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Effect of Treated Grey water in Concrete

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Abstract

CO2 and other greenhouse gas emissions from the production of Portland Cement, which is used in concrete, amount 2.5 billion tonnes globally. Furthermore, one of the most water-intensive sectors is concrete. Water is undeniably crucial in civil engineering, and there are now no viable alternatives. According to various concrete standards, chemical water limits for concrete advise that non-potable water can be used as mixing water. Grey water, for example, might be repurposed to relieve strain on fresh water supplies. The goal of this research is to find out how the usage of grey water affects the quality of concrete. To boost the strength of the concrete, a M 40 concrete mix was mixed with silica fume. The impact of treated grey water and tap water samples on concrete strength is then assessed.

Keyword: Treated grey water, Mechanical properties, Electroreduction

Introduction

Water scarcity is the most ambiguous topic. Despite the fact that over 1 billion people lack access to clean and safe drinking water due to its declining availability, we continue to take it for granted, waste it, and even overpay for it in the form of little plastic bottles.[6]

Concrete is the most commonly used building material in the construction industry, and it uses the most water. 1m3 of concrete requires 186 litres of water, according to IS10262-2009. A double-lane flyover of the same size can consume 70 million gallons of water. Water is also used in the building industry for mixing, washing aggregates, and curing concrete.

At least twice a year, two-thirds of the world's population (4 billion people) face severe water scarcity. Even in this day and age, many people in various parts of India spend their entire day seeking for water. The IWMI predicts that India will face a water crisis by 2025. (The International Water Management Institute). 150 litres of water are required for every m3 of concrete. The construction industry utilizes a lot of water, which is becoming increasingly scarce. With India's expanding population and construction, treated grey water might become a dependable and sustainable source of water. Grey water contains dirt, food, grease, hair, and numerous household cleaning products. Because it contains fewer bacteria, grey water is frequently safer to handle and treat than household waste water.

Scope Of Study

The ultimate goal of using treated grey water in concrete preparation is to define the qualities of the concrete.

Future Scope

The corrosion of reinforcement can be used to perform research on the usage of treated grey water in the construction of reinforced cement concrete.

Methodology

Grey water was gathered with everyday kitchen utensils. Samples were gathered and brought to a laboratory for testing and research on the early qualities of grey water. Grey water is treated with electrocoagulation for 4 to 6 hours. A series of tests were performed on concrete to evaluate and compare its mechanical qualities with varied amounts of silica fume. After curing, the strength qualities and acid test were carried out.

Test And Results.

Table 1 Test values on water Sample

S.no	Particulars	4 Hrs	6 Hrs	Recommended values
1	Acidity	2 ml	1.1 ml	Not be more than 5ml
2	Alkalinity	24 ml	21.5ml	Not be more than 25ml
3	Chlorides	160mg/l	142mg/l	500 for RCC 2000 for PCC

4	Sulphates	45	63mg/l	400mg/l max
5	Inorganic solids	752 mg/l	648mg/l	3000mg/l max
6	Suspended matters	**2300**mg/l	1900 mg/l	2000mg/l
7	Organic solids	182mg/l	190mg/l	200mg/l
8	pH value	**5**	7.22	Not less than 6

Cement paste consistency

When treated grey water is utilized instead of potable water, the fluidity of cement paste increases by 1.785%. The cement consistency should be between 24 and 30%, according to IS specifications. As a result, the obtained results are within acceptable limits.

Compression Strength Test

Concrete compressive strength testing is a common process for determining the ability of concrete to bear compressive stresses. It is a critical test for determining the quality and performance of concrete in a variety of applications, including the construction of buildings, bridges, pavements, and other structures.

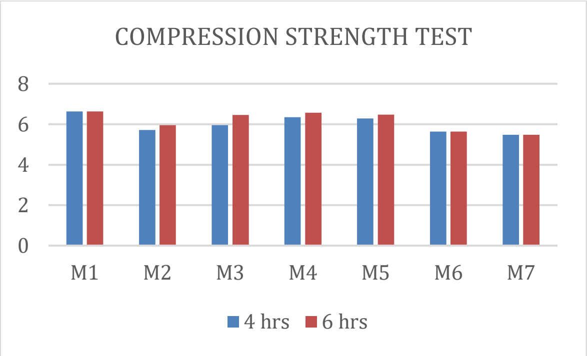


Fig 3 Compression strength test for 4 hours and 6 hours

Split Tensile Strength Test

When direct tensile testing is impossible or impractical, it is frequently used. A cylindrical specimen is subjected to a diametrical compressive load until it fails in tension.

