PERFORMANCE OF FLY ASH BASED GREEN CONCRETE FOR CIVIL ENGINEERING STRUCTURE

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Abstract

Concrete is an environmental friendly material and the overall impact on the environment per ton of concrete is limited. The paper covers the aspect on how to choose a material for green concrete. It presents the feasibility of the usage of by product materials like fly ash, query dust, marble powder/ granules, plastic waste and recycled concrete and masonry as aggregates in concrete. The use of fly ash in concrete contributes the reduction of greenhouse emissions with negative impacts on the economy. It has been observed that 0.9 tons of CO_2 is produced per ton of cement production. Thus, by the use of green concrete it is possible to reduce the CO_2 emission in atmosphere towards eco-friendly construction technique. To avoid the pollution and reuse the material, in this paper an attempt is made for assessment of compressive & flexural strength of Fly ash based cement concrete. Concrete mixes M30 is designed as per the Indian standard code (IS-10262-82) by adding 25% of fly ash. Concrete cubes of size 150mm X 150mm X 150 mm are casted and tested for compressive strength at 7 days, 14 days and 28 days curing for all mixes and the results are compared with that of conventional concrete. The compressive strength of all mixes is tabulated the present study is carried out. Thus, green concrete is an excellent substituent of cement as it is cheaper, because it uses waste products, saving energy consumption in the production. Over and above all green concrete has greater strength and durability than the normal concrete.

Keywords: Concrete, Eco-Friendly Concrete, Eco-Friendly Construction Material, Efficient Concrete, Green Concrete, Fly Ash, Compressive Strength, and M30 mix

Introduction

Green concrete is a concept of using eco-friendly materials in concrete, to make the system more sustainable. Green concrete is very often and also cheap to produce, because for example, waste products are used as a partial substitute for cement, charges for the disposal of waste are avoided, energy consumption in production is lower, and durability is greater. This concrete should not be confused with its color. Waste can be used to produce new products or can be used as admixtures so that natural resources are limited and used more efficiently and the environment is protected from waste deposits. Inorganic residual products like stone dust, crushed concrete, marble waste are used as green aggregates in concrete. Further, by replacing cement with fly ash, micro silica in larger amounts, to develop new green cements and binding materials, increases the use of alternative raw materials and alternative fuels by developing or improving cement with low energy consumption. Considerable research has been carried out on the use of various industrial by-products and micro-fillers in concrete. The main concern of using pozzolanic wastes was not only the cost effectiveness but also to improve the properties of concrete, especially durability.

This paper summarizes the various efforts underway to improve the environmental friendliness of concrete to make it suitable as a “Green Building” material. Foremost and most successful in this regard is the use suitable substitutes for Portland cement, especially those that are by products of industrial processes, like fly ash, ground granulated blast furnace slag, and silica fume. Also efforts to use suitable recycled materials as substitutes for concrete aggregate are gaining in importance, such as recycled concrete aggregate etc.

Material Product Selection Criteria

Overall material/product selection criteria:

- **Resource Efficiency:** Resource efficiency basically includes properties like recycled content, natural or renewable, resource efficient manufacturing process, locally available, salvaged/refurbished or remanufactured, reusable or recyclable and durability.
- **Indoor Air Quality:** Indoor air quality (IAQ) is enhanced by utilizing materials that meet the following properties: low or non-toxic, minimal chemical emission, moisture resistant and healthfully maintained.
- **Energy Efficiency:** This mainly refers to the energy used for making the concrete. Those materials are preferred that require the minimal amount of energy at the time of construction of the concrete.
- **Water Conservation:** Materials that help us and conserve water in landscaped areas are preferred to be used as construction save water at the time of construction or even help reduce water consumption in building materials.
- **Affordability:** Affordability can be considered when building product life-cycle costs are comparable to conventional materials or as a whole, are within a project-defined percentage of the overall budget.

Fly Ash as Cementitious Material

Fly ash is a very fine powder and tends to travel far in air. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled. When it settles on leaves and crops in fields around the power plant, it lowers the yield. When pulverized coal is burnt to generate heat, the residue contains 80% fly ash and 20% bottom ash. Fly ash produced in Indian power stations are light to mid-grey in color and have the appearance of cement powder. Use of Fly ash concrete in place of PCC will not only enable substantial savings in the consumption of cement and energy but also provide economy. The use of fly ash has a number of advantages. It is theoretically possible to replace 100% of Portland cement by fly ash, but replacement levels above 80% generally require a chemical activator. Studies have found that the optimum replacement level is around 30%. Moreover, fly ash can improve certain properties of concrete, such as durability. Because it generates less heat of hydration, it is particularly well suited for mass concrete applications. The use of fly ash in concrete in optimum proportion has many technical benefits and improves concrete performance in both fresh and hardened state. Fly ash used in concrete improves the workability of plastic concrete and the strength and durability of hardened concrete. Generally, fly ash benefits concrete by reducing the mixing water requirement and improving the paste flow behavior.

