CO_2 Absorbing Concrete Block

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ABSTRACT: In order to serious climate change, deep reduction in CO_2 emission will be required in coming decades.CO_2 absorption is one of the key technology to control the global warming. Global warming is caused by sharply increased greenhouse gases emission by human activities. In building industry, CO_2 emission mainly come from cement production. Capturing of CO_2 from point source, from ambient air and reducing atmospheric CO_2 concentration by using Zeolite powder and Zeolite sand. Concrete with Zeolite as a supplement material can absorb large quantity of CO_2.Introducing Zeolite material into the concrete absorbs CO_2 from the atmosphere hence it will be eco-friendly. Absorb CO_2 and reduces the air pollution, Keep environment clean and full of oxygen.

Keywords: CO_2 emission, Green House, Zeolite.

1. INTRODUCTION

There are several construction techniques as well as construction materials used presently. Most of the materials used are detrimental to the environment which is cause of several calamities. This detrimental materials concludes cement, aggregate, sand and admixtures etc. Even now-a-days we are preceding constructions with advance construction materials like polymer rubbers as well as different sands etc. Though we use advance materials we are far away from dominating pollution intensity .That is only reason we are facing multitudinous problems. The most disastrous gas which gets emitted from construction is CO_2. CO_2which act as back bone of global warming as well as cause of several maladies expel from constructions. So many remedies have been implied as a material, instruments, etc. These materials include different types of polymers, purifying machines, refineries, etc. But still we are unable to reduce percentage emission of CO_2. As it is been found that obtuse quantity of CO_2 get expelled from construction; impeding it would definitely reduce total percentage of CO_2 emission. This emission should be stopped and CO_2 from the air must be diminished putting this as a main soul we are designing a concrete (which is main constituent of construction) by taking Zeolite as a rationale. This Zeolite substitute for fine aggregate and cement will consequently absorb the CO_2. Zeolite is manufactured in factories. This kind of material has property to absorb $CO_2$with incredible strength. Because of this nature this material can be substituted in place of aggregate. The Zeolite is available in powder as well as in fine aggregates form which can be used to replace sand and cement in concrete in planting the property to absorb CO_2 from the atmosphere. This type of material is easily available in market. As the material literally costly even here the replacement is made only upto certain extent so that this will be affordable. Deliberating all these problems and properties of this material we are making this CO_2absorbing cement.

2. MATERIALS AND METHODS

2.1 Test on zeolite

Aim- Preparation of Zeolite blocks for testing of strength
Material- Zeolite powder, Zeolite sand, Cement M53 Grade, Crushed sand, Aggregate(size 16 to 20mm),Weighing balance
Procedure:-

1. Take Water, Cement, Sand and aggregate in the proportion of 0.378:1:1.128:2.35.
2. Prepare 4 block of dimension 15x15x15 for testing of strength and durability.
3. Preparation should be in normal way just little difference is that 4 blocks of sand are prepared by substituting 20% of the sand with zeolite powder and subrogating 10% of the cement with zeolite powder.
4. While remaining 4 are prepared with 10% substitution of sand with zeolite sand ad 10% normal cement with zeolite powder.
5. Hence for such preparation amount of material taken is given below
6. Thereafter mix is prepared with these materials and fresh potable water is mixed.
7. The concrete is prepared by proper mixing and moulds are filled with it.
8. Thereafter these blocks are kept on vibrator for proper settling of concrete into moulds.
9. These blocks are then kept in water for curing up to 7 days.
10. After 7 days blocks are removed tested in compression testing machine.
11. Readings are taken on 7^{th}, 14^{th},21^{th} and on 28^{th} days.
12. Following observations are obtained

Observation Tables:

