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Experimental Investigation on Carbon Dioxide Absorbing Paver Blocks

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***Abstract*—**Global warming is caused due to the emission of greenhouse gases such as carbon dioxide, methane, nitrous oxide. 72% of totally emitted greenhouse gases are CO_2. Carbon dioxide emission is the most important causes of global warming, most of the CO_2 has been released from the vehicles. To control this CO_2, absorbing a paver block was made by using various materials such as lime, potassium hydroxide, seaweeds, and potato peels in various proportions in M35 grade concrete and the absorption test were done by two methods such as carbonation and titration. The compressive strength is also tested for 7 days and 28 days. The experimental work has been carried out and the results obtained are presented and discussed in this report.

Keywords: Lime, Potassium hydroxide, Seaweeds, Potatopeel.

I. INTRODUCTION

The CO_2 concentration in the atmosphere is drastically increasing which leads to the serious effects of global warming as India is the second populated country the usage of transportation is high, which leads to the emission of CO_2 in the large amount. To control this CO_2 absorbing paver block has been made by using various materials such as lime, potassium hydroxides, seaweeds and potato peels in M35 concrete. Potassium hydroxide absorbs the excess CO_2 from the atmosphere, seaweeds acts as excellent heat insulation and fully biodegradable, potato peal act as an adhesive and binding material. Here the compressive strength of the paver block is studied

A) OBJECTIVE

The emission of CO_2 has been dramatically increased within the last 50 years and still increasing by almost 3% each year. The main aim of this project is listed below

- To check the CO_2 absorbing capacity of various materials that are replaced by cement.
- To suggest the effective material that absorbs CO_2 in the pavement where the vehicle flow is maximum.
- To evaluate the compressive strength of various types of paver blocks replaced by cement.

B) MATERIALS USED

Cement: Ordinary Portland Cement and Portland Pozzolana Cement are the two most common types of cement used in construction industries. For this project OPC53- grade cement is used.

Table 1.1 Cement properties

Properties	Result
Initial setting time	30 minutes
Final setting time	10 hours
Fineness modulus	5%
Consistency	33%
Specific gravity	3.15

Fine aggregate: Fine aggregate consists of natural sand, crushed stone sand, and crushed gravel stone dust. It should be passing through the IS 4.75mm size. For this study river sand is used.

Table 1.2 Sand properties

Properties	Result
Grading of sand	Zone II
Fineness modulus	5.34%
Specific gravity	2.67
Water absorption	0.8%

Coarse aggregate: Locally available crushed granite coarse aggregates are used in this project, having the maximum size of 10mm and it should be of hard, free from dust, dirt and other foreign matters.

Table 1.3 Coarse aggregate properties

Properties	Result
Specific gravity	2.88
Impact value	30.08%
Crushing value	40.71%
Water absorption	4.38%

Lime: Calcium oxide, commonly known as quick lime or burnt lime is a widely used chemical compound. It is a white, caustic and alkaline in nature and soluble in water, glycerol.

Table 1.4 Lime properties

Properties	Result
Chemical formula	Cao
Melting point	2572^0C
Density	3.35g/cm³

Potassium hydroxide: Potassium hydroxide is almost interchangeable and it can irritant when exposure to high levels. It is extremely corrosive and it absorbs excess CO_2 from the atmosphere.

Table 1.5 Potassium hydroxide properties

Properties	Result
Chemical formula	KOH
Boiling point	1327^0C
Density	2.12g/cm³

Seaweeds: Seaweeds is a purely natural material that offers numerous advantages such as an excellent heat insulator and heat capacity characteristics as well as fully biodegradable and strong carbon dioxide fixation.

Potato peels: It is an excellent source of potassium and used in making adhesive as well as binding material.

Water : In this experimental work, potable water is used for casting and curing of specimens. The pH value for the water used should not be greater than 6.

II. LITERATURE REVIEW

Prathikkulkarn and Dr. A. Muthadi (2017) made a review on seaweed as an integral curing agent and strengthening in concrete. studies have been done on seaweed since 0 years in different area such as food, cosmetics, construction industry. Studies done on concrete were mostly focusing on increasing the strength of concrete and use of seaweed as a internal curing agent. The compressive strength was increased due to use of seaweeds as a internal curing agent.

