate

Specific gravity	2.68	2.71
Fineness	Passing through 4.75mm sieve	Retained-4.75 mm sieve
Bulk density	1558.5kg/m3	1632.92kg/m3
Fineness modulus	3.16	7.12

Dolomite

Dolomite is a carbonate material composed of calcium magnesium carbonate **CaMg (CO3)2.** The term is also used to describe the sedimentary carbonate rock dolostone. Dolostone (dolomite rock) is composed predominantly of the mineral dolomite with a stoichiometric ratio of 50% or greater content of magnesium replacing calcium, often as a result of digenesis. Dolomite is a rock forming mineral which is noted for remarkable wettablity and dispersibility as well as moderate oil and plasticizers absorption. Dolomite has good weathering resistance. The properties of the dolomite powder are given in Table 3.

Table 3: Properties of Dolomite Powder

S. No	Property	Dolomite Powder
1.	Formula	$CaMg(CO_3)_2$.
2.	Specific gravity	2.85
3.	Color	White, grey to pink
4.	Tenacity	Brittle
5.	Mosisture contant(%)	Nil
6.	Crystal system	Trignal
7.	Sieve analysis	Zone II

Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. The water, which is used for making concrete should be clean and free from harmful impurities like oil, alkalis, acids etc. Water for making concrete should have pH between 6 and 8. Locally available drinking water was used in this work.

Details of Concrete Mix

In the present investigation, M_{20} mix was designed as per the guidelines given in IS 10262:2009. The water cement ratio adopted was 0.48. The quantities of cement, fine aggregate and coarse aggregate required for $1m^3$ of concrete are 399.13 kg, 526.56 kg, 1221.81 kg respectively.

Testing Procedure

The required water of standard consistency and setting time and volume expansion were examined according to TS-EN 196-3 [13]. The cement pastes were obtained using a mixer for 1 min at low speed (60 rpm) and 4 min at high speed (120 rpm). The paste was then poured into moulds creating 100×10×10 mm prisms. The samples were cured at 20 ± 2°C and 90 ± 2% relative humidity. The samples were then remolded and placed in deionized water. The cement paste specimens were cured for 2, 7, and 28 days, and then they were taken out of the water. The hydration process was stopped by grinding the hydrated samples with acetone and by washing the residue several times with more acetone. The samples were dried at 65°C.

The scanning electron microscopy studies, selected cement paste samples cured for 7 and 28 days were used. A cement prism was cut into cubes ≈10 mm square, one side of which was ground flat. The hydrated samples were flooded with acetone to stop hydration reactions. After drying and coating with gold the SEM image of samples were obtained using a ZEISS SUPRA 55VP FESEM scanning electron microscope.

The FT-IR spectra of hydrated Portland cement and composite cement pastes were recorded on a Bruker Vertex 70 FT-IR spectrometer equipped with the harric MVP2- unit in the range of 4000–500 cm^{-1} region.

Result and Discussion

Compressive Strength

Compressive strength was determined using compression testing machine (CTM) of 2000 KN capacity. Compressive test was carried out on 150 mm × 150 mm cube specimen for which three cubes were prepared for each mix. Strength of each cube was evaluated after 7, 14, and 28 days respectively.

Compressive Test for 7 days

For 10% replacement of WGP obtained greater strength when compared to other % of replacement in 7 days.

Dimension of specimen : 150mm × 150mm × 150mm

Days of curing : 7 days

Table 4. Compression test on cubes for 7 days

S.NO	Type of specimen % of dolomite powder	Compressive					
		Load in 10^3N			Strength in N/mm^2		
		Trial 1	Trail 2	Mean	Trail 1	Trail 2	Mean
1	Conventional	220	216	218	3.10	3.06	3.04
2	5%	164	158	161.6	2.33	2.24	3.24
3	10%	230	270	250	3.25	3.81	3.72
4	15%	375	315	290	5.33	4.40	4.10
5	20%	204	203	203.5	2.88	2.87	2.76

Compressive Strength Test for 28 days

For 10% replacement of WGP obtained greater strength when compared to other % of replacement in 28 days.

Dimension of specimen : 150mm × 150mm × 150mm

Days of curing : 28 days

Table 5. Compression test on cubes for 28 days

S.NO	Type of specimen % of dolomite powder	Compressive					
		Load in 10^3N			Strength in N/mm^2		
		Trial 1	Trail 2	Mean	Trail 1	Trail 2	Mean
1	Conventional	620	650	635	27.5	28.88	28.22
2	5%	675	705	690	30	31.33	30.66
3	10%	695	725	710	30.88	32.22	32.55
4	15%	560	600	580	24.88	26.66	25.77
5	20%	515	525	520	22.88	23.33	23.11

Split Tensile Strength

The split tensile strength test was conducted on cylindrical specimens of 150mm diameter and 300mm height cast and cured in the same manner as the cubes in the compressive test. Two wooden strips were placed, one at the top and the other at the bottom of the specimen.

Split Tensile Test for 28 days

For 10% replacement of WGP obtained greater strength when compared to other % of replacement in 28 days.

Dimension of specimen : 150mm × 150mm × 150mm

Days of curing : 28 days

Table 6. Compression test on cubes for 28 days

S.NO	Type of specimen % of dolomite powder	Split Tensile					
		Load in 10^3N			Strength in N/mm^2		
		Trial 1	Trail 2	Mean	Trail 1	Trail 2	Mean
1	Conventional	375	385	380	16.66	17.10	16.88
2	5%	390	410	400	17.33	18.22	17.77
3	10%	400	440	420	19.55	16.66	16.66
4	15%	395	415	405	17.55	18.44	17.98
5	20%	340	370	355	15.11	16.44	15.77

Flexural Strength

Flexural strength is the one which measures tensile strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending. It is measured by loading 6 × 6 inch (150 × 150-mm) concrete beams with a span length at least three times the depth. The flexural strength is expressed as Modulus of rupture (MR) in psi (MPa) and is determined by standard test methods of IS 516.

