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STEAM CURING DEVICE AND ITS ADVERSE EFFECTS ON CONCRETE

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ABSTRACT:

In view of One of the key ways civil engineers contribute to sustainability is by incorporating green technologies into their designs. This includes using renewable energy sources, such as wind and solar power, implementing water conservation measures, and minimizing waste production .it is imperative that mineral admixtures be used to replace cement in the concrete industry. This paper presents a laboratory study on the performance of steam cured concrete by adding mineral admixtures. Cubes, beams and cylinders are tested for its compressive strength, flexural stress and tensile strength after the completion of steam curing cycle of 12 hours. As compared to the ordinary cement concrete strength will be increased for concrete with the use of admixtures depending upon the conditions and type of use. Steam curing also aids in faster and safer construction Reduces the shear strength of concrete and Increases the speed of chemical reaction.

Keywords:*Sustainable development, Cement, Concrete.*

INTRODUCTION:

Concrete in construction is structural material consisting of a hard, chemically inert particulate substance, known as aggregate (usually sand and gravel), that is bonded together by cement and water.Among the ancient Assyrians and Babylonians, the bonding substance most often used was clay. The Egyptians developed a substance more closely resembling modern concrete by using lime and gypsumas binders. Lime (calcium oxide), derived from limestone, chalk, or (where available) oyster shells, continued to be the primary pozzolanicor cement-forming, agent until the early 1800s. In 1824 an English inventor, Joseph Aspdin, burned and ground together a mixture of limestone and clay. This mixture, called portland cemen, has remained the dominant cementing agent used in concrete production.

It is well known heterogeneous mix of cement, water, coarse aggregate and water. Portland cement production is one of the major reasons for CO2 emissions into atmosphere. It is due to the use of fossil fuels, including the fuels required to generate electricity during cement manufacturing process. The typical concrete mix is made up of roughly 10% cement, 20% air and water, 30% sand, and 40% gravel. This is called the 10-20-30-40 Rule– though proportions may vary depending on the type of cement and other factors.

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Fig1: Concreating

Steam Curingis done by increasing the temperature of concrete in wet conditions. This method allows the concrete to achieve its full strength within a short time; thus, curing is also finished within a short time. Steam curing is mostly adopted for the production of precast members.

The material to be dried is introduced to the superheated steam atmosphere where it is supplied convectively with heat and its moisture evaporates. Through the uptake of vapor released from the material, the volume of superheated steam increases, while its temperature decreases without changing the state to saturated steam. As superheated steam is recirculated and reheated in a closed loop to elevate the temperature to the desired level, evaporated mositure becomes excess steam and is carried off along with volatile compounds from the drying chamber. Generally the working temperature of superheated steam drying is 110 to 250 °C, but this can be increased.

STEAM CURING PROCESSES:

The steam curing process typically involves the following steps:

1. Preparation: Before steam curing can begin, the material to be cured needs to be properly prepared. This may involve removing any surface contaminants, ensuring proper moisture content, and applyingany necessary coatings or treatments.
2. Enclosure: The material is then placed inside an enclosure or chamber that is capable of containing the steam. This can be a specially designed curing room, a tent-like structure, or even a plastic sheeting enclosure.

3. Steam generation: Steam is generated using a boiler or other steam-generating equipment. The steam is then introduced into the enclosure, creating a high-humidity environment around the material.

4. Temperature control: The temperature inside the enclosure is carefully controlled to ensure optimal curing conditions. This may involve adjusting the steam flow rate, monitoring the

temperature using sensors, and making any necessary adjustments to maintain the desired temperature range.

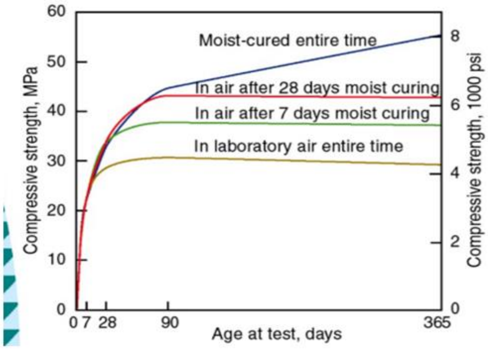
5. Curing time: The material is subjected to steam curing for a specific period of time, which can vary depending on factors such as the type of material being cured and its thickness. During this time, the steam penetrates into the material, accelerating the chemical reactions that lead to hardening and strengthening.