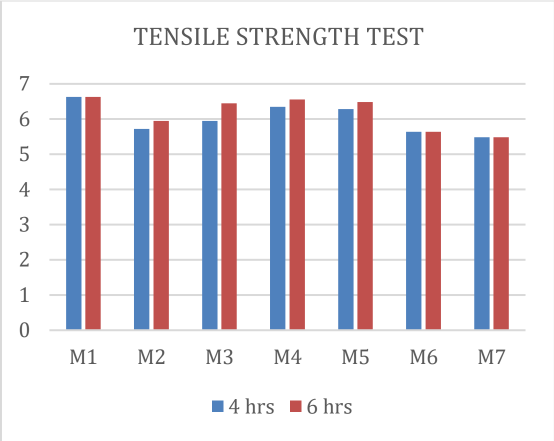
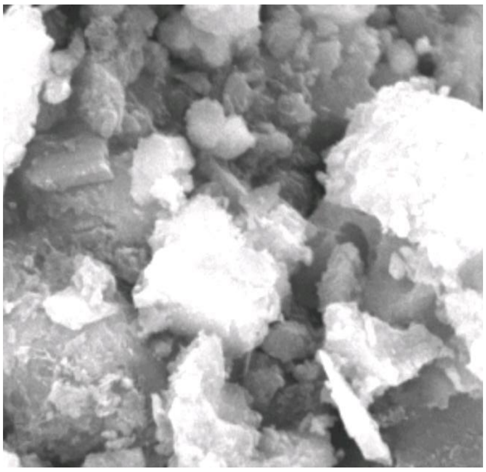


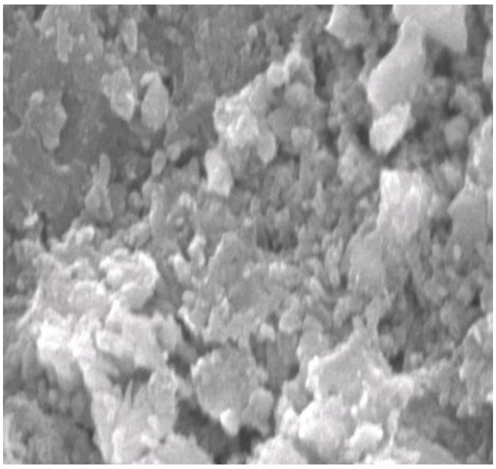
Fig 4 Tensile strength test for 4hours and 6 hours

SEM Analysis

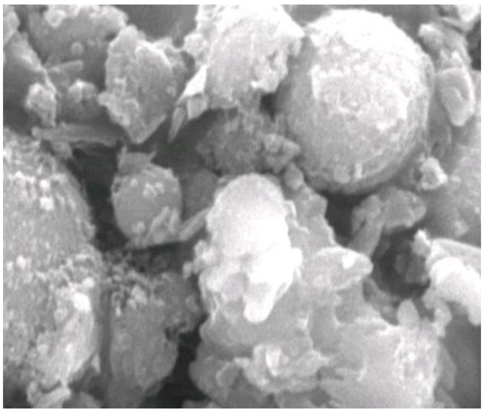
SEM (Scanning Electron Microscopy) is a strong technique for studying the microstructure of materials such as concrete. It generates high-resolution images and enables researchers to examine the surface morphology and internal microstructure of concrete at magnifications ranging from a few to several thousand times.