Flexural strength of concrete flexural MR is about 10 to 20 percent of compressive strength depending on the type, size, and volume of coarse aggregate used. However, the best correlation for specific materials is obtained by laboratory tests for given materials and mix design. The MR determined by third-point loading is lower than the MR determined by centre-point loading, sometimes by as much as 15%.

Flexural Strength Test for 28 Days

For 10% replacement of WGP obtained greater strength when compared to other % of replacement in days.

Dimension of specimen : 150mm × 150mm × 150mm

Days of curing : 28 days

Table 7. Compression test on cubes for 28 days

S.NO	Type of specimen % of dolomite powder	Flexural					
		Load in 10^3N			Strength in N/mm^2		
		Trial 1	Trail 2	Mean	Trail 1	Trail 2	Mean
1	Conventional	5.68	6.08	5.88	2.27	2.43	2.35
2	5%	10.08	9.78	9.92	4.03	3.90	3.97
3	10%	6.32	6.28	5.80	2.54	2.51	2.33
4	15%	4.32	3.84	4.08	1.73	1.54	1.63
5	20%	1.04	0.96	1.00	0.42	0.38	0.45

SEM Study

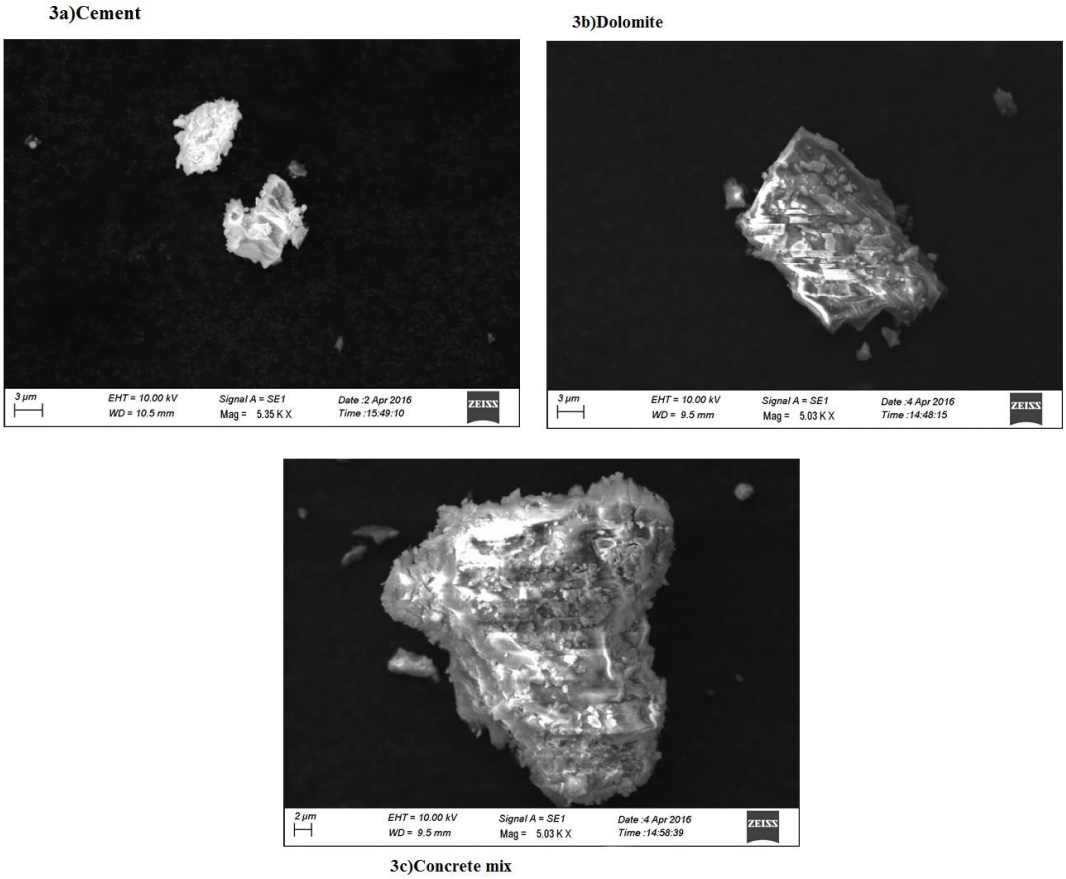


Fig. 3a. SEM images of cement

Fig. 3b. SEM images of dolomite

. Fig. 3c. SEM images of Concrete mix

Figs. 3a, 3b and 3c show that some microstructural characteristics of the Dolomite cement pastes cured for 28 days. As can be observed in these figures, the samples studied through SEM/EDX have quite different microstructures. In Dolomite - cement paste, significant quantity of ettringite $Ca(OH)_2$ (CH) crystals and a porous composite mass of calcium silicate hydrate are observed. Additionally, large amounts of the rectangle shape of Dolomite are seen everywhere. Due to covering of the Dolomite particles by the reaction products only a small number of round particles are distinguished. A significant quantity of ettringite is also evident in Dolomite-cement paste.