6.Cooling: After the desired curing time has elapsed, the steam is gradually removed from the enclosure, allowing the material to cool down. This cooling phase is important to prevent thermal shock and ensure uniform curing throughout the material

Fig 2:Steam Curing Chamber

OBJECTIVES:

Curing is the process of maintaining satisfactory temperature and moisture conditions in concrete long enough for hydration to develop the desired concrete properties. The potential strength and durability of concrete will be fully developed only if concrete is properly cured.



EQUIPMENTS USED:

1.COMPRESSOR: A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor.Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. The main distinction is that the focus of a compressor is to change the density or volume of the fluid, which is mostly only achievable on gases.

Gases are compressible, while liquids are relatively incompressible, so compressors are rarely used for liquids. The main action of a pump is to pressurize and transport liquids.

2.Thermostat:A thermostat is a regulating device component which senses the temperature of a physical system and performs actions so that the system's temperature is maintained near a desired setpoint.Thermostats are used in any device or system that heats or cools to a setpoint temperature. Examples include building heating, central heating, air conditioners, HVAC systems, water heaters, as well as kitchen equipment including ovens and refrigerators and medical and scientific incubators.

3.Immersion rod: Once plugged into the power source, the heating coil starts to warm up, transferring the heat to the water. The heating elements of the rod convert the electrical energy into heat and pass it on to the water. This ensures steaming hot water, ready for any purpose.

4. EXPERIMENTAL PROCEDURE

- Preparation of design mix of M30 grade using relevant details.
- The mix proportion arrived is 1:1.6:2.7 (C: FA: CA) with a water cement ratio of 0.44.
- Preparation of different concrete mix using fly as, GGBS, metakaolin, silica fume and rice husk ash as a partial replacement of 20%, 30%, 9%, 10% & 7% by weight of cement with a mix designations RA1, RA2, RA3, RA4, RA5 and RA6 respectively. The specimens are cast for compressive, flexural and split tensile test.
- The specimens are cured in steam chamber for 22:30 hours as per the steam cycle.
- 3hrs pre-streaming stage at temperature of¬ 40:C.
- 5:30hrs heating stage at rising temperature¬ of 40: to 60:C.
- 6hrs thermostatic stage at constant¬ temperature of 60:C.
- 8hrs cooling stage at temperature of 60:C¬ to 40:C.

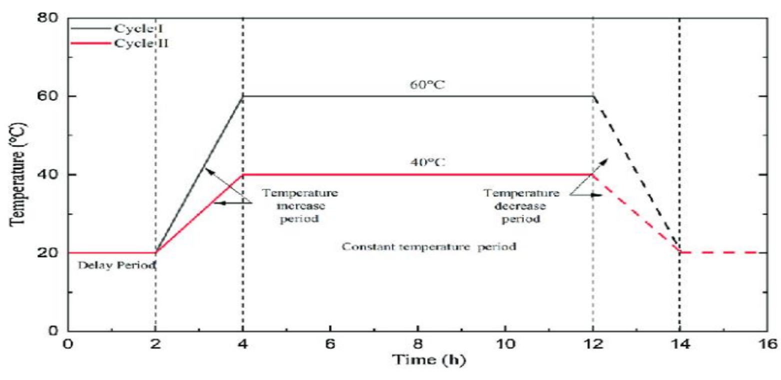


Fig3: Steam curing cycle

CONCLUSIONS:

Based on experimental observations, following conclusions can be drawn:

1.Steam curing also aids in faster and safer construction as sufficient strength attained in short period.

2. As compared to pure cement concrete mix, the material strength will be increases for concrete mix with mineral admixtures like fly ash, GGBS, metakaolin, silica fume.

3. Among them concrete with metakaolin gives more strength.

4. The concrete with a rice husk ash having less strength as compared to pure cement concrete.

5. As far as cost is concerned, the cost of mineral admixtures in the market is less than the OPC.

Table 1: Workability of concrete results

Mix Designation	Slump (mm)	Compaction Factor
R1	50	0.83
R2	32	0.90
R3	28	0.90
R4	25	0.90
R5	30	0.91
R6	80	0.90

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