iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

ENHANCING CONCRETE SUSTAINABILITY: ALCOFINE 1203 AS CEMENT REPLACEMENT AND STEEL SLAG AS COARSE AGGREGATE SUBSTITUTE

[1] J.Sree Naga Chaitanya, [2] Dr.K.Chandramouli, [3]Sk.Sahera, [4] Chilaka Praveen Kumar
[1&3] Assistant Professor, Department of Civil Engineering, NRI Institute of Technology, Visadala (V),Medikonduru(M),Guntur,AndhraPradesh,India. [2]Professor & HOD, Department of Civil Engineering, NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh, India.
[4]B.Tech Student, Department of Civil Engineering, NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh

ABSTRACT:-
Concrete, being the most widely utilized construction material, constantly demands innovations to improve its performance and sustainability. This study investigates the synergistic effects of incorporating steel slag and Alccofine 1203, a supplementary cementitious material, on the properties of concrete. Steel slag, a byproduct of steel manufacturing, is abundant and has shown promise as a partial replacement for conventional aggregates and cementitious materials in concrete production. Alccofine 1203, a high-reactivity metakaolin, has been recognized for its pozzolanic properties, contributing to the enhancement of concrete durability and strength. To determine the compressive strength and split tensile strength for 7 and 28 days.

Keywords:
Steel slag, Alccofine 1203, Pozzolanic properties, Compressive Strength and Split Tensile Strength.

1. INTRODUCTION

Concrete, as one of the most extensively used construction materials worldwide, continually undergoes refinement to enhance its properties and sustainability. The traditional production of concrete involves the extensive consumption of natural resources, primarily cement and aggregates, leading to environmental degradation and carbon emissions. In recent years, there has been growing interest in incorporating supplementary cementitious materials (SCMs) and alternative aggregates to mitigate these environmental impacts while improving concrete performance.

Alccofine 1203, a high-reactivity metakaolin, and steel slag, a byproduct of steel manufacturing, have emerged as promising candidates for partial replacement of cement and coarse aggregates, respectively, in concrete production. Alccofine 1203 exhibits pozzolanic properties, enhancing the reactivity of concrete mixtures and contributing to improved strength, durability, and workability. Steel slag, on the other hand, possesses similar physical and mechanical properties to conventional aggregates but offers the advantage of reducing the environmental footprint by repurposing industrial waste.

2. OBJECTIVES

(a) Determine if the addition of steel slag and Alccofine 1203 to concrete mixes affects the concrete's handling characteristics or construction schedules by assessing the concrete mixes' workability and setting times.
(b) Examine the effects on concrete's mechanical qualities, such as compressive strength and split tensile strength, of substituting steel slag for coarse aggregates and Alccofine 1203 for some of the cement.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

3. MATERIALS

1. Cement:- The primary ingredient in mortar, grout, and concrete, cement serves as a common binding factor in building. Clinker is often produced by burning a mixture of limestone, clay, shale, iron ore, and other materials at high temperatures in a kiln. Clinker is then pulverised into a fine powder.

2. Fine aggregate:- Sand, also known as fine aggregate, is a granular material composed of particles that typically have a diameter of 0.075 to 4.75 millimeters (mm). It is one of the primary constituents of mortar and concrete mixes, along with cement and coarse aggregate (such crushed stone or gravel).

3. Coarse aggregate:- Coarse aggregate is defined as granular materials with a typical size range of 4.75 mm to 75 mm in diameter; however, the maximum limit may vary depending on local regulations and needs. It is a main component in concrete, along with sand or fine aggregate and cement.

4.Alccofine 1203:- Alccofine 1203 is a specific brand name of metakaolin, which is a supplementary cementitious material (SCM) commonly used in concrete production. Metakaolin is derived from the calcination of kaolin clay at high temperatures, typically between 600°C and 800°C. This process results in the transformation of the clay into a highly reactive pozzolan with amorphous and highly reactive silica and alumina constituents.

5.Steel Slag:- Replacing coarse aggregate with steel slag in concrete is a sustainable practice that offers several potential benefits, including resource conservation, waste reduction, and improved durability.

6. Water:- Water plays a crucial role in concrete mixes, influencing the properties of the hardened material such as strength, durability, and workability. In order to create long-lasting and superior concrete constructions, it is essential to regulate the amount of cement to water and to apply appropriate mix design and curing techniques.

4. TEST RESULTS

(a) Compressive Strength: Compressive strength is the maximum load or force a material can withstand under compression (pressing or squeezing) before failing or breaking.. To determine for 7 and 28 days.

Table 1 : Compressive Strength Results on Concrete With Partial Replacement of Cement With Alccofine 1203.

Sl.no	% Alccofine 1203	Compressive Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	26.92	39.08
2	5%	29.94	42.87
3	10%	32.28	46.12
4	15%	29.28	43.51

Table 2: Compressive Strength Results on Concrete with Partial Replacement of Coarse Aggregate with Steel Slag.

Sl.no	% Steel Slag	Compressive Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	26.92	39.08
2	20%	30.04	43.01

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

3	40%	32.19	46.09
4	60%	29.18	42.39

Table 3: Combined Replacements of Compressive Strength Results on Concrete With Alccofine 1203 and steel slag

Sl.no	% of AF+ SS	Compressive Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	26.92	39.08
2	10 % AF+40% SS	34.68	49.56

Split Tensile Strength: Split tensile strength, or the material's resistance to tensile stresses and breaking, is an essential property of concrete. It is particularly significant in situations where it is anticipated that the concrete will be subjected to tensile forces. To determine for 7 and 28 days.

