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A STUDY ON SELF CURING CONCRETE USING SODIUM LIGNOSULPHONATE BY PARTIALLY REPLACING CEMENT WITH GGBS

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Abstract – *Self curing concrete is designed to maintain adequate moisture within the concrete mix and to cure itself without the need for external water curing. And also aid to ensure proper hydration and strength development. Sodium lignosulphonate can be used as water reducing agent, helping to maintain a consistent moisture level within the concrete. sodium lignosulphonate act as plasticizer and improves the workability of concrete mix. This leading to a more homogeneous mixture, which can contribute to better moisture distribution throughout the concrete mix. Thus it doesn't require additional water for curing. This self curing agent has water retaining property and allow the concrete to self cure over time. In this experimental study cement has been partially replaced with GGBS. By using GGBS ensures resource conservation, reduces carbon emission, enhances workability and reduces heat of hydration. Incorporation of GGBS makes the concrete more sustainable and contributing to a greener construction industry. The aim of this investigation is to study the strength of concrete using Sodium Lignosulphonate (NaLS) as self-curing agent. In this study, compressive strength, split tensile strength and flexural strength of concrete containing self-curing agent is investigated and compared with those of conventionally cured concrete. Self-curing agent NaLS (0.5%, 1%, and 1.5%) were added and also cement has been partially replaced with 10% of GGBS. Their strength properties were studied and compared with control mix.*

Key Words: **Self curing, Compressive strength, Split tensile strength, Flexural strength, GGBS, Sodium Lignosulphonate**

1.INTRODUCTION

Curing of concrete is the process of maintaining adequate moisture content and temperature in concrete. This is done to ensure proper hydration and strength development. If curing is not provided at the right time, this may lead to shrinkage of concrete and results in cracking, reduces durability and may not achieve desired properties for the concrete structure. Different methods of curing involve water curing, curing using chemical compounds, steam curing, membrane curing etc. Water curing is widely used method to cure the concrete. Construction requires huge amount of water for their work and large amount of water is wasted. But availability of water may not be assured in every region. So water curing cannot be conducted in water deficit areas. In order to reduce this problem, self curing agents are used. By using self curing agents, reduces the excessive evaporation of water from the concrete and increases the water retention capacity. Thus it solves the problem of water deficiency for curing and it is an effective method for curing concrete. Thus save the amount of water used in construction industry.

2. MECHANISM OF SODIUM LIGNOSULPHONATE AS SELF CURING AGENT

NaLS is used as water-reducing and self curing agent in concrete, but it does not undergo a chemical reaction when added to the concrete mixture. The NaLS molecules have a negatively charged surface which allows them to adsorb onto the surface of cement particles, forming a protective layer around them. This layer prevents the particles from coming into contact with each other and forming large aggregates, which would increase the viscosity of the mixture. The NaLS can disperse in the water, forming electrostatic repulsion with the cement particles and reducing the attractive forces between them. This helps to keep the particles in a more fluid state, allowing the concrete to flow more easily into molds and forms. The addition of NaLS as a self curing agent in concrete works to modify the physical properties of the mixture. On hardened concrete NaLS reacts with the free lime (CaO) present in the concrete to form insoluble calcium lignosulphonate. This creates a barrier within the concrete that helps to retain moisture, which is essential for the continued curing of the concrete. NaLS can penetrate the surface of the concrete and helps to strengthen the bonds between the cement particles. This can lead to an increase in compressive strength and a reduction in the permeability of the concrete.

3. OBJECTIVE

- To study the mechanical properties of self -curing concrete using sodium lignosulphonate. (Compressive strength, split tensile strength, flexural strength).
- To find the optimum percentage of Sodium lignosulphonate.
- To develop a sustainable building material by partial replacement of cement with GGBS.

4. MATERIALS AND PROPERTIES

4.1 Cement

Ordinary Portland cement 53 grade is used. Conforming to IS 12269-1987.