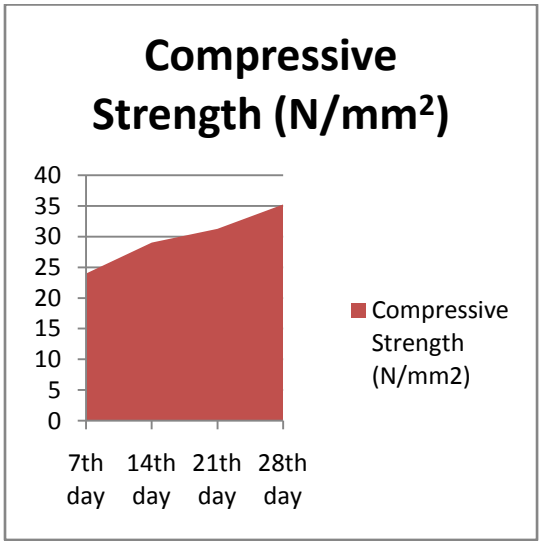
Table 1: 20% substitution by zeolite (10% sand+ 10% cement)

Block Number	Day of testing	Cross section of block(mm^2)	Maximum load (KN)	Compressive Strength (N/mm^2)
B1	7^{th} day	22500	539.884	23.99
B2	14^{th} day	22500	653.280	29.03
B3	21^{th} day	22500	703.489	31.266
B4	28^{th} day	22500	792.732	35.23

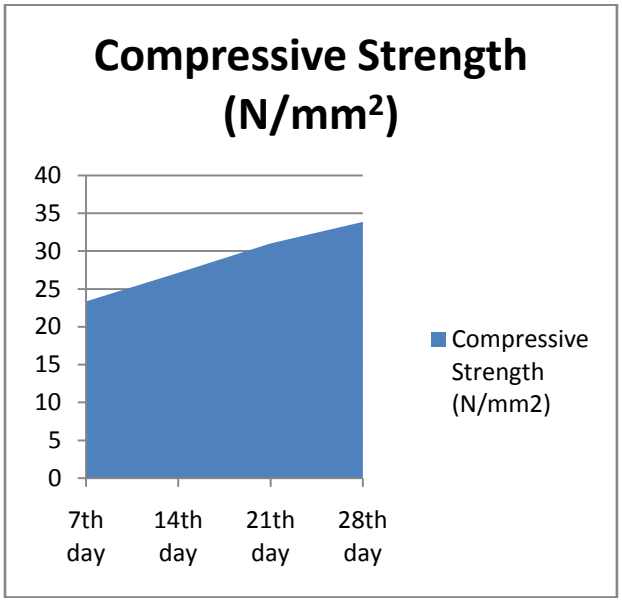
Table 2:30% substitution by zeolite (10% cement+20%sand)

Block Number	Day of testing	Cross section of block(mm^2)	Maximum load (KN)	Compressive Strength (N/mm^2)
B1	7^{th} day	22500	525.645	23.362
B2	14^{th} day	22500	610.689	27.14
B3	21^{th} day	22500	698.054	31.02
B4	28^{th} day	22500	761.965	33.865

Graphical Representation shown below elaborates more about Strength of zeolite block



Graph 1: Compressive strength of Zeolite Block (Replacement= 10% sand + 10% cement)



Graph 2: Compressive strength of Zeolite Block (Replacement 30% = 20% sand + 10% cement)

Result:
Compressive strength of concrete blocks made by zeolite substitution with cement and sand are

1. 20% Replacement (10% sand + 10% cement) = 35.23N/mm^2
2. 30% Replacement (20% sand + 10% cement) = 33.865N/mm^2

Conclusion:-
Blocks made by using Zeolite sand and powder as substitution have equivalent compressive strength as normal Portland cement concrete block.