Fly Ash Aggregates

Several lightweight concrete aggregates can be produced from fly ash. In addition to the use of furnace bottom ash in concrete masonry, pellets of fly ash can be bound by thermal fusion or chemically, using cement or lime. Such materials have many desirable properties. In the mid-1990s, Pacific Power conducted a feasibility study of the production of sintered fly ash aggregates (Powerlyte) and examined the use of such aggregates in concrete production. Fly ash was palletized and fired at controlled temperature to produce synthetic coarse and fine aggregates. These fly ash aggregates have a specific gravity range of 1.20–1.47, a bulk density range of 650–790 kg/m^3 and very high absorption from 16–24.8%. These properties showed very positive results for using fly ash as aggregates

Suitability of Green Concrete in Structures

Several factors which enhance the suitability of green concrete in structures include:

i. Reduce the dead weight of a structure and reduce crane age load; allow handling, lifting flexibility with lighter weight.
ii. Good thermal and fire resistance, sound insulation than the traditional granite rock.
iii. Improve damping resistance of building.
iv. Speed of construction, shorten overall construction period.
v. Reduction of the concrete industry's CO2-emission by 30 %.
vi. Increased concrete industry's use of waste products by 20%.
vii. No environmental pollution and sustainable development.
viii. Green concrete requires less maintenance and repairs.
ix. Green concrete sometimes give better workability than conventional concrete.
x. Good thermal resistant and fire resistant.
xi. Compressive strength behavior of concrete with water cement ratio is more than that of conventional concrete.
xii. Flexural strength of green concrete is almost equal to that of conventional concrete.

Scope in India

Green concrete is a revolutionary topic in the history of concrete industry. As green concrete is made with concrete wastes it does take more time to come in India because of industries having problem to dispose wastes and it also reduces environmental impact with reduction in CO_2 emission. Use of green concrete can help us reduce a lot of wastage of several products. Various non-biodegradable products can also be used and thus avoiding the issues of their disposal.

Brief Literature Review

As per Syed Afzal Basha Volume 4 Issue 4 December 2014 141 ISSN: 2319 – 1058, In this paper an attempt is made for assessment of compressive strength of Fly ash based cement concrete. Concrete mixes M25, M30, are designed as per the Indian standard code (IS-10262-82) by adding, 0%, 10%, 20%, 30% and 40% of fly ash. Concrete cubes of size 150mm X 150mm X 150 mm are casted and tested for compressive strength at 7 days, 14 days, 21 days and 28 days curing for all mixes and the results are compared with that of conventional concrete. The compressive strength of all mixes is tabulated.

As per Raijiwala D.B, Patil H. S., Sankalp, Civil Engineering and Architecture 1(1): 1-6, 2013 This paper aims at making and studying the different properties of Geopolymer concrete using this fly ash and the other ingredients which is available locally. Potassium Hydroxide and sodium Hydroxide solution were used as alkali activators in different mix proportions. The actual compressive strength of the concrete depends on various parameters such as the ratio of the activator solution to fly ash, molarity of the alkaline solution, ratio of the activator chemicals, curing temperature etc. The amount of the carbon dioxide released during the manufacture of OPC due to the calcinations of limestone and combustion of fossil fuel is in the order of one ton for every ton of OPC produced. In addition, the extent of energy required to produce OPC is only next to steel and aluminum. Attempts to reduce the use of Portland cement in concrete are receiving much attention due to environment-related.

As per CHIRAG GARG & AAKASH JAIN Vol. 2, Issue 2, Feb 2014, 259-264, the paper covers the aspect on how to choose a material for green concrete. It presents the feasibility of the usage of by product materials like fly ash, query dust, marble powder/ granules, plastic waste and recycled concrete and masonry as aggregates in concrete. The use of fly ash in concrete contributes the reduction of greenhouse emissions with negative impacts on the economy. It has been observed that 0.9 tons of CO2 is produced per ton of cement production. Also, the composition of cement is 10% by weight in a cubic yard of concrete.