Michael North, James Clark (2016) this paper says about the CO_2 capturing can be achieved using waste derived materials. The material made from potato peels and seaweed are as much as 65% more efficient at absorbing CO_2 emitted from industrial sites than other currently used methods, having in mind this compound can be made from potato peals and seaweeds, this discovery opens the door for extremely environmentally friendly and efficient CO_2 cleaning solutions for power stations or chemical plants

III. EXPERIMENTAL INVESTIGATION

M35 grade of concrete is designed in accordance with the guidelines of code book IS 10262:2019 with replacement of cement by lime, potassium hydroxide, seaweeds and the combination of seaweeds with potato peels. The mix proportion obtained is 1: 2.28: 2.32 (C: FA: CA) with water cement ratio of 0.41. Lime, potassium hydroxide, seaweeds and the combination of seaweeds with potato peels are added at two different proportions of having 0.5% and 5% by replacement of cement. The paver blocks are casted and cured in water for 7 and 28 days. After curing, the specimens are tested for their respective requirements.

IV. RESULTS AND DISCUSSION

A) CO_2 ABSORPTION TEST ON PAVER BLOCK

i) Carbonation depth using phenolphthalein indicator:

Table 4.1 and Fig 4.1, Fig 4.2 shows the details of carbonation depth of various paver blocks at 7 and 28 days.

Table 4.1 Carbonation depth

Days	Carbonation depth								
	CS	Lime (%)		KOH (%)		S & P (%)		Seaweeds (%)	
		0.5	5	0.5	5	0.5	5	0.5	5
7^{th} day	0	0	0.2	0.4	0.5	0.5	0.6	0	0
28^{th} day	0	0.8	0.9	1.5	1.2	1.6	1.9	1.1	0.8

ii) Titration method test:

The amount of CO_2 absorbed was calculated using titration method for each type of paver block casted and it was found that the CO_2 absorbing capacity was varied for various blocks. Table 4.2 shows the details of carbonation depth of various paver blocks at 7 and 28 days.

Table 4.2 Titration method

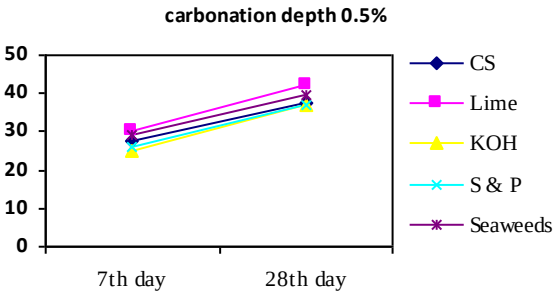
Type	Initial CO_2 (g)	Final CO_2 (g)		Amount of CO_2 absorbed (g)	
		0.5%	5%	0.5%	5%
CS	44	44		0	
Lime	44	43.3	43.2	0.7	0.8
KOH	44	43.1	43.4	0.9	0.6
S & P	44	42.78	42.4	1.22	1.6
Seaweeds	44	43.2	43.1	0.8	0.9

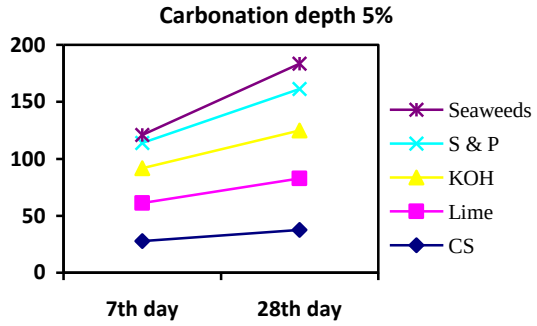
B) COMPRESSION TEST ON PAVER BLOCK

The paver blocks were tested on compression testing machine. Then the load is applied continuously at a constant rate until the specimen fails. The maximum load applied on the specimens were recorded. The compressive strength for 7 and 28 days were compared and tabulated below.

Table 4.3 Compressive strength

Name	Compressive strength at 7 days (N/mm^2)		Compressive strength at 28 days (N/mm^2)	
	0.5%	5%	0.5%	5%
CS	27.66		37.55	
Lime	30.30	33.53	42	45.20
KOH	25	30.50	36.90	42.20
S & P	26	22.22	37	36.45
Seaweeds	29.20	7.09	39.60	22





V. CONCLUSION

From the test result it has concluded that the following,

- Compared with other types of replaced paver blocks, the specimen having 5% of seaweeds and potato peel combination by the weight of cement will absorb more CO_2 .
- Compressive strength of above type of paver block was also more or less equal to that of conventional specimen.
- High compressive strength of paver block is attained in a specimen which has 5% of lime by weight of cement.
- When seaweeds added in 0.5% weight of cement, it's compressive strength is more or less equal to the conventional block. But added 5% weight of cement, it's compressive strength is nearly less.
- Seaweeds and potato peel combination paver block (5% weight of cement) absorb 1.6 g of CO_2 in one day.

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