Utilization of Sugarcane Industrial Treated Water in Concrete

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Abstract- *Population explosion coupled with urbanization has raised the demand for water resulting in its scarcity. With industrialization, the quantum of waste water generated too has soared up warranting appropriate measures for utilization of the same. We are here putting a step forward to utilize the industrial effluents in construction industry. Almost all industries depose there effluents either into agricultural lands or into natural water bodies. We are considering the effluent waste water which is being put in agricultural lands from sugarcane industries. Since the utilization of industrial waste water was not effectively done so far, we took this project as a challenge. We collected [5]water samples from a SAKTHI SUGARS Unit I in Erode district and tests was conducted to know its characteristics. We conducted tests to know B.O.D, C.O.D, Total Dissolved Solids, pH, Sulfate, Chlorides, Oil and Grease, and the result was compared with the Indian standards for drinking water. As the water used for drinking purpose that the sugarcane industrial waste water can be utilized for construction purposes. As a second step we have to cast laboratory scale concrete blocks and cylinders of M20 and M25 grade and should be tested for various fresh concrete and hardened concrete tests. The byproducts of sugarcane like baggash, press mud are used as replacements of aggregates; we surely believe that our project will become success. With the current water scarcity in India there is a need to look for alternate source for concrete production. By doing this project we can move the concrete industry towards zero discharge facility, and thereby reducing the wastage of a very precious natural resource.[2]*

Keywords- Water scarcity, waste water, samples, zero discharge facility

I. AIM AND OBJECTIVE

The aim of the study is to analyze the safety use of sugarcane effluent water in concrete and to give the proper strength for the required construction.

- It helps in better understanding of the project.
- It helps in giving knowledge about how to reuse the wastage of water .
- It gives clear idea about project objectives and all alternatives.
- It minimizes delays and problems in the project.
- It reduces the cost and availability of water in the sites.
- Gives a clear cut idea before starting a project.

The main objective of this project work is

- To examine the effluent treated water from the industries.
- To identify the key safety factors in the construction.
- To determine its strength in concrete with specific M20 grade of cement.
- Advantages of using sugarcane water for the construction projects.

1.2 Introduction

The construction industry in India currently uses portable water in the concrete industry. However, portable water is a precious resource, and as such, the use of portable water in construction industry will increase the demand of portable water, which is a scare resource.[3] Water resources are the greatest boon given to mankind by nature. This non renewable resource is getting depleted day by day and the predictions say that the third world war may arise for water. Hence an effort has been made to use industrial effluents to cure & use for mixing in concrete and thereby save water resources. Nevertheless, growth in population, agriculture and other industries consumes increasing supplies of portable water, and therefore, it is imperative that measures be taken to conserve portable water as much as possible to prevent shortages of water in the future.

Although it is known that water suitable for drinking can be used in concrete, water with up to 100 parts sulfur trioxide or 50 parts chlorine per 100,000 liters being not objectionable for preparation of concrete. The aim of this project is to upgrade the properties of treated wastewater by an innovative process so that value addition is made to the wastewater and demand for portable water is diminished. We therefore integrate our water projects, as well as our workforce & enterprise development for the agriculture programs. [2] This will be economically beneficial to both the government and the construction industry.

The application of reusing treated effluent in construction industry has to be carried out to successfully develop our countries .Therefore the focus of this study is to consider the applicability of reusing the treated effluent in concrete technology since some non-potable water is found to be suitable as the concrete mixing water.[3]

II. WATER

Water is a compound with the chemical formula H2O. A water molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is a liquid at standard Ambient temperature and pressure, but it often co-exists on Earth with its solid state, ice, and gaseous state (water vapor or steam). Water also exists in a liquid crystal state near hydrophilic surfaces.

Water covers 71% of the Earth's surface, and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air), and precipitation.[3] Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products.