2.2 Test on zeolite block (CO_2 absorption test)
Aim- Test of CO_2 Absorption by Zeolite concrete block
Apparatus- Weighing Balance, Moulds of Size 10x10x10 cm.
Procedure:-

1. Take Water, Cement, Sand and aggregate in the proportion of 0.378:1:1.128:2.35.
2. Prepare 4 block of dimension 10x10x10 cm for testing of CO_2 absorption by zeolite block.
3. Preparation should be in normal way just little difference is that 2 blocks of sand are prepared by substituting 20% of the sand with zeolite powder and subrogating 10% of the cement with zeolite powder.
4. One is prepared with 10% substitution of sand with zeolite sand ad 10% normal cement with zeolite powder.
5. Remaining one is prepared with normal Portland cement concrete.
6. Thereafter mix is prepared with these materials and fresh potable water is mixed.
7. The concrete is prepared by proper mixing and moulds are filled with it.
8. Thereafter these blocks are kept on vibrator for proper settling of concrete into moulds.
9. These blocks are then kept in water for curing up to 7 days.

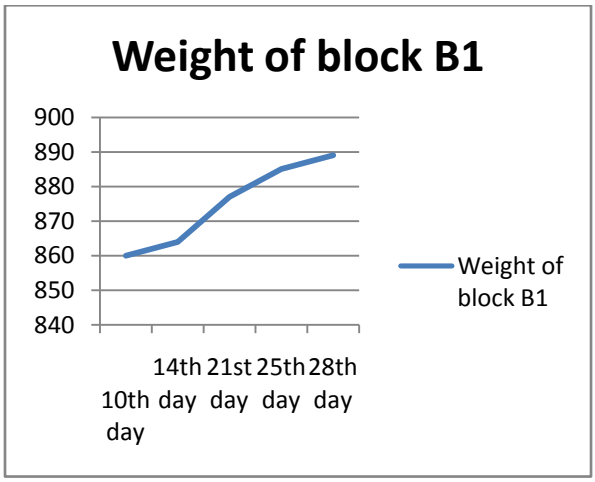
10. After 7 days weight of the blocks is taken.
11. Readings are taken on pre-planned days upto 28th day
12. Following observations are obtained

Observation Tables:

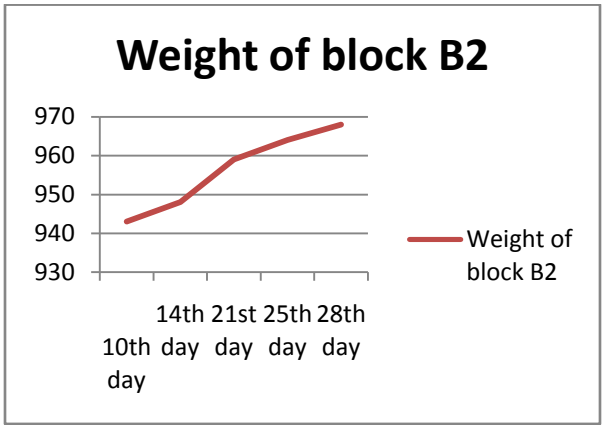
Table 3: Increase in weight of Zeolite block and decrease in weight of Normal block

	B1(30% Substitution)	B2(20% Substitution)	B3(30% substitution)	B4 (Normal Concrete Block)
Weight of block on 10th day(gm)	860	943	886	897
Weight of block on 14th day(gm)	864	948	894	890
Weight of Block on 21st day(gm)	877	959	908	875
Weight of block on 25th day(gm)	885	964	914	859
Weight of block on 28th day(gm)	889	968	917	852

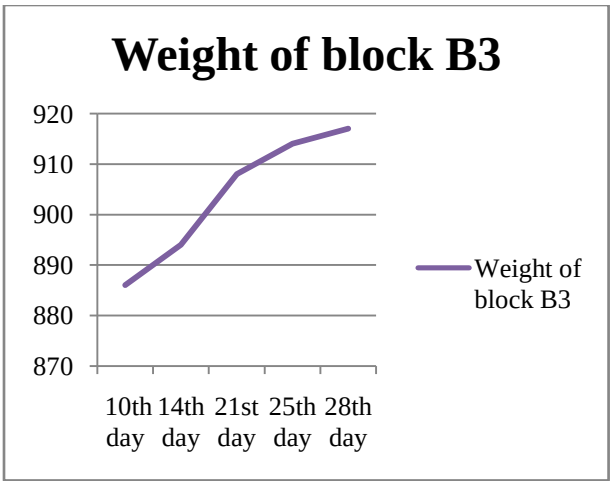
Graphical Representation of Increase in weight of every block due to absorption CO_2