FT-IR analyses of hydrated cement

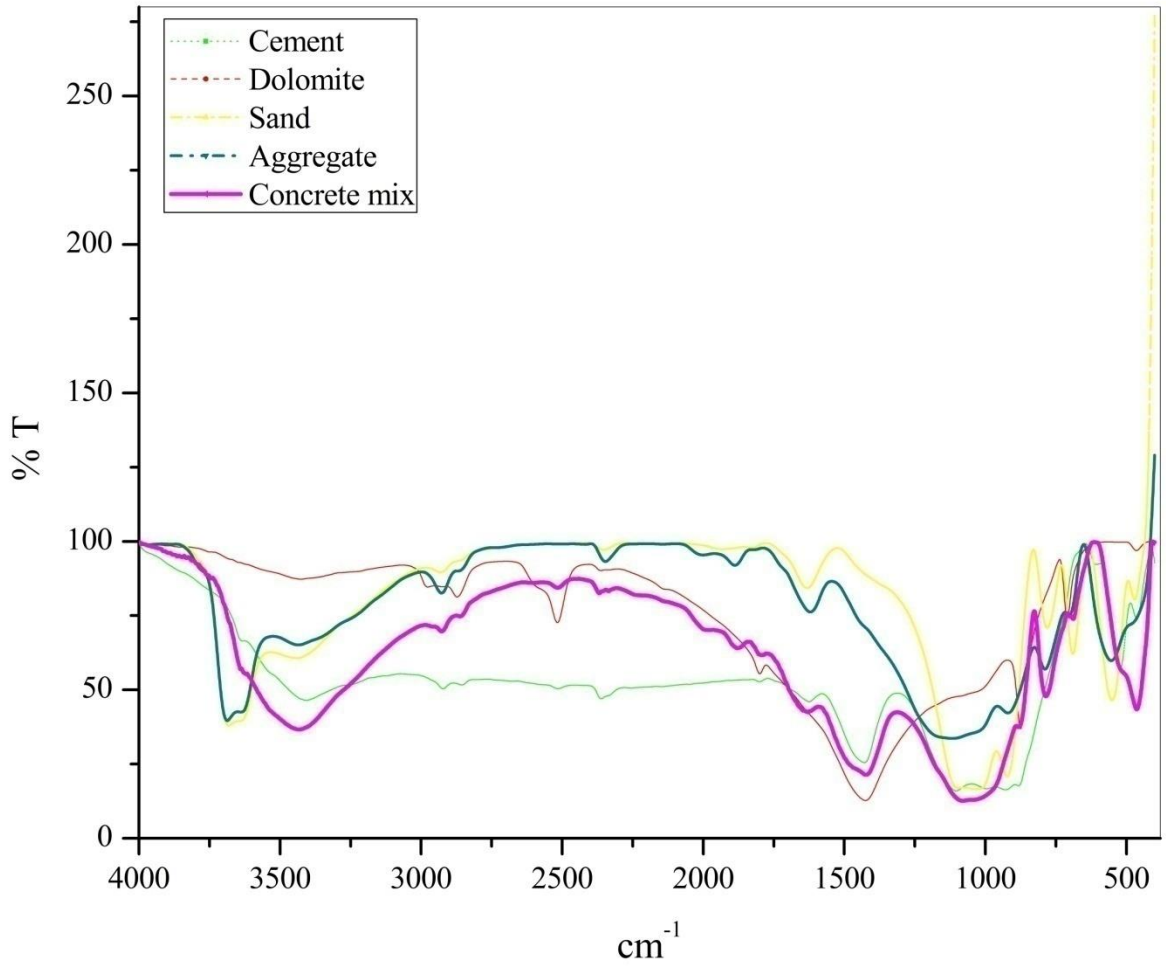


Fig. 4. FTIR Spectrum of cement composition: without additive and with dolomite additive.

The FTIR spectra of the Dolomite and cement hydrated up to 28 days are presented in Figs. 4. The major changes of the FTIR spectra in the hydrated cement pastes are:

(i) The strongest Si–O stretching band appears at 1089.59 cm^{-1}, and a weak one Si–O bending at about 463 cm^{-1} in all samples. However, the intensity of the Si–O stretching band is lower than that of the composite cement at 2 days curing ages.

(ii) The relative intensity of the Si–O bending vibrations also undergoes significant changes as curing time is expanded.

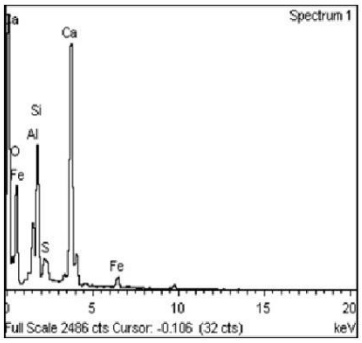
(iii) The C–O bending vibration at about 882 cm^{-1} and the C–O stretching at around 1421 cm^{-1} are the characteristic band of CO_3^{2-}.

(iv) A broad band centered at ≈ 3400 cm^{-1} is due to symmetric and antisymmetric stretching vibration of water bound in the hydrations products.

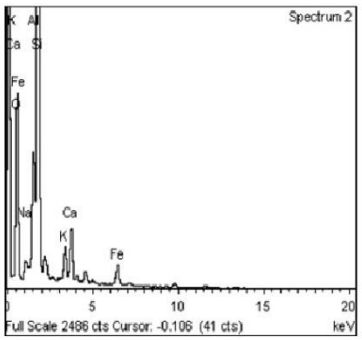
(v) A small but defined peak appeared at 3831–3846 cm^{-1} can be attributed to the OH band from calcium hydroxide. The intensity of corresponding peak, in the samples containing a Dolomite is lower than that of the other tested sample.

EDX Analyses of Hydrated Cement

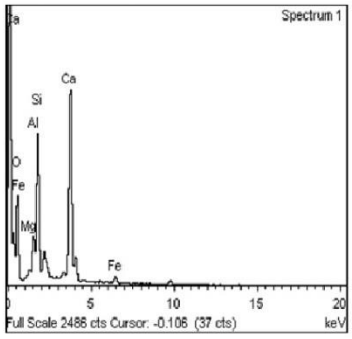
5a)Cement



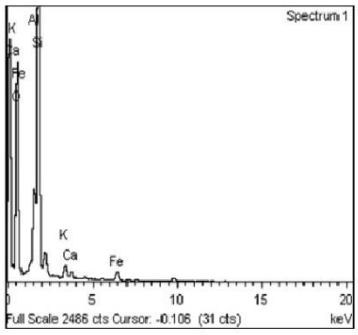
5b)Aggregate



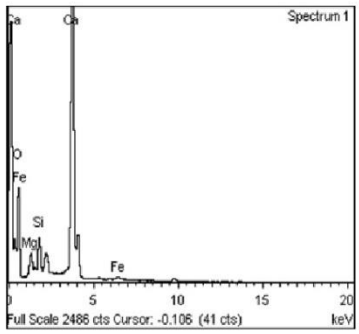
5e)Concrete mix



5c)Sand



5d)Dolomite



Energy dispersive X-ray (EDX) analysis is used for the determination of elemental composition and some of the specific elements in the adsorbent material, the figure. 5 and 6 of images shows that different peak positions and their elemental composition are Mg=1.93%,O=77.63%,Si=2.20%,Fe=0.26%.Ca=17.98%. After combination of cement and dolomite powder the concrete mixture the elemental composition also increased.