Water can dissolve many different substances, giving it varying tastes and odors. The taste of spring water and mineral water, often advertised in marketing of consumer products, derives from the minerals dissolved in it. However, pure H2O is tasteless. The advertised purity of spring and mineral water refers to absence of Toxins, Pollutants and Microbes, not the absence of naturally occurring minerals.[4]

2.1 RECYCLED WATER

a. Potable water – Water suitable for human consumption.

b. Recycled water – Water recovered from CPO or water generated from sewage, grey water or Storm water systems and treated to a standard that is appropriate for its intended use.

c. Reclaimed water – Treated recycled water supplied by the water authorities for Domestic, Agricultural and Industrial usage.

d. Use of treated water in concrete

Several researches around the world have studied the use of treated water in concrete, with various levels of success. The Re-use of recycled water from the recycling of unset concrete as mixing water for concrete is common practice in almost all ready-mixed concrete plants. The disposal of such wastewater is no longer being environmentally accepted. The recycled water consists primarily of the mixture of water, cement, and fines that remain after removal of the aggregate, but it also includes the wash water used for washing and cleaning the returning mixer trucks, concrete pumps, and other equipment, as well as the precipitation water collected on the production areas.

e. Health Assessment of Water Reuse

There are certain aspects that should be taken into consideration for water reuse: (a) expected degree of human contact with the reclaimed water; (b) what concentration of microbiological and chemicals of concern are expected; (c) which treatment processes is necessary to achieve the required reclaimed water quality; and, (d) what are the sampling/monitoring protocols to assure water quality needed. In terms of diseases caused by waterborne organisms, the main transmission route is fecal-oral. A large variety of pathogenic microorganisms that may be present in raw domestic wastewater is derived principally from the feces of infected humans and primarily transmitted by consumption.[5]

2.2 CHARACTERISTICS OF WATER

Water on the surface of the globe is present under its three physical states: solid, liquid and gaseous. Water (H2O) is the most abundant compound on Earth's surface, covering about 70 percent of the planet. In nature, water exists in liquid, solid, and gaseous states.

Many substances dissolve in water and it is commonly referred to as the universal solvent. Because of this, water in nature and in use is rarely pure and some of its properties may vary slightly from those of the pure substance. However, there are also many compounds that are essentially, if not completely, insoluble in water. Water is the only common substance found naturally in all three common states of matter and it is essential for all life on Earth. Water usually makes up 55% to 78% of the human body.

2.3 SUGARCANE WATER

Sugarcane, or Sugar cane, is any of six to 37 species (depending on which taxonomic system is used) of tall perennial true grasses of the genus Saccharum, tribe Andropogoneae, native to the warm temperate to tropical regions of South Asia. The world demand for sugar is the primary driver of sugarcane agriculture. Cane accounts for 80% of sugar produced; most of the rest is made from sugar beets.[6] Sugarcane predominantly grows in the tropical and subtropical regions, and sugar beet predominantly grows in colder temperate regions of the world.

2.3.1 CHARACTERISTICS OF SUGARCANE

i) Saccharum officinarum:

1. It is locally known as pundia or pondya.
2. Stalk is thick with soft rind.
3. It has high sugar content.
4. It gives higher yields as compared to other species.
5. It is resistance to smut disease.
6. It is susceptible to red rot and mosaic disease.

ii) Saccharum sinensis:

1. It is known by Pansahi, nargori and mungo groups.
2. It is found in North India.

iii) Saccharum barberi:

1. It is known by saretha and sannabile groups
2. It had wider adoptability so; it is grown all over India.
3. Stalk is thin and matures earlier.
4. It contains medium sugar.
5. It is poor in yield
6. It is susceptible to smut disease.
7. It is resistance to red rot and mosaic diseases.

III. COLLECTION AND TREATMENT OF SAMPLE

The treatment process which was followed in Sakthi Sugars is 'Aerobic Conventional Treatment Process' This Aerobic process is done with the help of sunlight. An aerobic treatment system or ATS, often called (incorrectly) an aerobic septic system, is a small scale sewage treatment system similar to a septic tank system,

These systems are commonly found in rural areas where public sewers are not available, and may be used for a single residence or for a small group of homes.

Process

The ATS process generally consists of the following phases:

- Pre-treatment stage to remove large solids and other undesirable substances from the wastewater; this stage acts much like a septic system, and an ATS may be added to an existing septic tank to further process the primary effluent.[3]
- Aeration stage, where the aerobic bacteria digest the biological wastes in the wastewater.
- Settling stage to allow any undigested solids to settle. This forms a sludge which must be periodically removed from the system.
- Disinfecting stage, where chlorine or similar disinfectant is mixed with the water, to produce an antiseptic output.