As per Gaurav Pandey, Amit Pandey ISSN:2319-7463 Vol. 4 Issue 2, Feb.-2015, pp: (135-138), Green concrete is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mixture design to structural design, construction and service life. Green concrete is a type of concrete which resembles the conventional concrete but the production or usage of such concrete requires minimum amount of energy and causes least harm to the environment. Since it uses the recycled aggregates and materials, it reduces the extra load in landfills and mitigates the wastage of aggregates. Thus, the net CO2 emissions are reduced. The reuse of materials also contributes intensively to economy. Green concrete can be considered elemental to sustainable development since it is eco-friendly itself. One of the practices to manufacture green concrete involves reduction of amount of cement in the mix, which helps in reducing the overall cement consumption. The use of waste materials also solves the problem of disposing the excessive amount of industrial wastes. This paper discuss the importance of Green Concrete in the present day context and highlights its merits over conventional concrete which otherwise posing a serious threat to the environment through global warming.

Experimental Investigation

Two different types of specimens are developed in the laboratory and Cubes of 150 mm size were cast for testing in compression and for Flexural the size of beams 150 X150X700 mm size were used.
Materials used:

i. Cement: Ordinary port land cement of 53 grade confirming to IS-12269 having specific gravity of 3.03

Physical properties of Cement

Specific Gravity of Cement	3
Initial Setting time	38 min
Final Setting time	575 min
Normal Consistency	29 %
Compressive Strength	48 mpa

Chemical compositions of Cement as per manufacturers test report

Sl No	Chemical property	Result	Limit as per IS
1	Lime saturation Factor (%)	0.78	0.66 min - 1.02 max
2	Alumina Iron Ratio (%)	1.2	Min 0.665
3	Insoluble Residue (%)	0.8	Max 2%
4	Magnesia (%)	2.1	Max 6%
5	Sulphuric Anhydride (%)	1.1	2.5% to 35
6	Loss on ignition (%)	2.0	Max 5%

1. Fine aggregate: Fine aggregate is natural and obtained from local market. The physical properties like specific Gravity, bulk density, gradation fineness modulus are tested in accordance with IS 2386.

2. Coarse aggregate: The crushed coarse aggregate of 20 mm maximum size as well as 12mm size are obtained from the local crushing plant, is used in the present study. The physical properties of the coarse aggregate like specific gravity, bulk density, gradation fineness modulus are tested in accordance with IS 2386.

3. Fly ash: In the present investigation work, the fly ash used is obtained from Eco-space Power Station in Kolkata. The specific surface area of fly ash is found to be 4750 m2/kg by Blaine's Apparatus. Fly ash meeting specifications of IS 3812-1981& IS 456 can be used to produce good quality concrete. Typical characteristics of good quality fly ash are as follows

a. Fineness (Blaine's): 475 m^2/kg (Min.)

b. Lime Reactivity: 4.5 N/mm^2 (Min.)
c. Loss on ignition: 5% (Max.)

4. Water: Confirming to IS 456:2000
5. Mix proportion: **Fly Ash Concrete Mix Design For M30**

A. Stipulation for proportioning:

a. Grade design : M30

b. Type of cement : Opc 53 grade

c. Types of mineral admixture : Fly ash

d. Maximum nominal size of aggregate : 20 mm

e. Minimum cement content :320 kg/m^3

f. Maximum water cement ratio :0.45

g. Workability : 0 mm (slump)

h. Exposure condition : Severe (for reinforced concrete)

i. Degree of supervision : Good

j. Type of aggregate : Crushed angular aggregate

k. Maximum cement content : 450 kg/m^3

l. Chemical admixture type : Super plasticizer

A. Test data for materials:

a. Cement used : Opc 53 grade

b. Specific gravity of cement :3.15

c. Fly ash : Conforming to IS 3812

d. Specific gravity of fly ash :2.2

e. Chemical admixture : Super plasticizer

f. Specific gravity of:

1. Coarse aggregate : 2.74
2. Fine aggregate :2.74

g. Water absorption:

1. Coarse aggregate : 0.5%
2. Fine aggregate :1%

h. Sieve analysis:

1. Coarse aggregate : Conforming to table 2 IS383
2. Fine aggregate : Zone 1 of table 4 IS 383

B. Target Strength for mix proportioning:

$$f'_{ck} = f_{ck} + 1.65\ s$$

Where, f'_{ck} = target average compressive strength at 28 days

f_{ck}= characteristics compressive strength at 28 days = 30

s = standard deviation= 5N/mm^2

Therefore, target strength= 30 + 1.65 X 5= 38.25 N/mm^2

C. Selection of water-cement ratio :

From Table 5 of IS 456, maximum water-cement ratio =0.42

0.42 < 0.45, hence O.K

D. Selection of water content:

From Table 2, maximum water content for 20 mm aggregate = 186 litre (for 25 to 50 mm slump range).