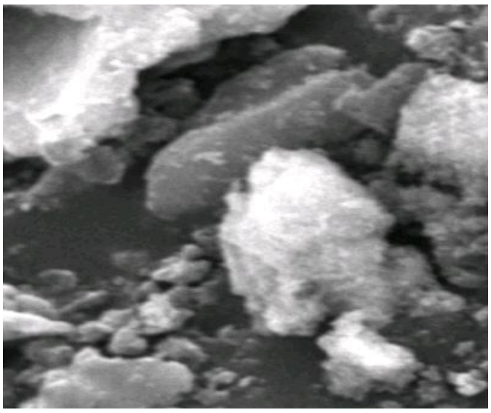
SEM Micrograph nominal mix



Treated grey water



TGW+ 3% silica fume



TGW+ 6% silica fume

The SEM Micrograph shown above in Fig made of nominal ,mix made of Treated grey water , 3 % silica fume with treated grey water, 6 % silica fume with treated grey water for revealed that C-S-H gel was widely distributed on the combination of hydrated cement paste, which was the primary reason of the effective strength. One of the reasons for the effective strength of the mix was the expanding dispersion of mineral elements

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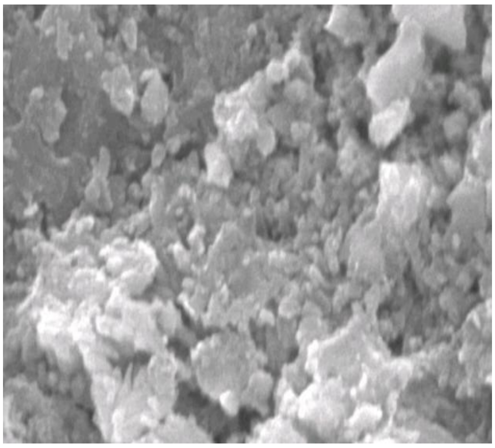
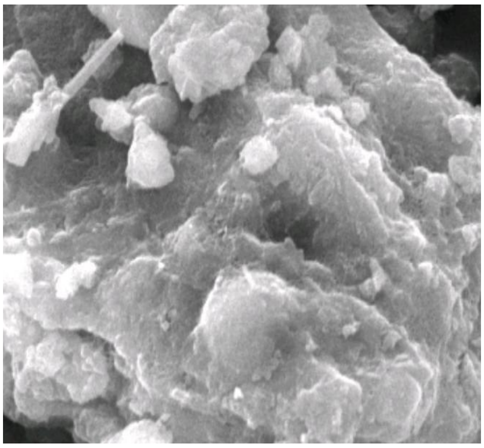
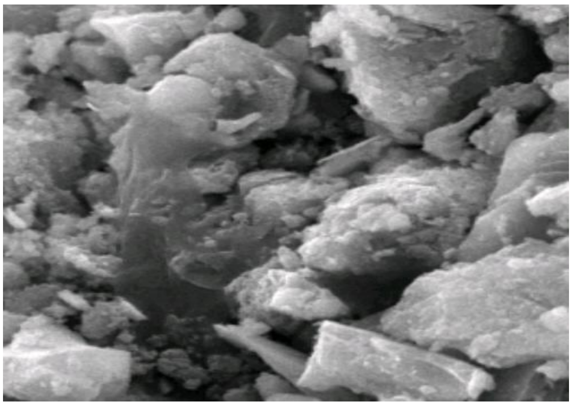


TGW+ 9% silica fume



TGW+ 12% silica fume



TGW+ 15% silica fume

The SEM Micrograph shown above in Fig made of 9 % silica fume with treated grey water, 12 % silica fume with treated grey water , 15 % silica fume with treated grey water for revealed that C-S-H gel was not widely distributed because of more silica content which reduce the strength of concrete.

Acid Attack Test

Corrosion of reinforcement is another outcome of acid attack. Acid can reach the reinforcement through cracks or by penetrating the concrete (high porosity). When acid comes into touch with steel, it promotes corrosion, which leads to concrete cracks. The reaction between the acids and the products of cement hydration causes acid assault on concrete. In solution, aggressive acids such as sulphuric acid, acetic acid, hydrochloric acid, and nitric acid inflict significant damage to concrete.

Acid combines with calcium hydroxide to form soluble salts in an acidic environment. After consuming calcium hydroxide, more aggressive acids such as sulphuric and acetic acid react with C-S-H gel. As a result, the solids in concrete begin to degrade, and the concrete becomes weakened. If the pH falls below the stability limits of cement hydrates, the hydrate loses calcium and decomposes into amorphous hydrogel.