3.1 DETERMINATION OF IMPURITIES

The determination of impurities from the effluent sugarcane industry collected from Erode Sakthi sugars where founded while testing in our chemical laboratory and the test results are as follows:

Impurity	Effect
Oil, fat or detergents	Air entraining possible
Calcium chloride and some other calcium salts	Probability of set acceleration
Sugar, salt or zinc, lead, and a range of other inorganic and organic materials	Probability of set retardation
Chloride ions	Strong probability of steel corrosion

Table 1 : Impurities and its effects

3.2 THE IMPURITIES WHICH HAS BEEN NOTED BY ITS NOTES AND LIMIT

Sl no	Chemicals	Limit ppm	Notes
1.	Chloride Cl	500-1000	Pre stressed concrete/grout, reinforced concrete.
2.	Sulfate SO4	3000	EN 1008 limit. Water with higher salt contents has been used satisfactorily. (Building Research Station).
3.	Total solids	50000	ASTM C9411 optional requirement. For possible use of water with solids exceeding the limit.
4.	pH	>5.0	AS 1379 requirement.
5.	Oil and grease	<50	AS 1379 requirement.
6.	Dissolved solids	2000 ppm	Testing to BS 3148* if limit is exceeded.
7.	Sucrose	500 ppm	0.03-0.06 wt % of cement retarded setting but increased strength, 0.1% severely retarded setting but increased strength, 0.15% caused quick setting and lowered 7-day strength & similar or lower 28-day strength. (Steinour3).
8.	Tannic acid	(0.5% wt of water)	No effect on strength but may well have a considerable effect on setting time (Steinour3).
9.	Silt or suspended clay particles	2000 ppm (turbidity)	USBR Concrete Manual**. Much higher amounts can be tolerated as far as the effect on strength is concerned (Abrams2).
10.	Zinc oxide	0.01% wt of cement	No significant effect but 0.1% strongly retarded setting and lowered strength. More information reported by Steinour3.

Table 2 :Impurities by its notes and limit

IV. TEST RESULTS [11][12]

4.1 COMPARISION OF NORMAL AND TREATED WATER

Sl no	Parameter	Treated water values (mg/l)	Normal water values (ppm)
1.	pH	7.80	6-8
2.	Total Suspended Solids	4	50-100
3.	Total Dissolved Solids	160	2000
4.	Chloride (as Cl)	25	500-1000
5.	Sulfate (as SO_4)	1.6	3000

6.	Chemical Oxygen Demand (COD)	16	2000-3000
7.	Biochemical Oxygen Demand 3 days at 27ºC (BOD)	<2	1000-1500
8.	Oil and Grease	<1	<50

4.2 Fresh Concrete

1.Slump cone test

The slump cone test has been conducted in our laboratory and the result is found to be "True slump"

Sl no.	Type of construction	Slump Max(cm)	Slump Min(cm)
1	Reinforced foundation walls and footings	10.0	5.0
2.	Unreinforced footings caissons & sub structure walls	7.5	2.5
3.	Reinforced slabs beams and columns	12.5	7.5
4.	Building columns	12.5	5.0
5.	Bridge decks	7.5	5.0
6.	Pavements	5.0	2.5
7.	Sidewalls driveways & slabs on ground	10.0	5.0
8.	Heavy mass construction	5.0	5.0

Table 4 : Slump Limits

2.Compaction Factor Test

Weight of empty cylinder (W1) = 7.0kg
Weight of partially compacted concrete (W2) =15.30kg
Weight of fully compacted concrete (W3) =18.60kg
Compaction Factor = (W2-W1)/(W3-W1)
= (15.30-7.0)/(18.60-7.0)
= 0.714

3.Vee-Bee Consist meter Test

Sl no	Vee-Bee Degree in Seconds
1.	40 sec
2.	35 sec
3.	39 sec

Table 5 : Tests results for Vee-Bee Consist meter Test

Hard Concrete

1.Compression Test

Sl no	Area of Specimen	No of days at the time of breaking	Maximun load at which the cube breaks (P)	Compressive strength (N/mm^2)
1.	150^2 =22500	7	549	16
2.	22500	14	793	23.4
3.	22500	28	832	37