Table 4: Split Tensile Strength Results on Concrete With Partial Replacement of Cement With Alccofine 1203.

Sl.no	% Alccofine 1203	Split Tensile Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	2.74	3.92
2	5%	2.96	4.25
3	10%	3.18	4.56
4	15%	2.89	4.37

Table 5: Split Tensile Strength Results on Concrete with Partial Replacement of Coarse Aggregate with Steel Slag.

Sl.no	% Steel Slag	Split Tensile Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	2.74	3.92
2	20%	3.01	4.29
3	40%	3.22	4.58
4	60%	2.85	4.26

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

Table 6: Combined Replacements of Split Tensile Strength Results on Concrete with Alccofine 1203 and steel slag

Sl.no	% of AF+ SS	Split Tensile Strength Results,(N/mm^2)	
		7 days	28 days
1	0%	2.74	3.92
2	10 % AF+40% SS	3.41	4.87

5. CONCLUSIONS

1. The Normal Concrete of Compressive Strength results for 7 and 28 days is 26.92 and 39.08 N/mm^2.
2. The Normal Concrete of Split tensile Strength results for 7 and 28 days is 2.74 and 3.92 N/mm^2.
3. By 10% of Alccofine 1203 as partial replacement with cement the Compressive Strength results for 7 and 28 days is 32.28 and 46.12 N/mm^2.
4. By 10% of Alccofine as partial replacement with cement the Split tensile Strength results for 7 and 28 days is 3.18 and 4.56 N/mm^2.
5. By 40% of Steel slag as partial replacement with coarse aggregate the Compressive Strength results for 7 and 28 days is 32.19 and 46.09 N/mm^2.
6. By 40% of Steel slag as partial replacement with coarse aggregate the Split tensile Strength results for 7 and 28 days is 3.22 and 4.58 N/mm^2
7. By the combination of 10% of Alccofine +40% of Steel slag on concrete the Compressive Strength results for 7 and 28 days is 34.68 and 49.56 N/mm^2.
8. By the combination of 10% of Alccofine +40% of Steel slag on concrete the Split tensile Strength results for 7 and 28 days is 3.41 and 4.87 N/mm^2.

6.REFERENCES

1.Balamuralikrishnan R.*, Saravanan J.Effect of Addition of Alccofine on the Compressive Strength of Cement Mortar Cubes, Emerging Science Journal,5(2),(2021),155-170.

2. Dr.K.Chandramouli,J.Sree Naga Chaitanya,Dr.N.Pannirselvam, Ultra High Strength Concrete by Using Alccofine (1203),9(8),(2021),b41-b44.

3. T. C. Niu, "High Performance Concrete with Alcofine 1203," in Advanced Concrete Technology, John Wiley & Sons, Inc., 2003.

4. Experimental studies on concrete by partial replacement of cement with flyash"Dr.K.ChandramouliISSN: 2348 – 8352, SSRG International Journal of Civil Engineering (SSRG - IJCE)– Special Issue ICITSET Sep 2018.

5. D. Jiang and H. Yang, "Effect of Alcofine 1203 on Properties of Cement-based Material," Advanced Materials Research, vol. 689, pp. 191-196, 2013.

6. Chandramouli,K, Pannirselvam,N, Vijayakumar,D, (2018), A Review on Programmable Cement, International Journal of Current Advanced Research, 7(11), pp. 16302-03.

7. S. Zemskov, "Alcofine 1203 in Concrete," Cement, vol. 3, no. 25, pp. 46-52, 2008.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

8. Dr. K.Chandramouli,J. Sree Naga Chaitanya, Dr.N.Pannirselvam, Experimental Study on Papercrete Concrete, 8(7),(2021),367-371.
9. Y. Dong, "Utilization of steel slag in concrete as coarse aggregate," Materials and Structures, vol. 48, no. 1-2, pp. 129-136, 2015.
10. Chandramouli K, Pannirselvam N, Anitha V, Vijayakumar D (2019), Dynamic Young's Modulus of Elasticity of Banana Fiber Concrete with Nano Silica, International Journal of Civil Engineering and Technology, 10(1), pp. 3018- 3026.
11. M. Zhu, "Effect of steel slag as a coarse aggregate on properties of sulfur concrete," Journal of Cleaner Production, vol. 219, pp. 10-20, 2019.
12. Patel, P.J., H.S. Patel. "Effect on Compressive and Flexural Strength of High - Performance Concrete Incorporating Alccofine and Fly ash". International journal of Civil, Structural, Environmental and Infrastructure Engineering 3, no. 4 (April 2013): 109-113.
13. Parveen, Dhirendra Singhal, M. Talha Junaid, Bharat Bhushan Jindal, and Ankur Mehta. "Mechanical and Microstructural Properties of Fly Ash Based Geopolymer Concrete Incorporating Alccofine at Ambient Curing." Construction and Building Materials 180 (August 2018): 298–307. doi:10.1016/j.conbuildmat.2018.05.286.
14. Dr. K.Chandramouli, J. Sree Naga Chaitanya, Dr.N.Pannirselvam, Strength Behaviour of Geopolymer Concrete byUsing Different Mineral Admixtures, 8(8),(2021),a951-a954.
15. A. Y. Chouhan et al., "Performance of Alcofine 1203 blended concrete," International Journal of Engineering Research & Technology, vol. 3, no. 2, pp. 1-6, 2014.