Conclusions

- At low percentage, from 5 to 15%, dolomite additive plays the role of active component or even acts as cement replacement. At higher amount the “dilution” effect occurs.
- The heat evolution process is not significantly altered in the presence of dolomite it means that setting of paste with dolomite additive is not retarded.

- The reactions dealing with water consumption and releasing some components to the liquid phase are accelerated in the presence of dolomite.
- The hydration of alite is accelerated.
- The application of dolomite material as a component of non - standard material, for example for geotechnology should be considered.
- Incorporation of 5%wt and more than 20%wt dolomite limestone into cement always reduces compressive strengths after 7 and 28 days. Specimens containing 10% dolomite limestone powder by weight have the maximal compressive strengths.

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Mineral Additive Based Mortar for the Enhancement of Water Repellent Properties

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Abstract

Vegetable oils from sunflower, peanuts and rapeseeds were tested as water repellents for mortars. Dosages were 0, 0.5, 1.0 and 1.5 % oil by cement weight. The oils were dispersed in the mixing water with the aid of Polyvinyl acetate. Compressive strength of 1:3 mortars with 0.50 w/c at 3 and 28 days were measured and significant strength decrease was only noticed at 28 days. Final Results show that, these represented oils were added to achieve minimum increase in compressive strength with maximum reduction in water absorption, bulk density, volume of voids due to addition sunflower oil, peanut oil and rapeseed oil with various proportions.

Keywords: Vegetable oils, water repellents, Polyvinyl acetate, Compressive strength, water absorption, bulk density, volume of voids.

Introduction

In a modern concept of using more and more organic admixtures for mortar and concrete are mostly incorporated with mineral oil derivates. Further improvements of future generation will expect natural replacements which can promote sustainable development. Water vapour is transported out by adding water repellent to concrete. It is approved that ingress of aggressive action carried by liquid water will be decreased (repellant effect) and that the interior of concrete or mortar will vapour out gradually thus requiring comparatively lesser water to proceed thereby less prone to degrading reactions [1,3,5].

High workability, adequate strength, abrasion resistance, low permeability and superior chemical resistance is possible and yielded by using oil which function as air

entraining admixtures. These properties can be useful for the surfaces which are subjected to mild abrasion and aggressive chemical action [3,8].

Concrete curing till the invention of modern curing chemicals were introduced in the 1970's and there is evident usage of natural, plant based curing compounds have been used successfully in the past. Linseed oil had been widely used in concrete curing operations [2]. Vegetable and animal fat had been used as damp proofing agents in the form of paste or emulsion under the aid of organic carrier as finely divided silica [3,4,6].

Corn, mustard oil and 0.8% of linseed oil had been added for gradually reducing the water absorption and some of the hydration retardation problems and possible improper dispersion of the oil. It may overcome in the dispersing of oil in the mixing water to blending to its present study [3]. The objectives of the investigation are to test and clarify if different vegetable oils can function effectively as water repellents by the action of bio admixtures.

A. Methodology Adopted

- Finding the properties of materials.
- Calculate mix design and mix proportions of materials to be used.
- Determine compressive strength, water absorption, bulk density and volume of voids of the various mortar mixes.
- Compare the obtained results with reference cement mortar.

Materials

A. Cement

OPC 43 grade was carried out for these tests and its required properties. Specific gravity - 3.15, Initial & Final setting time is 85 & 225 mins.

B. Fine Aggregate

The Natural river sand was used as fine aggregate, not exceed 4.75mm gauge, free from all impurities. Specific gravity - 2.6

C. Water

The drinking water should be used for mortar preparation. Water cement ratio - 0.5.

D. Vegetable oil

Sun flower oil, Peanut oil, Rapeseed oil had been used for carrying out these tests.

E. Lime stone filler

It is a binding material to control the hydration process. 20% of lime stone filler added to the cement weight.

F. Polyvinyl acetate

It is a chemical added with the water and oil mixer to provide good contact and perfect bond between oil and water. 0.3% of polyvinyl acetate added to the cement weight.

Fig 1. a) Sun flower seed, b) Peanut seed, c) Rape seed, d) Polyvinyl acetate

Specimen Details

A. Mix Proportions

Standard mortar is composed of OPC cement, sand, water whereas design mortar consists of OPC cement, sand, water, 20% of lime stone filler, 0.3% of polyvinyl acetate, 0 to 1.5% vegetable oil like sun flower, peanut and rapeseed oil. Mix proportion is 1:3:0.5.

B. Description of Specimen

There are two specimens were used for this testing purpose mainly cube of size 70.6x70.6x70.6 mm used for compressive strength test, whereas cylinder of dia 100 mm and height 20 mm used for water absorption test, density test and volume of voids test.

Results And Discussion

A. Compressive Strength test

This test was carried out to determine the compressive strength of various mortars after 3 and 28 days curing.