Graph 3: Increase in weight of block B2



Graph 4: Increase in weight of block B2

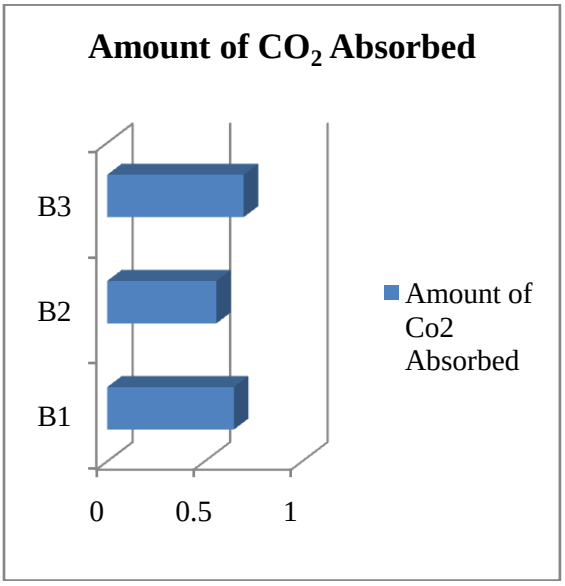


Graph 5: Increase in weight of block B3

Calculation:
Calculation of CO_2 absorbed by blocks= Final Weight – Initial weight/Molecular weight of CO_2
CO_2 absorbed by B1-889-860/44=29/44=0.65mole
CO_2 absorbed by B2=968-943/44=0.56mole
CO_2 absorbed by B3=917-886/44=0.70mole

Table 4: Amount of CO_2 Absorbed by each zeolite block

Block number	Amount of CO_2 Absorbed(Mole)
B1	0.65
B2	0.56
B3	0.70



Graph 6: CO_2 absorption by zeolite blocks

Average amount of CO_2 absorbed = 0.65+0.56+0.70/3 = 0.63
Result: CO_2 absorbed by blocks equal to 0.63 mole of CO_2

2.3. Test on Normal Block of Concrete

Aim: To determine the compressive strength of concrete specimens as per IS: 516 - 1959.
Apparatus: Compression Testing Machine
Age at test:
Tests should be done at recognized ages of the test specimens, usually being 7 and 28 days. The ages should be calculated from the time of the addition of water to the drying of ingredients.
Number of specimens:
At least three specimen-s, preferably from different batches, should be taken for testing at each selected age.
Procedure:

I. The specimens, prepared according to IS: 516 - 1959 and stored in water, should be tested immediately on removal from the water and while still in wet condition. Specimens when received dry should be kept in water for 24hrs. before they are taken for testing. The dimensions of the specimens, to the nearest 0.2mm and their weight should be noted before testing.
II. The bearing surfaces of the compression testing machine should be wiped clean and any loose sand or other material removed from the surfaces of the specimen, which would be in contact with the compression platens.
III. In the case of cubical specimen, the specimen should be placed in the machine in such a manner that the load could be applied to the opposite sides of the cubes, not to the top and the bottom. The axis of the specimen should be carefully aligned with the centre of thrust of the spherically seated platen. No packing should be used between the faces of the test specimen and the steel platen of the testing machine. As the spherically seated block is brought to rest on the specimen, the movable portion should be rotated gently by hand so that uniform seating is obtained.
IV. The load should be applied without shock and increased continuosly at a rate of approximately 140kg/sq.cm/minute until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen should then be recorded and the appearance of the concrete and any unusual features in the type of failure should be noted.

