International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June 2018 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON CEMENT CONCRETE WITH PVC POWDER AND QUARRY DUST AS PARTIAL REPLACEMENT TO FINE AGGREGATE

K.N.JANARDHANAN[1], E.MOHANA PRIYA[2]

[1] Dept. of Civil Engineering, Murugappa Polytechnic College, Chennai
[2]Lecturer, Dept. of Civil Engineering, Murugappa Polytechnic College, Chennai, ,

---

Abstract - *Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures. Concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. River sand, which is one of the constituents used in the production of conventional concrete, has become very expensive and also becoming scarce due to depletion of river bed. Quarry dust is a waste obtained during quarrying process and PVC powder. It has very recently gained good attention to be used as an effective filler material instead of fine aggregate. In the present study, the hardened and durable properties of concrete using quarry dust and PVC powder were investigated. Also, the use of quarry dust and PVC powder as the fine aggregate decreases the cost of concrete production in terms of the partial replacement for natural river sand. This paper reports the experimental study which investigated the influence of partial replacement of sand with quarry dust and PVC powder. Initially cement mortar cube was studied with various percentages of replacement of quarry dust and PVC powder (5, 10, 15 and 20%). The experimental results showed that the addition of quarry dust and PVC powder for a fine to coarse aggregate ratio of 0.6 was found to enhance the compressive properties as well as elastic modulus.*

Key Words: **Concrete, quarry dust, fillers, elastic modulus, compressive strength**

Chapter- I

1.0 Introduction

In the recent past good attempts have been made for the successful utilization of various industrial by products (such as flyash, silica fume, rice husk ash, foundry waste) to save environmental pollution. In addition to this, an alternative source for the potential replacement of natural aggregates in concrete has gained good attention. As a result reasonable studies have been conducted to find the suitability of granite quarry dust in conventional concrete. However, recycled concrete aggregate, fly ash, blast furnace slag, as well as several types of manufactured aggregates have been studied by many researchers, Zain et al. (2000); Neville (2002); Gambhir (1995). Quarry dust, a by-product from the crushing process during quarrying activities is one of those materials that have recently gained attentions to be used as concreting aggregates, especially as fine aggregates. Quarry dust have been used for different activities in the construction industry, such as road construction, and manufacture of building materials, such as lightweight aggregates, bricks, tiles and autoclave blocks. Researches have been conducted in different parts of the world, to study the effects of incorporation of quarry dust into concrete. Galetakis and Raka (2004) studied the influence of varying replacement proportion of sand with quarry dust (20, 30 and 40%) on the properties of concrete in both fresh and hardened state (Nevillie, 2002). Saifuddin et al. (2001) investigated the influence of partial replacement of sand with quarry dust and cement with mineral admixtures on the compressive strength of concrete (Gambhir, 1995), whereas Celik and Marar investigated the influence of partial replacement of fine aggregate with crushed stone dust at varying percenttages in the properties of fresh and hardened concrete (Safiuddin et al., 2001; Celik and Marar, 1996). The present study is intended to study the effects of quarry dust addition in conventional concrete and to assess the rate of compressive strength development for different quarry dust to coarse aggregate ratio, (Goble (1999); De Larrard and Belloc, 1997).

1.1 Binding Materials

Cement or limes are used as the binding material. They behind the individual units of fine aggregate and coarse aggregate by virtue of its properties of setting or hardening in combination with water. The binding material helps to fill voids and imparts density to concrete.

1.2 Fine Aggregate

Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 3/8-inch sieve. Coarse aggregates are any particles greater than 0.19 inch, but generally range between 3/8 and 1.5 inches in diameter.

Quarry Dust

Quarry dust is a byproduct of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as waste. So it becomes as a useless material and also results in air pollution. Therefore, quarry dust should be used in construction works, which will reduce the cost of construction and the construction material would be saved and the natural resources can be used properly. Most of the developing countries are under pressure to replace fine aggregate in concrete by an alternate material also to some extent or totally without compromising the quality of concrete. Quarry dust has been used for different activities in the construction industry, such as building materials, road development materials, aggregates, bricks, and tiles.

PVC Powder

Polyvinyl Chloride (PVC) that is a widely used thermoplastic polymer. Polyvinyl Chloride (PVC) finds application in diverse construction applications. We procure superior quality Polyvinyl Chloride (PVC) from reliable manufacturers across the country.