TABLE I. AVERAGE COMPRESSIVE STRENGTH (N/mm^2)

Oil type	Dose (%)	Average Compressive Strength (N/mm²)	
		3 Days	28 Days
None	0	5.50	12.47
Sun Flower	0.5	5.13	11.88
	1.0	5.30	11.66
	1.5	4.90	10.70
Peanut	0.5	5.33	11.93
	1.0	5.30	10.60
	1.5	5.25	10.68
Rapeseed	0.5	5.33	11.97
	1.0	5.37	11.66
	1.5	4.75	10.93

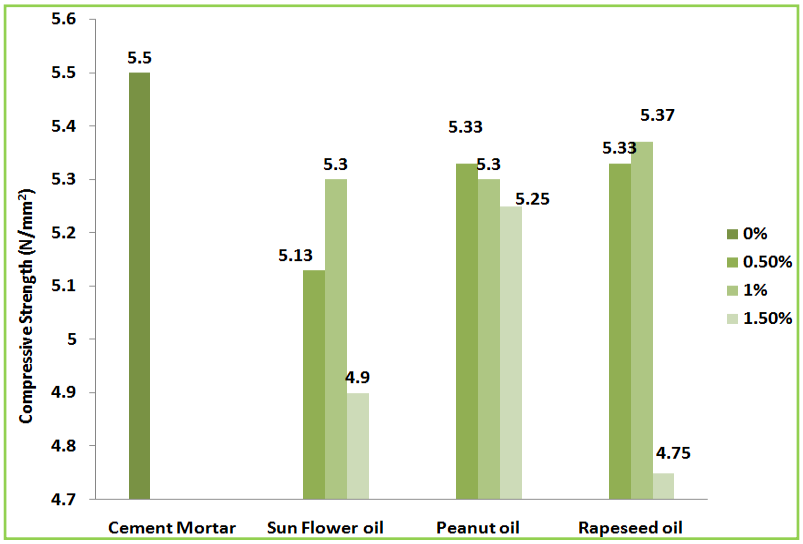

Fig 2. Average Compressive Strength after 3 days

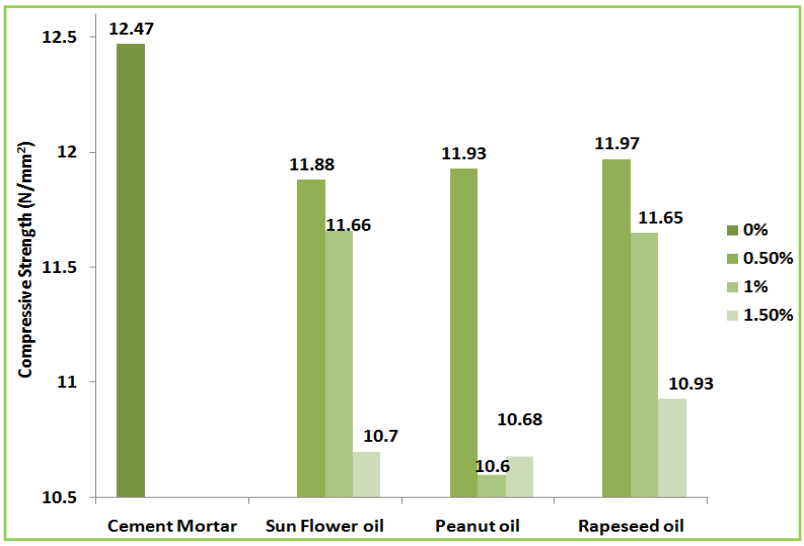

Fig 3. Average Compressive Strength after 28 days

B. Water absorption test

This test was carried out after 48 hours immersion in water at a temperature of 27 $\pm$ 2^0 C and boiling at a temperature of 100^0 C for 24 hours to determine water absorption or permeability of mortar with different proportion of vegetable oil after 28 days curing.

TABLE II. WATER ABSORPTION (%)

Oil type	Dose (%)	After immersion (%)	After boiling (%)
None	0	7.84	9.07
Sun Flower	0.5	6.13	7.14
	1.0	4.87	5.90
	1.5	4.33	5.36
Peanut	0.5	5.31	6.36
	1.0	3.90	4.68
	1.5	3.06	3.55
Rapeseed	0.5	4.57	5.73
	1.0	3.66	4.37
	1.5	3.03	3.75

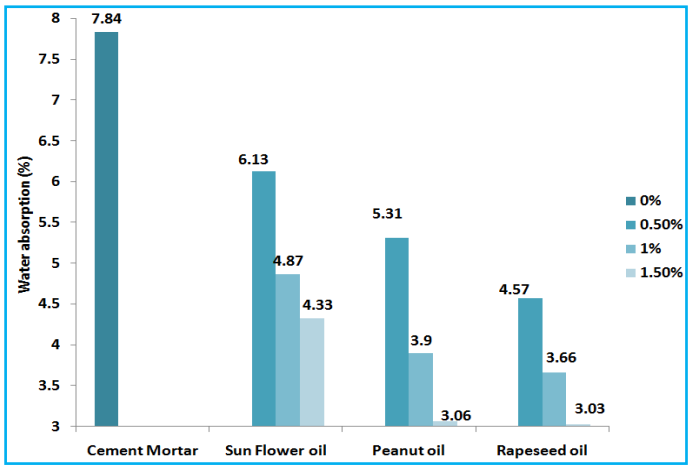

Fig 4. Water Absorption after immersion (%)

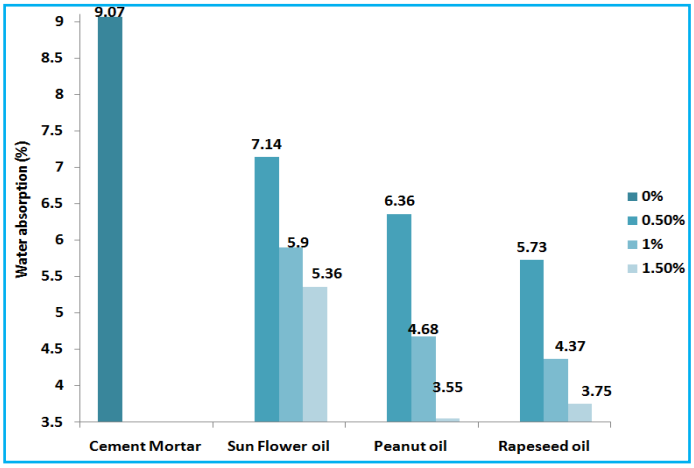

Fig 5. Water Absorption after boiling (%)

C. Bulk Density test

Bulk density was determined from the ratio between the weight of the dry sample and its volume after 28 days curing.