Observation and calculation:

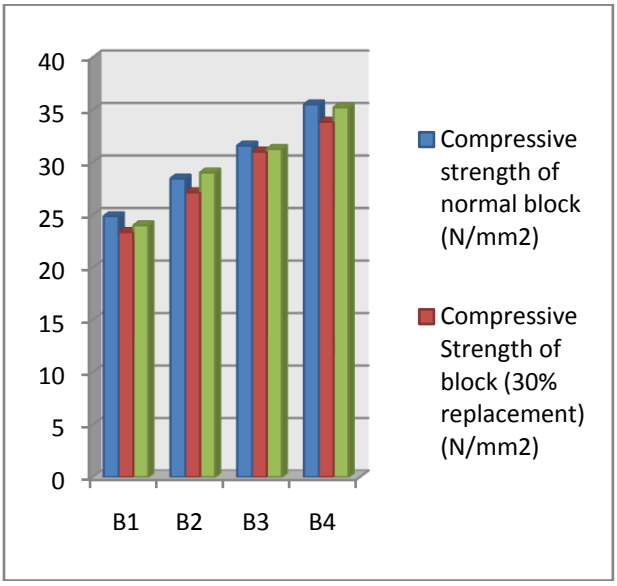
Table 6: Readings of Compressive strength of normal block

Sr. number	Cube	Age of cube in days	C/s area of cube (mm^2)	Maximum load (KN)	Compressive strength (N/mm^2)
1	B2	7	22500	559.350	24.86
2	B2	14	22500	640.235	28.45
3	B3	21	22500	710.854	31.58
4	B4	28	22500	798.940	35.50

Result: The compressive strength of normal cube made up of Portland cement concrete= 35.50N/mm^2

3. RESULT AND DISCUSSION

The graph shows that there is no effect on strength of block prepared by zeolite sand and powder as a substitute. Hence this can be utilized without any problem in the buildings. The zeolite block can be used in the road pavements, Chimney of factory as well as at the faces of building. The Zeolite is costly material hence only small substitution by it would make it affordable for the people. The zeolite is available in abundant amount. This can also be manufactured. As CO_2 Is causing too many problems which is leading to the heavier pollution effects like greenhouse effect, Environmental imbalance. The CO_2 plays major role in this. Hence it is very important to reduce its percentage from the environment. CO_2 is in gas form hence it will directly come in contact with construction built around. Apart from that construction industry contribute 70% of the total CO_2 expelling. As while cement production and at the time of curing of the structure it will get evolved into atmosphere. Hence it is very important to reduce its emission. This material will definitely reduce its emission. Hence it must be used in the construction.



Graph 7: Comparison of Strength of Zeolite blocks (30% and 20% replacement) and normal block.

4. CONCLUSION

The recent trends in technologies are leading to tremendous increase in pollution. Hence it is need of time to reduce the pollution otherwise consequences will be devastating. The zeolite made concrete is capable of absorbing CO_2 without any emission of it. Otherwise general concrete evolve huge amount of CO_2 into the atmosphere. The zeolite concrete block of size 10x10x10 cm has ability to absorb around 1 mole of CO_2 in 50 days. This property does not lose its strength and durability. Hence it can be used at any place without any doubt. This type of block is affordable and hence can be used generally.

4.1 Advantages of Model

- It reduces the rate of emission of CO_2 while producing the cement in the industry.
- It absorbs the CO_2 from the surrounding environment and helps to stop the air pollutions.
- It gives more durability as well as great performance against ordinary Portland cement concrete.
- The presence of olivine material in the concrete increases the strength.
- The addition Zeolite has important advantages: Improves mechanical strength to the cement and stops emission CO_2.

5. ACKNOWLEDGMENT

We are really thankful to Prof. Lonpande sir for their true guidance during whole project. Specially during taking tests for CO_2 absorption and compressive strength of blocks. We also want to appreciate Prof. Narule sir for allowing us to do experiment in the laboratory

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