Table 6 : Compression Test Results

2.Split Tensile Strength Test

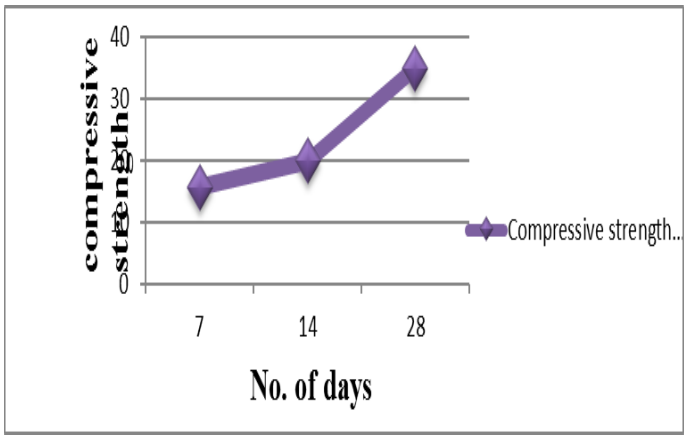
Sl no	No of days at the time of breaking	Split strength (N/mm^2)
1.	7	22
2.	14	28
3.	28	43

V. RESULTS AND DISCUSSION

Strength Of Concrete

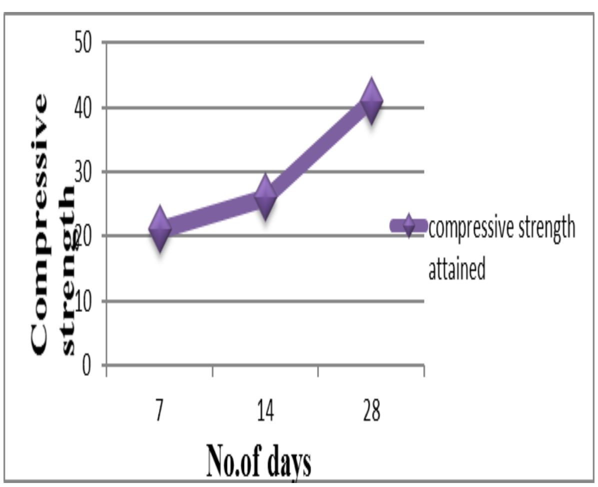
(i)Using Portable water (Standard) M20

Normal Cube



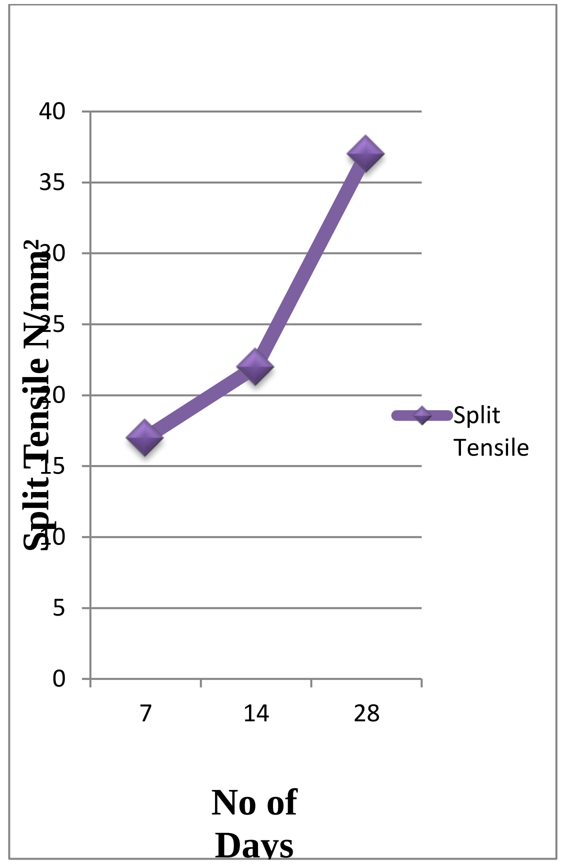
Graph 1 : Using Portable water for M20 normal Cube

Normal Cylinder



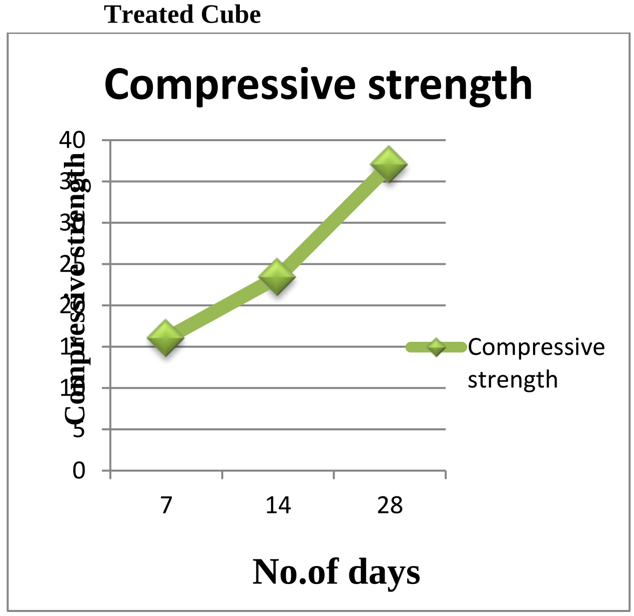
Graph 2 : Using Portable water M20 normal Cylinder