TABLE III. BULK DENSITY (g/cm^3)

Oil type	Dose (%)	Bulk density (g/cm^3)
None	0	1.26
Sun Flower	0.5	1.52
	1.0	1.27
	1.5	1.29
Peanut	0.5	1.27
	1.0	1.29
	1.5	1.31
Rapeseed	0.5	1.33
	1.0	1.33
	1.5	1.35

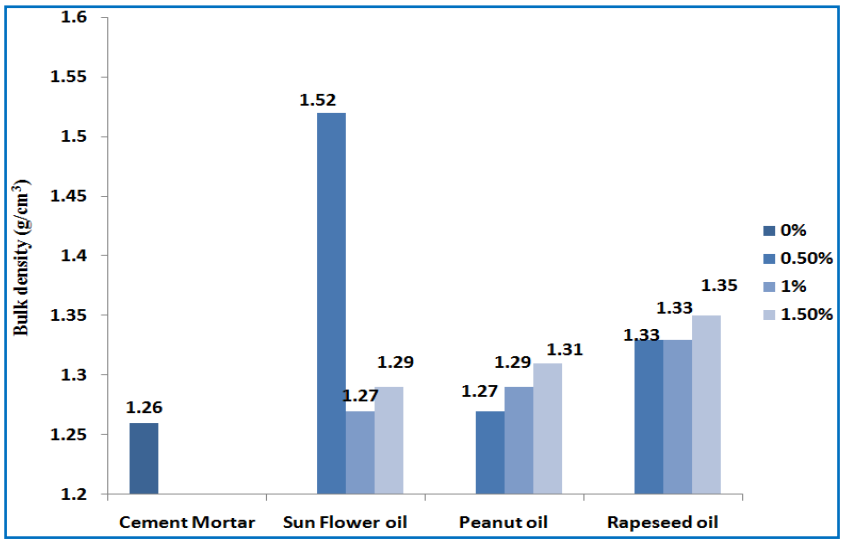

Fig 6. Bulk Density (g/cm^3)

D. Volume of voids test

Volume of voids was calculated from mass of dry sample, bulk density and specific gravity of mortar after 28 days curing.

TABLE IV. VOLUME OF VOIDS (%)

Oil type	Dose (%)	Volume of voids (%)
None	0	8.57
Sun Flower	0.5	8.2
	1.0	6.91
	1.5	6.37
Peanut	0.5	7.39
	1.0	5.62
	1.5	4.35
Rapeseed	0.5	7.01
	1.0	6.26
	1.5	5.73

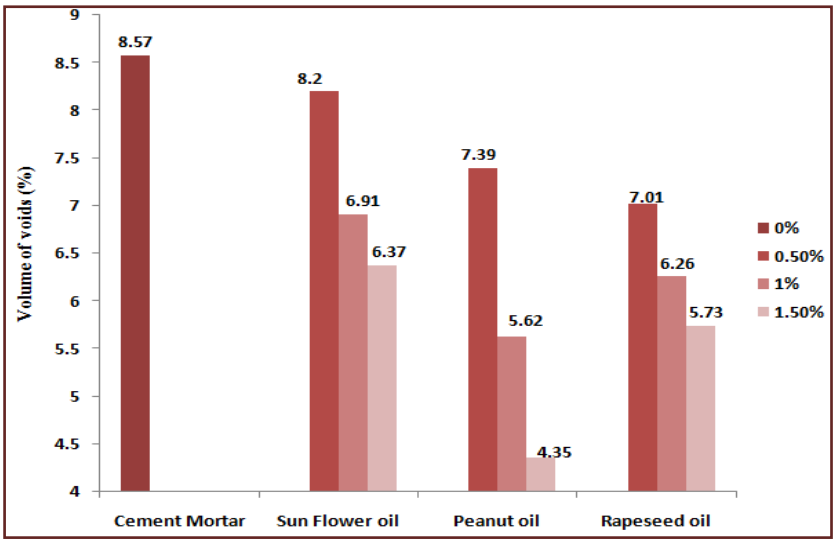

Fig 7. Volume of Voids (%)

Conclusion

A. Compressive strength test

- After 3 days of curing, addition of 1% of rapeseed oil gives good strength when compared to other oils. But it could not satisfy the strength of reference cement mortar.
- After 28 days of curing, addition of 0.5% of rapeseed oil gives good strength when compared to other oils. But it could not satisfy the strength of reference cement mortar.

B. Water absorption test

- After immersion and boiling process in water absorption test, addition of 1.5% of peanut and rapeseed oil gives lower water absorption and it nearly achieves 60% reduction in water absorption compared to reference cement mortar.

C. Bulk density test

- Addition of 0.5% of sunflower oil only increase 15% of weight when compared to reference cement mortar and addition of other oils like peanut and rapeseed oils attains its own weight.

D. Volume of voids test

- Addition of 1.5% of peanut oil attains 50% reductions of voids when compared to reference cement mortar.

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Study on Waste Rubber Tyre in Concrete for Eco-friendly Environment

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Abstract

Waste rubber tyre is one of the significant environmental problems worldwide because of increase in auto mobile production huge amounts of waste tyre need to be dispose. Due to rapid depletion of available sites for waste disposal, many countries banned the disposal of waste rubber tyre in landfills. Hence, efforts have been taken to identify the potential application of waste rubber tyre in civil engineering projects. Rubber tyre chips are a waste material that is ideal for use in concrete applications. This has an additional advantage of saving in natural aggregates used in production of concrete which are becoming increasingly scarce. In this essence, our present study aims to use of waste rubber tyre as partial replacement of coarse aggregate to produce rubberize concrete in M20 grade of mix. Different partial replacements of rubber chips (0, 10, 20 and 30%) by volume of coarse aggregates are casted and tested for compressive strength in water as well as in acid curing on 14 and 28 days. The results show that, 10% of rubber waste gives higher compressive strength and durability performance and so considered as light weight concrete. It is recommended to use the rubberized concrete for nonstructural applications.

Key word: Coarse aggregate, Rubber tyre chips, Rubberized concrete, Workability, Compressive strength, Acid curing, Durability, Light weight concrete.