E. Calculation of cement and fly ash content:

Water-cement ratio =0.425

Cementations material (cement+ fly ash) content = 186/0.425 = 437.64 kg/m^3

From table 5 of IS456 minimum cement for severe conditions = 320 kg/m^3

437.64 kg/m^3 > 320 kg/m^3, hence ok

Now, to proportion a mix containing fly ash the following steps are suggested:

a. Decided the percentage fly ash to be used based on project requirement and quality of materials
b. In certain situations increased in cementations material content may be warranted. The decision on increased in cementations material content and its percentage may be based on experience and trial is with increased of 10 % cementations material content

Cementations material content	= 437.64 X 1.10 = 481.42 kg/m^3
Water content	= 186 kg/m^3
So, water-cement ratio	= 186/481.42 = 0.38
Fly ash @ 25% of total cementations material content	= 481.42 X 25%= 120.35 kg/m^3
Cement (OPC)	= 481.42-120.35 = 361.07 kg/m^3

F. Proportion of volume of coarse aggregate and fine aggregate content:

From Table 3, volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate for water-cement ratio of 0.50=0.60. In the present case water-cement ratio is 0.425. Therefore, volume of coarse aggregate is required to be increased to decrease the fine aggregate content. As the water-cement ratio is lower by 0.075, the proportion of volume of coarse aggregate is increased by 0.02 (at the rate of -/+ 0.01 for every $+_{-}$ 0.05 change in water-cement ratio). Therefore, corrected proportion of volume of coarse aggregate for coarse aggregate for the water-cement ratio of 0.40=0.62

Therefore, volume of coarse aggregate = 0.62

Volume of fine aggregate = 1-0.62 = 0.38

G. Mix calculations

The mix calculations per unit volume of concrete shall be as follows:

a. Volume of concrete = 1m^3

b. Volume of cement = Mass of cement/ (1000X specific gravity of cement)

= 361.07/ (3.15 x 1000) = 0.114 m^3

c. Volume of fly ash = Mass of fly ash/ (1000 X specific gravity of fly ash)

= 120.03/ (2.2 X 1000)= 0.054 m^3

d. Volume of water = Mass of water/ (1000x specific gravity of water)

= 186/ 1000 X 1 = 0.186 m^3

e. Volume of chemical admixture (super plasticizer) @ 2.0 % by mass of cementations material) = Mass of admixture/ (1000 X spg of admixture)

Mass of admixture = 481.42 X 2% = 9.64 kg/m^3

= 9.64/ (1000 X 1.145) = 0.0084 m^3

f. Volume of all in aggregate = [a-(b+c+d+e)]

= [1- (0.114 + 0.054+0.186+0.0084)]

= 0.64 m^3

g. Mass of coarse aggregate = f X volume of coarse aggregate X spg of coarse aggregate X 1000

= 0.64 X 0.62 X 2.74 X 1000 = 1087.232 kg

h. Mass of fine aggregate = f X volume of fine aggregate X spg of fine aggregate X 1000

= 0.64 X 0.38 X 2.74 X 1000 = 666.38 kg

G. Mix proportions:

Cement = 361.07kg/m^3

Fly ash = 120.04 kg/m^3

Fine aggregate = 666.38 kg/m^3

Coarse aggregate = 1087.23 kg/m^3

Chemical admixture = 9.64 kg/m^3

Water cement ratio = 0.38

So the final ratio is 1:0.33:1.8:3.02

Specimen Preparation:

The above specified Concrete grade was poured in cube moulds & beams Specimens are prepared with varying percentages of fly ash.
9 Specimens namely:

1. **Moulds**

Plain concrete: 3 specimens for M30
Plain with admixture (25% Fly ash): 3 specimens for M30 (7, 14, 28 days)

2. **Beams**

Plain with admixture (25% Fly ash): 3 specimens for M30 (7, 14, 28 days)

Casting*:* Standard cast iron Cubes of dimensions 150mm X 150mm X 150mm are used to cast the specimens for compression test. The side plates of the mould where sufficiently stiff to eliminate spreading and warping. Before the concrete was placed in the mould, all the joints were checked thoroughly for any leakage. A thin film of grease was applied to cover the joints between the halves of the mould at the bottom surface of the mould and its base plate in order to ensure that no water escapes.

Curing: After casting, the specimens are stored in the laboratory at room temperature for 24 hours. After these periods the specimens are removed from the moulds and immediately submerged in clean, fresh water of curing tank and specimens are cured for 7, 14 and 28 days in the present investigation work.