Table 1: Physical properties of cement

Properties	Values
Specific gravity	3
Standard consistency	33%
Initial and Final setting time	45 min and 600 min
Compressive strength of cement mortar cube	53 N/mm^2

4.2 Fine aggregate

Aggregates that pass through 4.75 mm sieve is designated as Fine aggregate. Here M sand is adopted instead of river sand.

Table 2: Physical properties of fine aggregate

Properties	Values
Specific gravity	2.6
Water absorption	0.19%
Bulk density of compactly and loosely packed fine aggregate	1.68 Kg/l and 1.57 Kg/l
Percentage air void of compactly and loosely packed fine aggregate	37.7% and 41.85%

4.3 Coarse aggregate

Good quality aggregates with angular shape and 20 mm size are used.

Table 3: Physical properties of coarse aggregate

Properties	Values
Specific gravity	2.65
Water absorption	0.65%
Bulk density of compactly and loosely packed coarse aggregate	1.617 Kg/l and 1.50 Kg/l
Percentage air void of compactly and loosely packed coarse aggregate	42.25% and 46.21%

4.4 Sodium lignosulphonate

Sodium Lignosulphonate is a yellow brown color water soluble polymer. It is a byproduct of sulfite pulping process for paper. It is used as a water reducing agent in concrete structure.

Table 4: Physical properties of Sodium Lignosulphonate

Properties	Values
Specific gravity	1.25
Lignosulphonate	55%
Calcium and Magnesium	0.5%
Moisture	7%

4.5 Ground Granulated Blast Furnace Slag (GGBS)

GGBS is a co-product produced simultaneously with iron, molten blast furnace slag is cooled instantaneously by quenching in large volume of cold water to produce blast furnace slag.

Table 5: Physical properties of GGBS

Properties	Values
Color	White powder
Specific Gravity	2.94
Bulk density	1200 kg/m^3

4.6 Water

Water used for experiment was potable water conforming as per IS 456-2000.

5. TEST RESULTS

In this experiment both fresh and mechanical properties of specimen were carried out.

Note* :
M1 : Mix 1, Control mix [GGBS-0, NaLS -0]
M2 : Mix 2 [GGBS-10%, NaLS -0.5%]
M3 : Mix 3 [GGBS-10%, NaLS -1%]
M4 : Mix 4 [GGBS-10%, NaLS -1.5%]

5.1 Slump cone test

Fresh properties of concrete specimen were tested using slump cone and results were shown below.

Table 6: Fresh properties of concrete by slump cone test

Mix	Values (mm)
M1	25
M2	75
M3	150
M4	180

Fig.1: Graphical representation of slump values

5.2 Compressive strength test

The compressive force applied per unit area on the specimen is termed as compressive strength. Here both 7th and 28th day strength were conducted.

Table 7: Compressive strength of cubes at 7th and 28th day

Mix	Compressive strength at 7th day (N/mm²)	Compressive strength at 28th day (N/mm²)
M1	26	28.49
M2	13.33	25.81
M3	5.3	20.34
M4	1	14.3

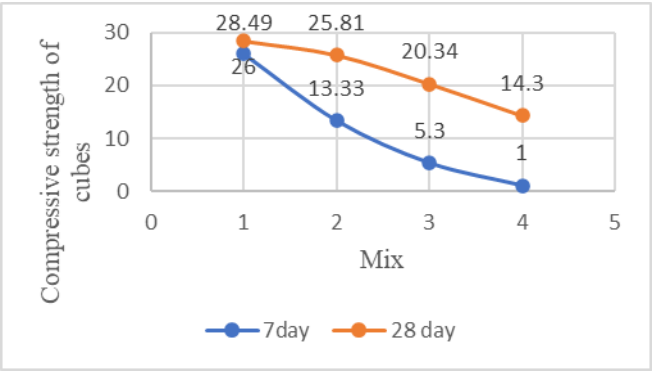

Fig.2: Graphical representation of compressive strength of cubes at 7th and 28th day test

5.3 Split tensile strength test

The tensile force applied per unit area on the specimen is termed as split tensile strength. Here 28th day strength was conducted.