1.3. Coarse Aggregate

It is the main filler and forms the bulk of concrete, broken stones, broken bricks and gravels are generally used as coarse aggregates. Granite, basalt are also excellent coarse aggregate.

Crushing strength sand water tightness of concrete and its resistance to wear and tear depend upon the aggregates. The aggregate should be clean dense, hard, strong durable and sound.

1.4. Water

Water facilitates the spreading of cement over the aggregate and regulates the consistency. Water used should be clean. Sea water should not be used as it retards setting.

1.5. Properties of Materials

1.5.1. Cement

- Initial testing time should be less than 30 minutes.
- Final setting time should not more than 10Hrs.
- Compression strength after 7 days should not less than 22N/mm^2.
- Tensile strength after 7 days should be 2.5 N/mm^2.
- By I.S 90 micron sieve, residue by weight should not exceed 10%.
- Ratio of percentage alumina to that iron oxide should not be less than 0.65%.
- Weight of magnesia should not exceed 5%.
- Weight of insoluble residue should not be greater than 1.50%.

1.5.2 Fine Aggregate

- It should be clean and coarse.
- It should be free from any organic or vegetable matter; usually 3-4% clay is permitted.
- It should be chemically inert
- It should contain sharp, angular, coarse and durable grains.
- It should not contain salts which attracts moisture from the atmosphere.
- It should be well grade; it should contain particles of various sizes in suitable proportions.
- It should be strong and durable.
- It should be clean and free from coating of clay and silt.

1.5.3 Coarse Aggregate

- It should be contain sharp, angular, coarse and durable grains.
- It should be clean and free from coatings of clay and slit.
- It should be strong and durable.
- It should be free from any organic or vegetables matter; usually 3-4% clay is permitted.
- It should be clean and coarse

Chapter- II

2.0 Material Testing and Results

Cement

Portland Pozzolona cement of 53 grades is taken for the test and the results are follows;

Table 1: Cement Tests and Results

S.No	Brand Name	Test	Results
1	PPC	Fineness	4%
2	PPC	Initial Setting Time	30 min
3	PPC	Final Setting Time	480min/8Hrs
4	PPC	Normal Consistency	32%

Sand, Quarry Dust, Coarse Aggregate and PVC Powder

Pycnometer apparatus is used to measure specific gravity and bulk density, fineness modulus of aggregate is found by using set of sieves.

Table 2: Test Results of Sand, Coarse and Fine aggregate

Properties	Sand	Coarse	Quarry Dust	PVC Powder
Specific Gravity	1.67	2.53	1.6	1.18
Bulk Density	2.56	1.05	0.27	0.28
Fineness Modulus	2.67	6.75	2.9	2.8

Fineness modulus of sand is found by using the set if sieves of 4.75mm, 2.36 mm, and 1.18 mm, 600 and 300 micron.

Chapter- III

Test Setup and Procedure

Test for Compressive Strength

- Testing is done after 7 days 28 days, the days taken into account is from the time of water added to the ingredients.
- Test a minimum of 3 specimens at a time.
- Test the specimen immediately after talking it from the water and while they are in wet condition, wipe of the surface water. If the specimen received and dry, then keep them in water for 24hours before testing.
- Note down the dimension nearest to 02.mm and also note down height 1.

Conducting Experiment

- Place the specimen in such manner that load shall be applied to opposite side of cubes.
- Align carefully, at the Centre of the thrust of the spherically seated plate.
- Apply the loads slowly and at the rate of 140Kg/cm^2 per min till the cube breaks.

Note down the maximum load and appearance of the concrete failure.

Chapter- IV

Results and Discussion

The compressive strength of concrete using PVC and quarry dust was found and the results are discussed.

Compressive Strength of 7 Days Curing

Table 3: results of Compression Tests on Concrete Cubes (7days)

S.No	Identification of Cubes	Compressive Strength (N/mm$^{2)}$
1	Normal concrete of CC1:1.5:3	22.13
2	5% 0f PVC Concrete of CC1:1.5:3	14.80
3	10% 0f PVC Concrete of CC1:1.5:3	16.83
4	15% 0f PVC Concrete of CC1:1.5:3	17.76
5	20% 0f PVC Concrete of CC1:1.5:3	24.39
6	5% 0f Quarry Dust Concrete of CC1:1.5:3	23.04
7	10% 0f Quarry Dust Concrete of CC1:1.5:3	21.16
8	15% 0f Quarry Dust Concrete of CC1:1.5:3	21.41
9	20% 0f Quarry Dust Concrete of CC1:1.5:3	17.19

We are obtaining compressive strength of normal concrete of after 7 days is 22.13 N/mm^2.

