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Experimental Study on Concrete Infused with Carbon Dioxide

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ABSTRACT: On average, each year, three tons of concrete are consumed by every person on the planet. In India, the cement sector is one of the prominent contributors to conventional as well as GHG emissions. It is estimated that 5% of the world's annual CO₂ emissions are attributable to cement production.

In year 2017 cement production reached almost 280 million metric tons. Technologies to produce sustainable and greener concrete are required to be developed. One way to achieve green concrete is to reduce cement content in concrete.

KEYWORDS: GHG Emissions, CO₂ Emissions, Carbon Emissions.

I. INTRODUCTION

Though Concrete (cement) is the most widely used building material in the world. But it is also responsible for roughly 7% of the world's greenhouse gas (GHG) emissions, making it the second largest industrial emitter behind coal. On average, each year, three tons of concrete are consumed by every person on the planet. In India, the cement sector is one of the prominent contributors to conventional as well as GHG emissions. Carbon dioxide emissions are recognized as a significant issue relating to cement production and the use of concrete as a building material. It is estimated that 5% of the world's annual CO₂ emissions are attributable to cement production.

In year 2017 cement production reached almost 280 million metric tons. Technologies to produce sustainable and greener concrete are required to be developed. One way to achieve green concrete is to reduce cement content in concrete.

II. RELATED WORK

CO₂ Infused concrete

CO₂ is the primary GHG emitted through human activities, which substantially contributes to environmental pollution. CO₂ Capture and Storage (CCS) is one of the options to mitigate GHG emissions to the atmosphere.

- 1) $3\text{CaO} \cdot \text{SiO}_2 + (3-x) \text{CO}_2 + y\text{H}_2\text{O} \rightarrow x\text{CaO} \cdot \text{SiO}_3 \cdot y\text{H}_2\text{O} + (3-x) \text{CaCO}_3$
- 2) $2\text{CaO} \cdot \text{SiO}_2 + (2-x) \text{CO}_2 + y\text{H}_2\text{O} \rightarrow x\text{CaO} \cdot \text{SiO}_3 \cdot y\text{H}_2\text{O} + (2-x) \text{CaCO}_3$
- 3) $\text{Ca}(\text{OH})_2 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CaCO}_3 + 2\text{H}_2\text{O}$ Weathering carbonation
- 1) $\text{Ca}(\text{OH})_2 + \text{H}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + 2\text{H}_2\text{O}$
- 2) $\text{H}_2\text{CO}_3 + \text{CaO} \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
- 3) $\text{C}_3\text{S} + 3\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C-S-H} + 3\text{CaCO}_3 + 347 \text{ kJ/mol}$
- 4) $\text{C}_2\text{S} + 2\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C-S-H} + 2\text{CaCO}_3 + 184 \text{ kJ/mol}$

III. METHODOLOGY

Carbon dioxide (CO₂) gas is sourced from the smokestacks of industrial emitters. Carbon Cure's proprietary delivery system precisely injects the CO₂ into the concrete mix. The CO₂ is chemically converted into solid calcium carbonate, which is permanently embedded within the concrete. When the concrete structure is demolished and pulverized, the gas will not escape –because it no longer exists. The technology may be used to increase the compressive strength

performance of a concrete mix. The strength improvement can then be leveraged in the optimization of the mix design for a specific end goal, such as early age strength, 28-day strength or binder efficiency. This is a technology that has been demonstrated at three large concrete plants, in Halifax, San Francisco and Toronto and blocks are installed in a growing number of buildings, including in Halifax at a new high school and on the Dalhousie University campus. However, this technology is not yet implemented in our country.

IV. EXPERIMENTAL RESULTS

○ **Acceleration in setting time:**

As CO₂ infusion in concrete increase early reaction with cement compounds which leads to early setting of concrete.

○ **Increase in compressive Strength:**

Initial carbonation process in concrete leads to formation calcium silicate gel, helps to fill pores in concrete and is responsible for increase in strength.

○ **Cost effective technique:**

As emission of CO₂ leads to increase in strength, therefore we can reduce the cement content for the same strength of concrete.

○ **Reduction in permeability:**

As pore spaces get filled throughout the concrete, so there is no scope of pore space.

V. CONCLUSION

It is beneficial for the environment, and it has a great scope in infrastructure industry. The degradation of the industrial waste will reduce and became a useful infrastructure material. It saves natural resources.

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