Introduction

Major pressures and problems to the local authorities identifying the potential and recycling application for waste products like waste rubber tyres which are expensive and its meets that more problems by decreasing the number of landfills. The disposal of waste tyres to landfill is legally banned in all the countries due to environmental impact. So that

sustainable management of that aforesaid. Waste rubber tyre is a huge task to the industries and public sectors. Decomposing of waste rubber tyre which contains composed of materials and it cause serious contamination for environmental conditions. Another decomposing process is burning and harmful pollutions are causes by that gases exhausted from its [1,2,9,11] burning.

Most of the studies were carried out to recycle and reuse scrap tyres in a variety of rubber products. Generating the electricity or as a fuel for cement clinks as well as in asphalt concrete by incineration [5,6].

For usage waste tyres in civil engineering is currently very low and its one of largest potential routes in construction. Depends on its examinations, another way is using the tyres in concrete. These results in the improvement of energy absorption, ductility and resistance to cracking which undergoes under mechanical and dynamical properties [2,4,10].

When we compared waste rubber mixture is to normal concrete its more workable and also it is useful in making light weighted aerated concretes. Non structural applications are mainly required usage of rubberized concrete [3.8, 9].

In our present investigations were request the rubber aggregate which made by mechanical cutting the tyre into the required sizes. It not easy to handle at initial stage and it's very laborious and time consuming forever at these difficulties can be easily sorted out and proper cutting tools and machinery are made for these particular usage and large scale production is devised. Sources of rubber aggregates is the extracted and discarded tyre that is trucks tyres which is gathered and collected from the local market and rubber tyre coarse aggregates are prepared from aggregate crushing machine [1,7,8,10].

In this study, the rubber aggregates are prepared mechanically by cutting the tyres to maximum nominal size equal to 20 mm and after cleaning with portable water kept for air drying. The specific gravity is obtained from test equal to 1.10 [7].

The main objectives of this study is,

- Observation of some physical properties of concrete mix contained from waste tyre aggregates.

- Compressive strength of concrete mix using different percentage replacement in water and acid curing.
- Comparing and discussion of test results obtained from rubberized concrete with the normal concrete in various mixes.

Materials

Cement - OPC 43 grade used.
Specific gravity 3.12
Fineness 2%
Normal Consistency 33%
Initial setting time 88 mins
Final setting time 215 mins

Fine Aggregate - River sand used.
Specific gravity 2.58
Fineness modulus 3

Coarse Aggregate - Crushed stones used.
Specific gravity 2.88
Fineness modulus 6.96

Water - Portable water used.
pH 7 to 8
Temperature 36°c

Rubber tyre chips - 20mm size used
Specific gravity 1.15
0, 10, 20, 30% replace by CA

Chemical Admixture - 0.5% dilute Hcl and NaOH (acid curing)

Fig. 1. Rubber tyre chips

Methodology

- Define preliminary character of materials
- Calculate mix design of concrete
- Casting of concrete in cubes
- Test on fresh concrete (Workability)
- Determination of compressive strength in water curing at 14 and 28 days
- Determination of compressive strength in acid curing at 28 days
- Determination of density of concrete at 28 days

Experimental Setup

- In this experimental investigation consists of 4 different mix proportions by replace coarse aggregate in 0, 10, 20 and 30% of waste rubber tyre in M20 grade concrete.
- Total numbers of 36 cubes (150x150x150 mm) were casted for durability test as well as optimum compressive strength test. After that cubes were immersed into acid solution until the curing period. Compressive strength test was performed at the age of 14 and 28 days and durability test at age of 28 days curing. Compressive strength calculated using compressive strength machine.
- Density also conducted after 28 days for light weight concrete properties.

Results and Discussion

A. Workability of concrete

TABLE 1. WORKABILITY OF CONCRETE

% Replacement of waste rubber tyre	Slump value (mm)
Conventional Concrete	80
10%	73
20%	66
30%	43

Table 1 shows that, Slump value of fresh concrete has been decreased due to increase in percentage of waste tyre chips in all replacement of concrete mix.

B. Compressive Strength in Water curing at 14 and 28 days

TABLE 2. COMPRESSIVE STRENGTH IN WATER CURING

% Replacement of waste rubber tyre	Average Compressive Strength (N/mm²)	
	14 Days	28 Days
Conventional Concrete	17.38	20.39
10%	20.19	23.11
20%	18.11	20.84
30%	9.53	13.28