Normal Split Tensile Strength



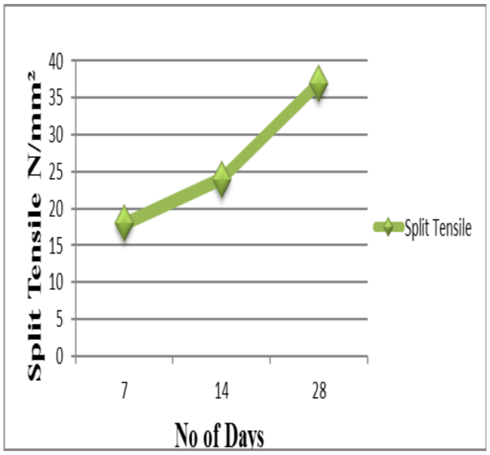
Graph 3 : Using Portable water M20 normal Split Tensile

(ii)Using Effluent Sugarcane Treated Water M20 Treated Cube



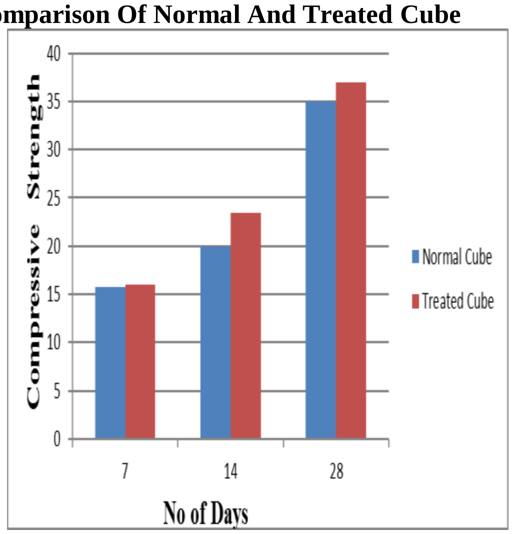
Graph 5 : Using Treated water for M20 normal Cylinder

Treated Split Tensile Strength



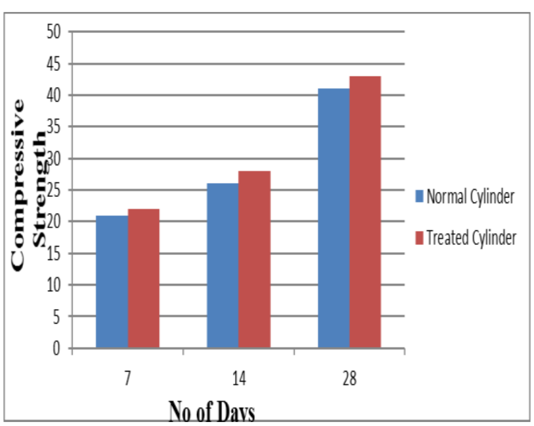
Graph 6: Using Treated water for M20 normal Split tensile strength

M20 Comparison Of Normal And Treated Cube



Graph 7 : Comparison of Normal and Treated Cube (M20)

M20 Comparison Of Normal And Treated Cylinders



Graph 8 : Comparison of Normal and Treated Cylinder (M20)

VI. CONCLUSION

The results obtained from this project on the various concrete mixes showed that this treated sugarcane waste water did not have an adverse effect on compressive strength.

Compared with concrete cast with 100% potable mixing water, an increase in compressive strength was observed in concrete cast with treated wastewater in the 28-days compressive strength.

The initial and final setting times of cement paste mixed with treated effluent increase compared with potable water. The result obtained from this study indicates that treated effluent could be used as mixing water in concrete in accordance with IS3184.

From the results obtained in this study, concrete with improved initial compressive strength could be made with treated sugarcane wastewater used totally for the mixing water in the concrete area .It would be more useful in now-a-days because of the scarcity of the normal water.

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