Strength*:* Of the various strengths of concrete the determination of compressive & flexural strength has received a large amount of attention because the concrete is primarily meant to withstand compressive stresses. Generally cube & beams are used to determine the compressive & flexural strength. In the present investigation the size of concrete mould 150 X 150 X 150 mm & beams is 150 X 150 X700 mm are used. In the compressive test, the cube while cleaned to wipe of the surface water, is placed with the cast faces in contact with the planes of the testing machine, i.e. the position of the cube then tested is at right angles to that as cast. The specimens were removed from the moulds and submerged in clean fresh water until just prior to testing. The temperature of water in which the cylinders were submerged was maintained at 27^{o} C+2^{o} C and 90% relative humidity for 24 hours. The specimens were cured for 7, 14 and 28 days.

Tests of concrete cubes & beams with and without fly ash: Compressive strength tests were carried out on cubes of 150 mm size using a compression testing machine of 2000 KN capacity as per IS 516:1959. And Flexural strength were carried out on beams 700 mm using a Flexural testing machine of 100 KN capacity as per IS 516:1959.

Compressive strength properties of M30 grade concrete with and without fly ash

Sl. NO		No of days
1	25 % Of Fly ash	7, 14, 28
2.	Normal Mix	7, 14, 28

Experimental Data: For M30 grade concrete

Sl No	No of days	Compressive Strength		Flexural Strength	
		Normal Mix	Fly Ash	Normal Mix	Fly Ash
1	7	50 %	50%	85%	85%
2	14	70%	60%	95%	95%
3	28	100%	96%	100%	100%

Note: Final strength can be measured by 56 days.

Conclusions

Green concrete has manifold advantages over the conventional concrete. Since it uses the recycled aggregates and materials, it reduces the extra load in landfills and mitigates the wastage of aggregates. Thus, the net CO2 emissions are reduced. The reuse of materials also contributes intensively to economy. Since the waste materials like aggregates from a nearby area and fly ash from a nearby power plant are not much expensive and also transport costs are minimal. It helps in recycling industry wastes. It reduces the consumption of cement overall and has better workability, greater strength and Durability than normal concrete. Compressive strength and Flexural behavior is fairly equal to that of the conventional concrete. Thus, it may be concluded that the green Concrete is a futuristic building material for Green Buildings.

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Study of Soil Characteristics of MIET Campus Area at BANDEL

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ABSTRACT

Site feasibility study for geotechnical projects is of far most beneficial before a project can take off. Site survey usually takes place before the design process begins in order to understand the geotechnical characteristics of soil upon which the decision on location of the project can be made Field observation and laboratory test can be useful to identify characteristics and category of soil. A geotechnical site investigation is the process of collecting information and evaluating the conditions of the site for the purpose of designing and constructing the foundation for a structure, such as a building, plant or bridge, road railways , airport etc. Good planning and management of a geotechnical site investigation program is the key to obtain sufficient and correct site information for designing a building foundation in a timely manner and with minimum cost for the effort needed. The effort and detail of the geotechnical site investigation to obtain sufficient and correct site information to select and design a foundation for a building .For safe and economical design of a building and any other structure, the collection of geotechnical data and the siteinvestigation report for a proposed structure should be considered in design criteria of the proposed structure.\

INTRODUCTION

The design of foundations of structures such as buildings, bridges, and dams generally requires a knowledge of such factors as (i) the load that will be transmitted by the superstructure to the foundation system, (ii) the requirements of the local buildings code, (iii) the behavior and stress-related deformability of soils that will support the foundation system, and the geological conditions of the under consideration. To a foundation engineer, the last two factors are extremely important because they concern soil mechanics. The geotechnical properties of a soil-such as the grain-size distribution, plasticity, compressibility, and shear strength-can are assessed by proper laboratory testing. And, recently, emphasis has been placed on in situ determination of strength and deformation properties of soil, because this process avoids the sample disturbances that occur during field exploration. However, under certain circumstances, all of the needed parameters cannot be determined or are not determined because of economic or other reasons. In such cases, the engineer must make certain assumptions regardingthe properties of the soil.

The assessment of the accuracy of soil parameters-whether they were determined in the laboratory and the field or were assumed-the engineer must have a good grasp of the basic principles of soil mechanics.

LITERATURE REVIEW

W. F. Sullivan and A. E. Jacobsen (1959): The theory underlying the application of sedimentation procedures for particle size distribution is presented. Modifications of the theory to satisfy the several types of sedimentation techniques are described. Consideration is given to the various experimental techniques, particularly to the advantages and disadvantages of each. Experimental results are presented for the entire sub sieve range.