MIX	% Of SF	LOSS OF WEIGHT IN %	LOSS OF STRENGTH IN %
M1	TAP WATER	5.82	28.8
M2	TGW	5.88	25.9
M3	3%SF+TGW	5.68	27.7
M4	6%SF+TGW	5.79	26.8
M5	9%SF+TGW	5.98	29.8
M6	12%SF+TGW	6.56	32.9
M7	15%SF+TGW	7.25	38.7

Conclusion

The IS limit is met for the initial and final setting times of cement produced by mixing treated waste water. According to the findings, water treated for 6hrs has got better strength when compared to 4hrs. Also there is little difference in strength between concrete built using TGW and tap water containing up to 9% silica fume. Due to shrinkage and cracking, adding more admixture reduces the strength.. In some ways, concrete built with TGW can overcome water scarcity. Plain concrete is better suited to TGW-produced concrete. Also there is loss in strength of concrete in acid attack test when the mix is above 9 % of silica fume.

By using treated waste water in concrete, low-cost and environmentally friendly concrete can be produced. Nowadays, there is such a scarcity of water that other sources of water for concrete or the construction of building units are required .

References

1. R.T. Peche, Dr. S.S. Jamkar, Dr. P.S. Sadgir: ―Grey water- A Potential Source of Water for Construction‖ IOSR-JMCE, pp. 12-17
2. Abdul Razak B.H., Dr. D.L. Venkatesh Babu, ―Experimental Investigation on usage of grey water in Concrete production‖ IRJET (20145)
3. K.A. Olonade (2016). ―A Review of the effects of waste water on reinforced concrete structures in Nigeria‖ NIJOTECH, pp. 234- 241.
4. Ayoup M. Ghrair, et. al. (2018). ―Influence of grey water on physical and mechanical properties of mortar and concrete mixes‖ Ain Shams Engineering Journal 9, pp. 1549-1525
5. Akash Jaiswal, Dr. J N Vyas (2019). ―Study of the Effect of Curing with Fresh Water and Sewage Water on Structural Strength of Concrete- A Review‖ IJSRD.
6. Mr. Manjunatha. M, Mr. Dhanraj M R: ―An Experimental Study on Reuse of Treated Waste Water in Concrete – A Sustainable Approach‖ IJLERA, pp. 124-132
7. Prof. A. B. More, Prof. R.B. Ghodake, Himanshu. N. Nimbalkar, Pritam P. Chandake, Sagar P. Maniyar, Yogita D. Narute: ―Reuse of Treated Domestic Waste Water in Concrete - A Sustainable Approach‖ Indian Journal of Applied Research, ISSN- 2249-555X
8. Marcia Silva and Tarun R.Naik, "Sustainable use of resources-Recycling of Sewage treatment plant water in concrete", Second international conference on sustainable construction materials and Technologies, (2010)
9. G.L.Low, K.Y.Ng, W.L.Ng, C.T.Tam, R.B.W.Heng, " Use of Recycled cement based slurry water for making concrete", Journal of The Institution of Engineers, Malaysia, (2007)
10. Rickert.J and Grube.H, "Influence of recycled water from fresh concrete recycling systems on the properties of fresh and hardened concrete", VDZ, Concrete Technology Reports. Dusseldorf, Germany. (2003)
11. Chini. S.A and Mbwambo "Environmentally friendly solutions for the disposal of concrete wash water from ready mix concrete operations",in Proceedings of CIB W89 Beijing International Conference,(1996)
12. Cebeci.O.Z & Saatci.A.M, "Domestic sewage as mixing water in concrete", ACI Materials Journal, 86(5):503-5066
13. Marciasilva and Tarun naik "Sustainable use of esources-recyclig of sewage treatment plant water in concrete" 25 june 2014
14. IbrahimAl-Ghusain & Mohammed J Terro "Use of waste water for concrete mixing in Kuwait", Kuwait J.Sci.Eng.30 (1) 2003.
15. lishan lal jain, Ankit kumar and Abhinav kumar "Utilization of waste water to check strength parameters of concrete", volume-3 issue-7 july 2016.