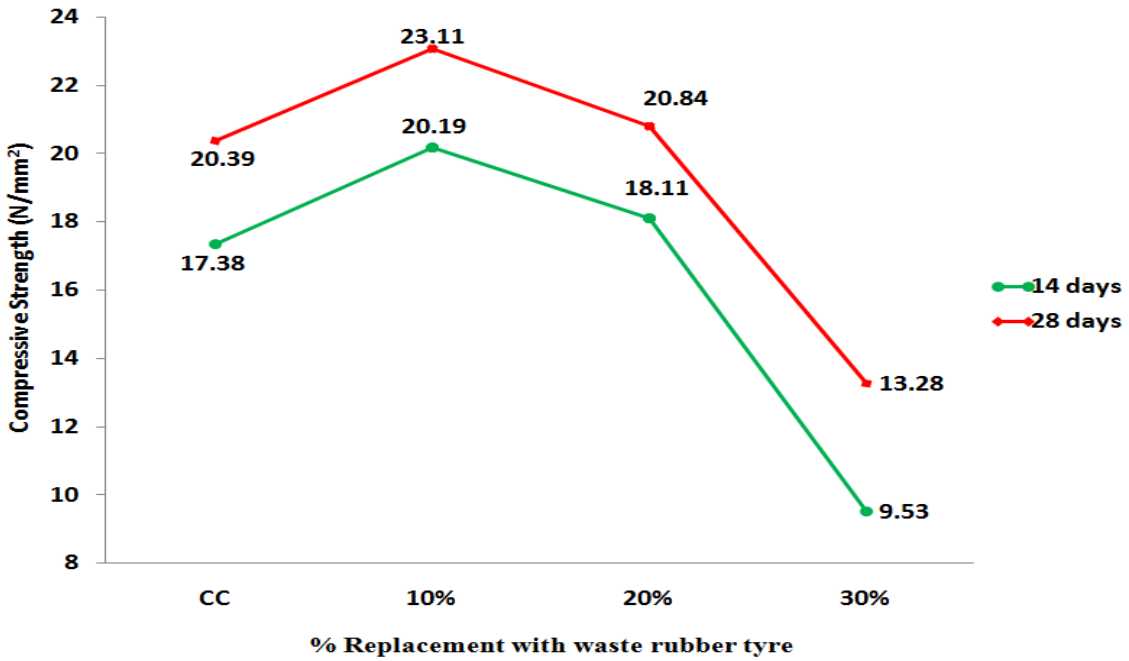

Fig. 2. Compressive strength in Water curing

Fig 2 shows that, 0 to 20% of replacement of waste rubber tyre in concrete increases the strength between 0.5 to 2.5 N/mm^2 at both 14 and 28 days strength in water curing.

C. Compressive Strength in Acid curing (durability test)

TABLE 3. COMPRESSIVE STRENGTH IN ACID CURING

% Replacement of waste rubber tyre	Average Compressive Strength (N/mm^2) at 28 Days
Conventional Concrete	16.69
10%	19.95
20%	17.72
30%	9.73

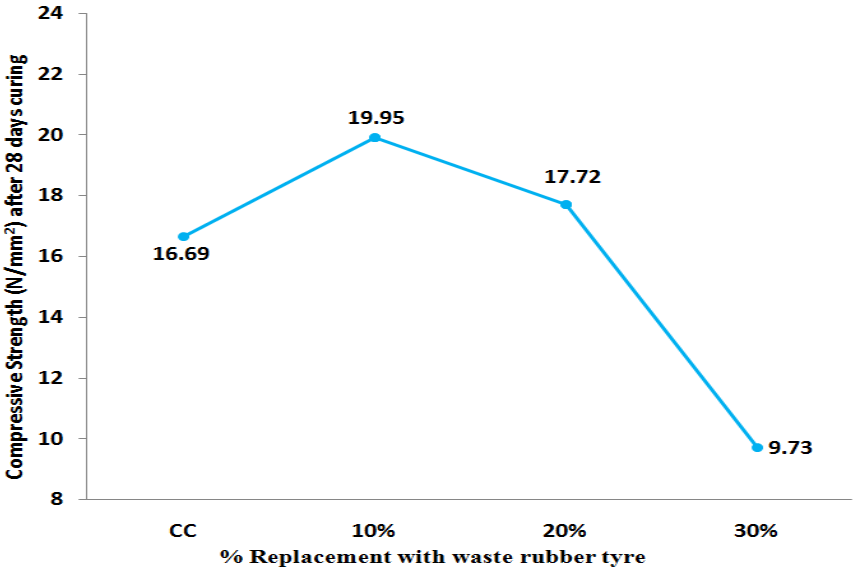

Fig. 3. Compressive strength in Acid curing

Fig 3 shows that, 0 to 20% of replacement of waste rubber tyre in concrete increases the strength between 1 to 3 N/mm^2 at 28 days strength in acid curing.

D. Density test on Concrete

TABLE 4. AVERAGE WEIGHT OF CONCRETE

% Replacement of waste rubber tyre	Average Weight of Concrete (Kg) after 28 Days
Conventional Concrete	8.431
10%	7.624
20%	7.182
30%	6.815

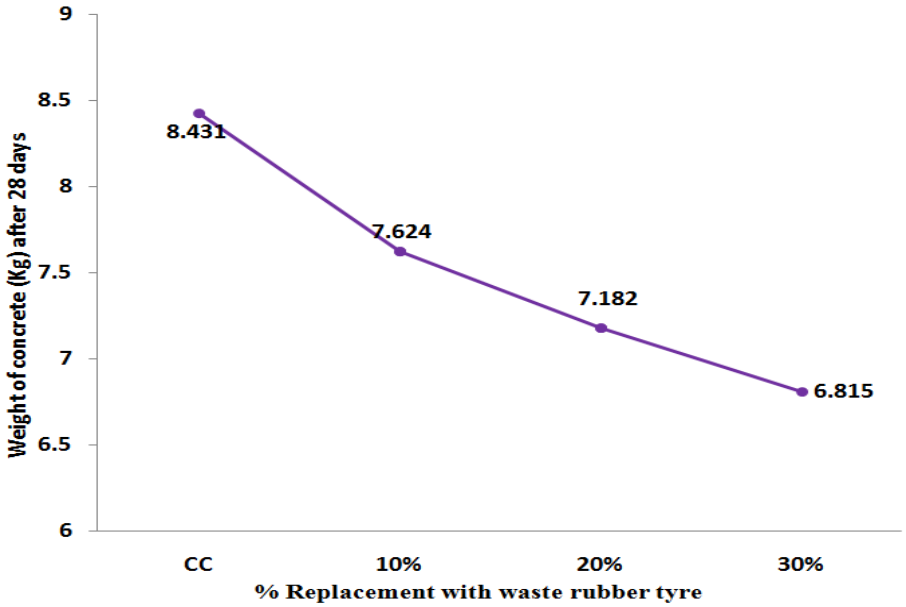

Fig. 4. Average weight of concrete

Fig 4 shows that 0 to 30% of replacement of waste rubber tyre in concrete reduce the weight between 0.8 to 1.6 Kg in 150x150x150 mm cube at 28 days strength.

Conclusion

The various strength tests were conducted for the concrete mix which containing different replacement proportions for waste rubber tyre. Addition of waste rubber tyre into normal concrete mix leads to decrease in workability for the various mix samples.

When 10% coarse aggregate was replaced by waste rubber tyre:

- In water curing, Compressive strength of concrete increases nearly about 15%.
- In acid curing, Compressive strength of concrete increases nearly about 20%.
- Density of concrete decreases nearly about 10%.
- Strength decreases with increasers the waste rubber tyre due to poor bonding strength between cement and waste rubber tyre chips at both 14 and 28 days strength.

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