ToralvBerre(1982): Originally, triaxial tests at the Norwegian Geotechnical Institute (NGI) were used mainly to determine shear strength parameters for the case where the vertical stress increases and the horizontal stress is kept constant. Gradually realized that laboratory specimens ought to be subjected, as closely as possible, to the same stresses and stress changes as in the field. Equipment and procedures were then developed so that any combination of vertical and horizontal stresses, including cyclic loading, can be applied. Readings, and to some extent stress or strain regulations during the test, were automated.

LABORATORY INVESTIGATION:

Following geotechnical investigation has been considered for this studyandanalysis of soil characteristic for the present study.

1. Determination of grain size distribution of soil by sieve analysis.
2. Determination of Atterbergs limit.
3. Determination of field density of soil by Core cutter method.
4. Determination of shear parameter of soil by direct shear test.
5. Standard Proctor compaction test

TEST RESULT

Table 5.1: Summary of results

Name of experiment	**Result**	**Remarks**
Specific gravity	2.37	
Water content	41.5%	
Grain size distribution by sieve analysis	Soil-C	Well Graded Sand
Liquid limit (w_l)	37.51	soil is Inorganic silty clay
Plastic Limit (w_p)	27.2%	
Plasticity index(I_P)	10.31	soil category is clay sandy gravel
Liquidity index(I_L)	0.485	
Consistency index(I_C)	0.515	
Flow index(I_f)	16.15	
Toughness index(I_T)	0.638	
Maximum dry density	1.64 g/cc	

Optimum moisture content	15.70%	

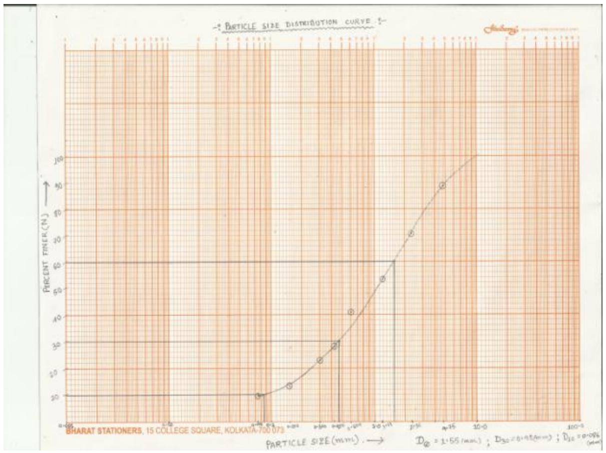

FIG.no.1- Particle size distribution curve

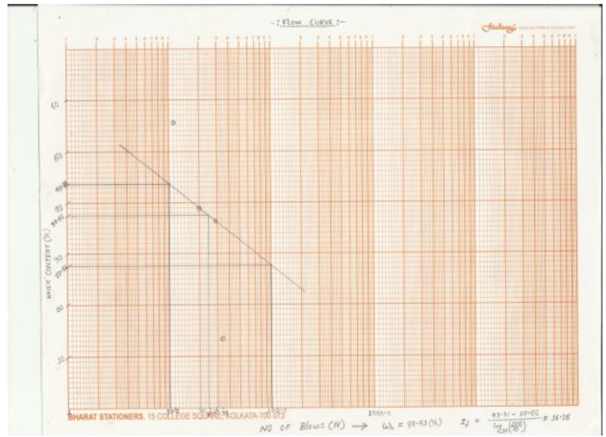

Fig No. 2-Flow Curve

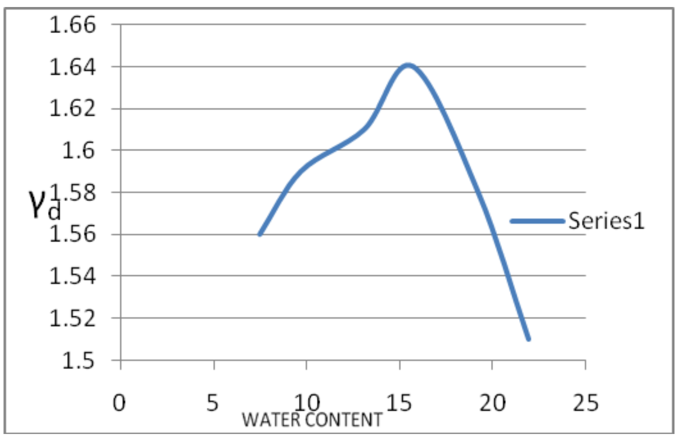

FIG.no- 3 Optimum moisture content graph

CONCLUSIONS

- The grain size distribution graph represents that the soil is **"C "** type and it is fall in **well graded sand.**
- As the value of **plasticity inde**x is **10.31** and the value of **liquid limit** is **37.51** so we can predict that the soil has **organic and in-organic silt and silt clays**.
- As the value of **plasticity inde**x is **10.31**so the soil is in between **low to medium plasticity**.
- Plasticity index value found 10.31, so group index GC , and soil category is clay sandy gravel. So the dry strength of the soil is medium to high, the compressibility and expansion is slight. The drainage characteristics of this kind of soil is poor to practically impervious.
- Consistency index is useful in the study of field behavior of saturated fine gravel as our $\mathbf{I_c}$Value is 0.515 which is in between 0 to 1 so it is fall in between liquid and plastic limit..
- Liquidity index is inversely proportional to yield stress. As our value of$\mathbf{I_l}$ is 0.485 so we can predict that the

yield stress is very high.