Partially replaced PVC concrete of different percentages such as 5, 10, 15 and 20 after 7 days curing it found to be 14.80, 16.83, 17.76 and 24.39 N/mm^2.

Partially replaced Quarry dust concrete of different percentages such as 5, 10, 15 and 20 after 7 days' curing is found to be 23.04, 21.16, 21.41 and 17.19 N/mm^2.

Compressive Strength of 28 Days Curing

Table 4: results of Compression Tests on Concrete Cubes (28days)

S.No	Identification of Cubes	Compressive Strength (N/mm^2)
1	Normal concrete of CC1:1.5:3	35.49
2	5% 0f PVC Concrete of CC1:1.5:3	20.67
3	10% 0f PVC Concrete of CC1:1.5:3	22.40
4	15% 0f PVC Concrete of CC1:1.5:3	27.79
5	20% 0f PVC Concrete of CC1:1.5:3	28.73
6	5% 0f Quarry Dust Concrete of CC1:1.5:3	36.12
7	10% 0f Quarry Dust Concrete of CC1:1.5:3	32.12
8	15% 0f Quarry Dust Concrete of CC1:1.5:3	31.54
9	20% 0f Quarry Dust Concrete of CC1:1.5:3	30.16

We are obtaining compressive strength of normal concrete of after 28 days is 35.49 N/mm^2.

Partially replaced PVC concrete of different percentages such as 5, 10, 15 and 20 after 7 days curing it found to be 20.67, 22.40, 27.79 and 28.73 N/mm^2.

Partially replaced Quarry dust concrete of different percentages such as 5, 10, 15 and 20 after 7 days' curing is found to be 36.12, 32.12, 31.54 and 30.16 N/mm^2.

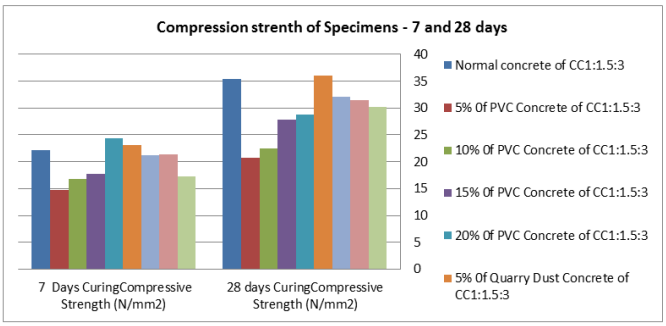

Figure 1: Comparison of Compressive Strength of 7 & 28 Days Curing

Chapter- V

Conclusion

The analysis of experimental data showed that the addition of the quarry dust improved the strength properties of concrete which was on par with that of conventional concrete. From above testing results, it is inferred that the quarry dust may be used as an effective replacement material for natural river sand. The increase of cement content in the mortar phase shows an increase in the strength. The fine quarry dust tends to increase the amount of super plasticizers needed for the quarry mixes in order to achieve the rheological properties. When the quarry dust has high fineness, its usage in the normal concrete is limited because it increases the water demand.

Chapter – VI

References

[1] Celik T, Marar K (1996). Effects of crushed stone dust on some properties of concrete, Cement Concrete Res., 26(7):1121-1130.

[2] De Larrard F, Belloc A (1997). The influence of aggregate on the compressive strength of normal and high-strength concrete. ACI Mater J., 94(5):417–426.

[3] Galetakis M, Raka S (2004). Utilization of limestone dust for artificial stone production: an experimental approach. Miner. Eng., 17:355– 357.

[4] Gambhir ML (1995). Concrete Technology-Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

[5] Goble CF, Cohen MD (1999). Influence of aggregate surface area on mechanical properties of mortar. ACI Mater. J., 96(6):657–662.

[6] IS: 516-1959. Indian Standard Methods of Test for Strength of concrete. Bureau of Indian Standards, New Delhi.

[7] Nevillie AM (2002). Properties of Concrete –Fourth and Final Edition, Pearson Education Limited, Essex.

[8] Safiuddin M, Zain MFM, Mahmud MF, Naidu RS (2001). Effect of quarry dust and mineral admixtures on the strength and elasticity of concrete, Proceedings of the Conference on Construction Technology, Kota Kinabalu, Sabah, Malaysia, pp. 68-80.