International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072

A STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY USING GEOPOLYMER TAILING

NAVANEETH M[1], MADHU A[2], MANIKUMAR B R[3], NAGARAJA P R[4] AND SUNIL C L[5]

[1,2,3,4]UG Students, Dept. of Civil Engineering, DSCE College, Bengaluru, Karnataka, India
[5]Assistant Professor, Dept. of Civil Engineering, DSCE College, Bengaluru, Karnataka, India

---

Abstract - *Concrete is that the basic material in all the construction works and coarse aggregate constitutes nearly 60 to 70% of the combination but the procurement and therefore the generation of the natural coarse aggregate is being deficit day by day and that lead to the use of other alternative materials which are naturally available in India. Fly ash and IOT are the best suitable materials for replacement of natural aggregates because of the availability of these huge sources in all over India. Even though the iron ore tailing utilized in foreign country in the various construction industries, the Indian construction sector if lagging beyond to use in a concrete mixes because the lack of knowledge and the lack of literature. The more research is required during this regard, by this IOT are often sufficiently utilized within the various constructions in India. The Iron ore tailing is procured for the KIOCL, kudremukh wherein the large amount of IOT is available as a waste. And it is checked for the effective use of IOT in concrete as a replacement as a fine aggregate with the replacement of 20%, 40%, 60%, 80% and 100%. This study is taken up to determine the variation of various properties of strength and mainly durability of concrete made by the geopolymer coarse aggregate for M30 grade of concrete. Geopolymer coarse aggregates are prepared by using IOT, flyash and alkaline activator of variable molarity. XRD and SEM analysis is preferred for determination of physical and chemical properties. The cubes are casted with different morality of alkaline activator solution as 8M, 10M, 12M, 14M. And the compressive strength should be determined to seek out the optimum molarity of Alkaline activator solution and then the cubes are crushed to supply the coarse aggregates.*

Key Words: Concrete, Iron ore tailing, Fly ash, Coarse aggregates, Alkaline activator.

1. INTRODUCTION

In recent years, steel production has increased significantly to meet the construction industry demands. This has resulted in the generation of huge amount of iron ore tailings (IOT) which are disposed of as waste in landfills, quarries, etc. India produces millions of tons of IOT. A statistical survey showed that India produces about 210 million tons of IOT in 2017-2018. These tailings pose serious environmental problems besides occupying large area of landfill sites. One way of disposing these IOT is to utilize them in construction industry where they would be recycled and reused to supply green and sustainable product. It might also save landfill space and reduce the extraction of natural raw materials.

India is one among the important iron ore producers and exporter within the world. However, the rapid climb in production, especially from large surface mines, have already caused ecological imbalance in their respective regions and emerge because the source of main environmental hazards. The waste/tailings that are ultra-fines or slimes, having diameter but 150 µm, aren't useful and hence are discarded. In India approximately 10–12 million tons of such mined ore is lost as tailings. The safe disposal or utilization of such vast mineral wealth within the form ultra-fines or slimes has remained a serious unsolved and challenging task for the Indian iron ore industry. Flyash is also the another largest waste producing in the country. Flyash as a geopolymer and sodium silicate and sodium hydroxide used with the required proportion for the synthesis of light weight aggregates. Using these aggregates the geopolymer concrete will be prepared for which compressive strength, split tensile strength and flexural strength will be found out.

2. OBJECTIVES

1. To Characterize iron ore tailings and flyash for physical and chemical properties.
2. To identify the optimum molarity of alkaline activator and optimum mix for manufacture of geopolymer coarse aggregates as per test for coarse and fine aggregates specified in BIS code IS: 383-1970.
3. To compare the various basic properties of Geopolymer coarse aggregate with that of naturally available coarse aggregate.
4. To examine the various strength properties (for 28days) of geopolymer aggregates such as compressive strength, split tensile strength, and flexural strength.

3. LITERATURE

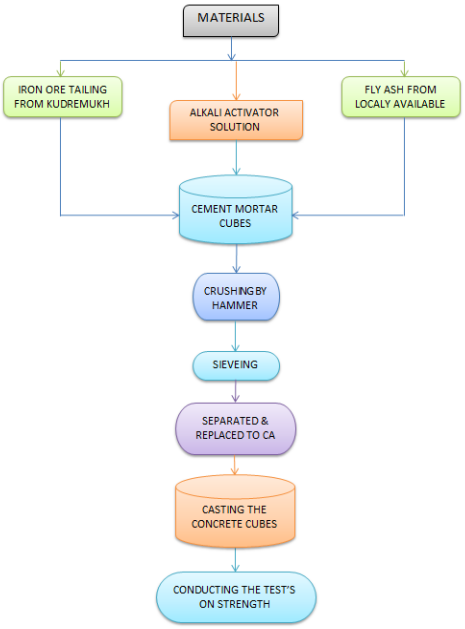
S.V Joshi and et.al (2012) Investigated and administered the study to understand the "Role of Alkaline Activator in Development of Eco-friendly FlyAsh Based Geo Polymer

Concrete". It is observed that compressive strength of geo-polymer concrete increases with increase in molar concentration. Substantial increase in 28 days average compressive strength is observed at 8M, 10M, &12M to 14M.

T. I. Ugama and et.al (2014) administered the study on "effect of iron ore tailing on the properties of concrete". And arrived at the results that workability reduced with increase in IOT percentage, the replacement of 20% sand by IOT has no much difference then the conventional concrete. Ali Umara shettima and et.al (2016) administered the study on "Evaluation of iron ore tailings as a replacement for fine aggregate in concrete" and met the result that addition of IOT increased the water demand and decreased the slump value. Thus the workability decreases with increase of IOT , characteristic compressive strength of concrete containing 25% of IOT is consistently more than the reference concrete at all the age.