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Water Treatment Plant

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Abstract:

The experimental protocol, performed in an average of twice per week over a period of three years, included analysis and measurements of water quality and physical parameters. In addition, two studies were performed when daily samples were analysed during a period of two-three weeks. Furthermore, the removal of pathogens in the system, and the microbial composition in the first hydroponic tank were investigated. Inflow concentrations were in an average of around 500 mg COD/L. The results show that 85-90% of COD was removed in the system. Complete nitrification was achieved in the hydroponic tanks. Denitrification, by means of pre-denitrification, occurred in the first anoxic tank. With a recycle ratio of 2.26, the achieved nitrogen removal in the system was around 72%. Approximately 4% of the removed amount of nitrogen was credited to plant uptake during the active growth period. Phosphorus was removed by adsorption in the anoxic tank and sand filters, natural chemical precipitation in the algal step induced by the high pH, and assimilation in plants, bacteria and algae. The main removal occurred in the algal step. In total, 47% of the amount of phosphorus was removed. Significant recycling of nitrogen and phosphorus through harvested biomass has not been shown.

Theory:

It is the branch of environmental engineering in which the basic principles of science and engineering are applied to the problems of water pollution control. So, as an overview, this wastewater engineering includes wastewater treatment, sludge disposal and reuse, wastewater reclamation and reuse, effluent disposal and the role of engineer. Every community produces both solid and liquid wastes. The liquid waste is known as the wastewater. It may be defined as liquid wastes collected in a sewer system and conveyed to a treatment plant for processing. In view of their sources of generation it may be defined as a combination of the liquid or water carrying wastes removed from residences, institutions, commercial and industrial establishments together with ground water, surface water and storm water (may also be present).

Storm wastewater means the wastes from rains or floods while sanitary or domestic wastewater refers to liquid collected from residences, business buildings and institutions. Municipal wastewater is the wastewater treated in a municipal treatment plant which comes from towns frequently containing industrial effluents from dairies, laundries, bakeries, factories and in large cities it may have wastes from major industries such as chemical manufacturing, breweries, meat processing, metal processing or paper mills etc

Literature Review:

Mittal K, Jamwal P et al. in 2010 evaluated the water quality profiles at different stages of treatment for l6 STPs in Delhi city. These STPs are based on conventional Activated Sludge Process (ASP), extended aeration, physical, chemical and biological treatment (BIOFORE), Trickling Filter and Oxidation Pond. The primary effluent quality produced from most of the STPs was suitable for Soil Aquifer Treatment (SAT). Extended Hydraulic Retention Time (HRT) as a result of low inflow to the STPs was responsible for high turbidity, COD and BOD5 removal. Conventional ASP based STPs achieved 1.66 log FC and 1.06 log FS removal. STPs with extended aeration treatment process produced better quality effluent with maximum 4 log order reduction in FC and FS levels. “Kondli” and “Nilothi” STPs employing ASP, produced better quality secondary effluent as compared to other STPs based on similar treatment process. Oxidation Pond based STPs showed better FC and FS removals, whereas good physiochemical quality was achieved during the first half of the treatment.

Sinha S, Pandey S et al. In 2014 they concluded that the development of innovative technologies for treatment of wastewaters from steel industries is a matter of alarming concern for us, especially in reference to development of design of industrial effluent Treatment Plants (ETP) system. Physical treatment methods include sedimentation, Floatation , filtering , stripping, ion – exchange, adsorption and other processes that accomplish removal of dissolved and undisclosed substances without necessarily changing their chemical structure. The mathematical approaches are very useful and more realistic for developing a well operating cost–effective treatment system for industrial wastewater treatment.

R Kaur, Wani SP et al. In 2010 Current and future fresh water demand could be met by enhancing water use efficiency and demand management. Thus, wastewater/low quality water is emerging as potential source for demand management after essential treatment. An estimated 38354 million litres per day (MLD) sewage is generated in major cities of India, but the sewage treatment capacity is only of 11786 MLD. Similarly, only 60% of industrial waste water, mostly large scale industries, is treated.