Table 8: Split tensile strength of cylinder

Mix	28th day split tensile strength (N/mm²)
M1	2.52
M2	2.21
M3	1.83
M4	1.16

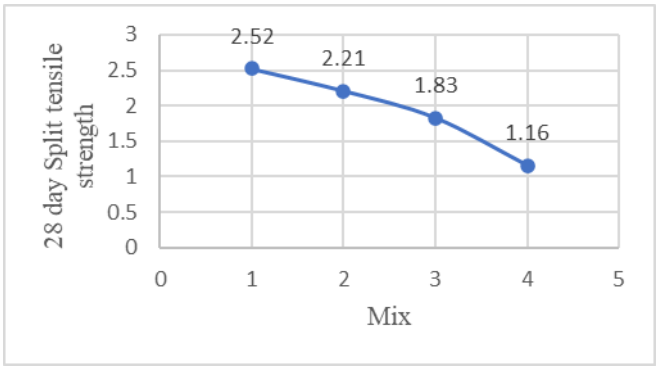

Fig.3: Graphical representation of split tensile strength of cylinder at 28th day

5.4 Flexural strength test

Flexural strength is the ability of the material to withstand bending forces applied perpendicular to its longitudinal axis. Here 28th day strength was conducted.

Table 9: Flexural strength of beams

Mix	28th day flexural strength (N/mm²)
M1	4.26
M2	3.83
M3	2.83
M4	1.34

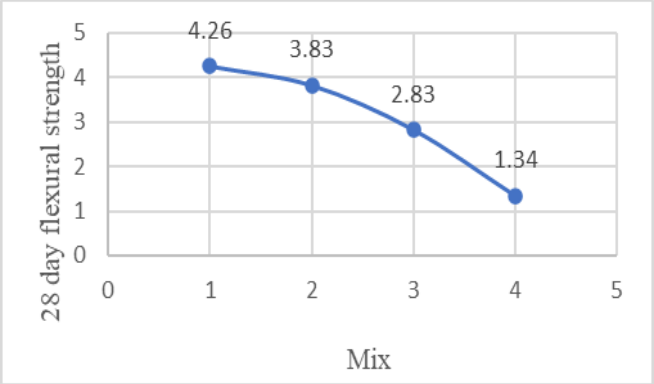

Fig.4: Graphical representation of flexural strength of beam at 28th day

6. CONCLUSION

In this project work, the effects of Sodium Lignosulphonate (NaLS) on the mechanical properties of concrete were studied. M25 mix is used and it is designed according to IS 10262:2009. The concrete specimens such as cubes, cylinders and beams were casted and tested for finding the strength of concrete for various percentage of NaLS. And also cement has been partially replaced with 10% of GGBS. Based on the investigation following conclusions are drawn.

• From the experimental work, it can be concluded that the slump value of self curing concrete increased with increase in percentage addition of NaLS. For 1.5% addition of NaLS, slump value is increased up to 86% compared to control mix. Hence it can be concluded that NaLS improves the workability of concrete.

• Compressive, split tensile and flexural strength were tested and the highest value were observed for the control mix. For the test specimen with NaLS, the strength was found to decrease with increase in percentage addition of NaLS. This may be due to the presence of lignin. Lignin can reduce the overall strength of the cured concrete, especially if it is used in higher concentrations. But mix M2 which is having 0.5% NaLS has achieved the required strength on self curing. Therefore it can be applied in low grade concrete and can be used in pavement purpose.

• Water availability maybe deficit in some areas which make curing almost impossible. So self curing can come as alternative method to overcome this problem.

• Adding GGBS ensures sustainability and reduces pollution.

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