B. P. Sharath and et al (2018) Investigated and administered the study on "sustainable utilization of iron ore tailing as the fine aggregates in fly ash based geopolymer mortar" and concluded that setting time has been reduced due to the use of iron ore tailing in the production of geopolymer mortar and the compressive strength of geopolymer mortar with the natural sand and the iron ore tailing is ranges from 2.9 to 4.9 Mpa and 3.47 to 8.27 Mpa respectively. P. Shubhananda Rao, and et al (2019) Investigated and administered study on "use of iron ore tailing in infrastructure projects" and concluded that the produced in iron ore processing are often utilized in brick making and use of pertile waste also showed that effective as a density controller.

3. METHODOLOGY



3.1 FLY ASH: The fly ash, annually million tons of fly ash produced all over the world and 9 million tons in India with 6500 acres of the land occupied for the disposal. Fly ash is a by product obtained in the combustion process of the coal in the electronic precipitator of the power plant. In coal the combustible elements like such as carbon and hydrogen and oxygen and Hydrocarbons and non-combustible minerals impurities of coal chemically recombines and fuse to provide crystalline molten ash in various stages in power plants of coal. Its grey in colour contains the spherical glassy fine particles rise with the flue gases.

3.2 IRON ORE RESOURCES IN INDIA: Most important ores in India are hematite and magnetite. About 79% hematite ore deposited in Eastern Sector (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) about 93% magnetite ore deposits found in Southern Sector (Andhra Pradesh, Goa, Karnataka, Kerala & Tamil Nadu). Karnataka contributes 72% of magnetite deposit in India. Between these, haematite is that the superior due to its higher grade.

Fig 1: Source of Iron Ore Tailings (Lakya Dam, Kudremukh,)

Indian deposits of haematite may belong to the series of Precambrian Iron Ore and therefore the ore is within banded ore formations occurring as, laminated, massive, friable and also in powdery form. India produces colossal volumes of mine waste annually, even now, around 1500 to 2000 million plenty of iron mineral tailings dumped at adjacent mining destinations. In this venture we have utilized Kudremukh ore which has put away IOT to the tune of 150 million tons in Lakya dam.

3.4 ALKALI ACTIVATOR SOLUTION:

3.4.1 Sodium Hydroxide (NaOH): Sodium hydroxide is an inorganic compound. A metallic base Alkali salts of Highly caustic white solid materials available in flake or granules pellets or and which are prepared as different concentration of solution.

Fig 2: Formation of geopolymer Coarse aggregate

3.4.2 Sodium Silicate (Na2SiO3) : Sodium silicate is named liquid glass or water glass. It's available in solid form and also in aqueous solution. It's white or colourless.

4. INFERENCES

IOT might be utilized in concrete as sand replacement which might minimize environment problems, cost and natural resources depletion. Concrete with IOT indicates good resistance to carbonation compared to control specimen [4].

As the IOT percentage increases workability of mix reduces hence for better workability needs use of super plasticizers is suggested [1].

As Compared to Natural coarse Aggregates, Non-natural Geopolymer coarse Aggregates have more water absorption. Hence during Concrete mix process, more quantity of water is required. Due to its flaky shape, geopolymer coarse aggregates have good workability than the workability of natural coarse aggregates [5].

REFERENCES

[1] Ali Umara Shettima , Mohd Warid Hussin, and et al, (2016) "Evaluation of iron ore tailings as replacement for finer aggregate in concrete", ELSERVIER , Construction and building Materials 120, Pg no. 72 – 79.

[2] B N Skanda Kumar, Subas R, and et al, (2014) "Utilization of iron ore tailing as the partial replacement for the fine aggregate in the construction of rigid pavements" International journal of research in engineering and technology, Volume: 3.

[3] Chang-long Wang,Wen Ni,Si-qi Zhang,Shuang Wang,Guo-sheng Gai and Wei-kang Wang, "Properties and Preparation of Autoclaved Aerated Concrete Using Coal Gangue and Iron Ore Tailings", Construction and building materials 104 (2016) 109-115.

[4] Chuansheng Xiong, Weihua Li, Linhua Jiang, Wei Wang and Qingxiang Guo, "Use of grounded iron ore tailings and BaCO3 to improve sulphate resistance of *pastes*" Construction and building materials 150 (2017) 66-76.

[5] K. J Osinubi , and et al, (2015) "Cement modification of tropical black clay using iron ore tailings as admixture". ELSERVIER, Transportation Geotechincs 5, Pg no. 35 – 49.

[6] P Shubhananda Rao, and et al, (2019) "use of iron ore tailing in Infrastructure projects" and International journal of Mining and Mineral Engineering, Volume: 10 No. 1 .

[7] T.I Ugama, S. P Ejeh, and D Y Amartey, (2014) "Effect of iron ore tailing on the properties of concrete".and International Institute for science, Technology and Education , Volume: 6 No. 10.

[8] Sunil C L, Bharath R B, and et al, (2020) "IOT Based on Geopolymer CA using fly ash as Precursor In the construction industry" , International Research Journal of Engineering and Technology , Volume: 7.

IS code book.

[1] IS 456-2000,"Indian Standard Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi 110002.

[2] IS 10262-2009, "Indian Standard Code for Guidelines of Concrete Mix Proportioning", Bureau of Indian Standards, New Delhi 110002.

[3] IS 2386 (Part 1) 1963, "Methods of Test for Aggregates for Concrete (PART 1) Particle Size and Shape", Bureau of Indian Standards, New Delhi 110002.

[4] IS 383-1970, "Specification for Coarse Aggregate and Fine Aggregates from Natural Sources for Concrete", Bureau of Indian Standards, New DelhI 110002.