OBJECTIVES:-

Conditions in treatment facilities of comparatively smaller size

The objectives of wastewater treatments are as follows.

- To understand various terms used in wastewater treatment
- To understand basics of wastewater treatment
- To acquaint with different steps involved in primary treatment of wastewater.
- To promote the treatment and reuse of wastewater.
- To extract pollutants and remove the toxicants.
- Neutralize coarse particles and kill the pathogens.
- Discharge the pollutant fee i.e., environmental friendly water to water bodies and the agricultural land.
- To control and monitor pollution, private sewers and the use of equipment in relation to wastewater treatment.

Stages of Wastewater Treatment:-

It is composed of a combination of unit operations and unit processes designed to reduce certain constituents of wastewater to an acceptable level.

- Primary treatment.
- Secondary treatment.
- Tertiary treatment.

PRIMARY TREATMENT

In primary treatment, a portion of the suspended solids and organic matter is removed from incoming wastewater. This removal is usually accomplished with physical operations such as screening, commuting, grit chambers and sedimentation etc. The effluent from primary treatment will ordinarily contain considerable organic matter and will have a relatively high BOD (Biological Oxygen Demand). The principal function of primary treatment will continue to be as a precursor to secondary treatment.

Steps of the primary treatment:-

i. Screening.
ii. Comminutor.
iii. Grit Chamber.
iv. Detritus Tank.
v. Oil & Grease Trap.
vi. Skimming Tank.
vii. Primary Clarifier.

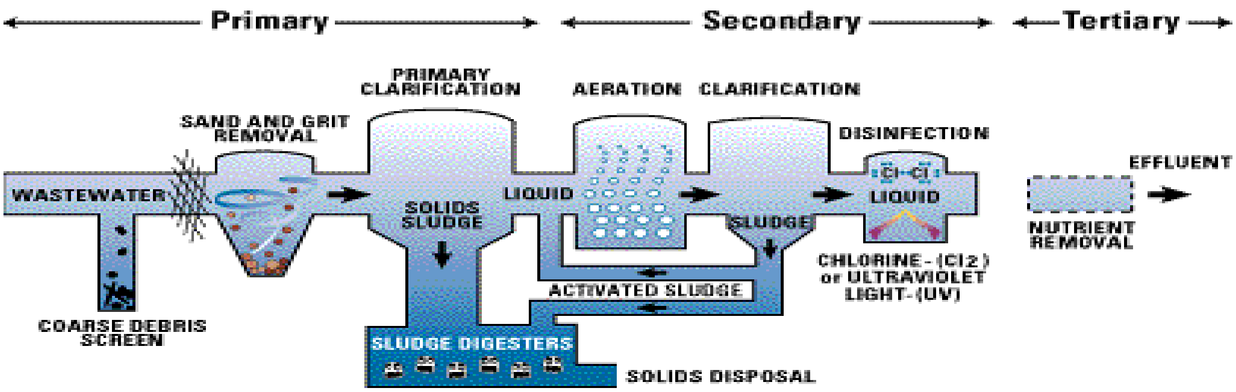
SECONDARYTREATMENT:-It consists of biological conversion of dissolved and colloidal organics into biomass that can be subsequently removed by sedimentation.
Systems may be used in this treatment:

i. Activated Sludge System.
ii. Trickling Filter system.
iii. Oxidation Ditch,

iv. Aerated Lagoon.
v. Intermittent Sand Filters.

TERTIARY TREATMENT:-

To learn about advanced treatment of wastewater, waste water disposal and reuse and disinfection of water. Additional treatment, usually referred to as tertiary treatment, often involves the removal of nitrogen and phosphorus compounds, plant nutrients associated with eutrophication.



Test Result:

Source of water		before test	after test	Permissible limit
Domestic wastewater sample	p^H	8.4	7	6.5 - 9
	TDS	580	500	< 300; Excellent 300 to 600; Good 600 to 900; Fair 900 to 1200; Poor >1200; Unacceptable
	TSS	220	3	
	BOD	250	6	
	COD	500	2	

Conclusion

The long retention time in the system is proposed as one of the reasons for the achieved removal. Safety measures are recommended regarding human contact with wastewater in the early open part of the system. The waste water treatment plant has attracted many visitors during the years and thereby contributed to discussions regarding wastewater and treatment. Today's restrictions towards reusing sludge in agriculture are related to the diversity of substances in the inflow to the treatment plants. Some of these substances originate from household chemicals. With green systems, technology can be brought closer to the users, and thus hopefully increase the awareness of the public.

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