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EXPERIMENTAL INVESTIGATION QUARRY DUST AND POLYPROPYLENE FIBRE IN CONCTERE

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Abstract: ***The demand of natural sand is quite high as there is an extensive use of concrete in the world of globalization era and this will lead to certain problems in construction field. India is one of the countries that are facing the same problems as other developing countries. Due to this situation, some developing countries are facing a shortage in the supply of natural sand. Due to shortage of natural sand in Mumbai many construction site used quarry dust in place of sand. This paper reports the experimental study undertaken to determine the optimum mix ratio and compressive strength of compressed concrete using quarry dust. mix proportions of sand with quarry dust were practiced in the concrete mixes that 0%, 10%, 20%, 30%, 40% & 50% (cement: sand: quarry dust: polypropylene fibre) with 0.55 w/c ratio. The concrete block of 150x150x150 is used for casting purpose. Then this specimen is all cured for 7 & 28 days. The cubes are air dry for 15 to 20 min before testing. Before testing the weight of cube measured accurately.***

Key words: **Quarry Dust, Sand, Concrete, polypropylene fibre**

INTRODUCTION

Concrete is world's most commonly used construction material than the total of all other building materials including wood, steel, plastic and aluminium and second only water as the most-consumed substance on Earth. Fine aggregate is one of essential component in concrete. Natural River or pit sand is the most commonly used for fine aggregate. The demand of natural sand is quite high as there was an extensive use of concrete in the world of globalization era and this will lead to certain problems in construction field. The demand of natural sand is quite high in developing countries since the available sand is not able to meet the demand of construction sector. Natural sand takes millions of years to form and it is not replenish able. In such a situation the Quarry rock dust can be an economic alternative to the river sand.

Polypropylene fibres are new generation chemical fibres. They are manufacture in large scale and have fourth largest volume in production after polyesters, polyamides and acrylics. About four million tonnes of polypropylene fibres are produced in the world in the year. It should not be used for structural reinforcement. These fibres should not be used to produce thinner section and also to increase joint spacing than those suggested for unreinforced masonry. Polypropylene has its low density (0.9gm/cc), high

crystalline, high stiffness and excellent chemical/bacterial resistance, is tactic PP is widely used in many industrial applications such as nonwovens, industrial ropes, packaging material, furnishing product, etc. PP fibre has potential, high volume applications in the carpet, textile, apparel and industrial textile markets.

I. LITERATURE REVIEW

Ilangovan and Nagamani studied the usage of quarry dust as hundred percent substitute for natural sand in concrete and conducted experiments to judge the properties of fresh concrete and strength properties. It is found that the compressive strength, flexural strength and durability properties of concrete made of quarry dust are nearly 10% more than conventional concrete.

As reported by **Shahul Hameed *et al*.,** the quarry dust, which is produced as a residue after extraction and processing of rocks from crusher units, will also reduce environmental impact if consumed by the construction industry in large quantities.

Sahu *et al*. reported that concrete containing quarry dust as fine aggregate is promising greater strength, lower permeability and greater density which enable it to provide better resistance to freeze/thaw cycles and durability in adverse environment.

Murugesan *et al*., examined the effect of super plasticizer in quarry dust replaced concrete and reported that the compressive strength of quarry dust concrete can be improved with admixture E.

As suggested by **Prachoom Khamput,** super plasticizers can be used to improve the workability of quarry dust replaced concrete

EXPERIMENTAL MATERIALS

(a) Cement

Ordinary Portland cement available in local market was used in the investigation. Care has been taken to see that the procurement made from a single batch and is stored in airtight containers to prevent it is being affected by atmospheric, monsoon moisture and humidity. The specific gravity was 3.10 and fineness was 3200 m^2/Kg. The cement confirms to 53 Grade. Figure 1 shows the cement material.

Figure 1: Cement

(b) sand

The sand is important part of concrete. The textures of sand like cubical, rounded, smooth, glassy, granular etc. The texture of natural F.A. is always not ideal but it depends on place to place. And cubical rounded and smooth texture of sand is give good workability. The locally available river sand was used as fine aggregate in the present investigation. The sand is free

from clayey matter, salt and organic impurities. The sand is tested for its properties like Specific Gravity; Bulk Density etc in accordance with IS 2386-1963. Figure 2 shows the sand material.

Figure 2: Sand

(c) Aggregate

The course aggregate is also important part of concrete. It gives the body to the concrete reduce shrinkage and effect economy. The use of coarse aggregates in concrete provides significant economic benefits for the final cost of concrete in place because aggregates typically make up about 60% to 75% of the volume of a concrete mixture. Machine Crushed angular granite metal of maximum size of 20mm retained on 4.75mm I.S. sieve confirming to I.S. 383-1970 was used in the present investigation. It is free from impurities such as dust, clay particles and organic matter etc. Figure 3 shows the aggregate material.

Figure 3: Aggregate

(d) Quarry Dust

Quarry dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Quarry dust basically has the same physical characteristics to sand as the size and its properties are very close to sand. Physically, quarry dust has smooth, long, angles, sharp at corner and grey in colour. The basic tests on quarry dust were conducted as per IS-383-1987and its specific gravity was around 1.95. Wet sieving of quarry dust through a 90 micron sieve was found to be 78% and the corresponding bulking value of quarry dust was 34.13%. Figure 4 shows the quarry dust material.

Figure 4: Quarry Dust

(e) Water

Water is the least expensive but most important ingredient of the concrete. The water, which was used for making concrete was clean and free from harmful impurities like oil, alkalis, acids etc. in general, the water which is fit for drinking should be used for making concrete.

(f) Polypropylene Fibre (Admixture)

Polypropylene is the first stereo regular polymer to have achieved industrial Importance and it is presently the fastest growing fibre for technical end-uses where high tensile strength coupled with low cost is essential features. The fibres from polypropylene were introduced to the textile arena in the 1950's and become an important member of the rapidly growing family of the synthetic fibres. Today polypropylene enjoys fourth spot behind the three fibre classes i.e. polyester, rayon and acrylics. Figure 5 shows the Polypropylene Fibre material.

Fibre can be dyed using conventional disperse dyes in a manner similar to that used for polyester fibre. The fibres feature a wide array of inherent benefits and properties including:

1. Light weight and comfort
2. Cottony softness
3. Easy care, easy wear
4. Moisture management
5. Durability breathability
6. Thermal insulation
7. Strain resista

Figure 5 Polypropylene Fibre

MATERIAL PROPERTIES

(a) Physical Properties

Physical properties of quarry rock dust and natural sand are mention in below table-1.

TABLE 1: PHYSICAL PROPERTY OF QUARRY ROCK DUST AND NATURAL SAND

Property	Quarry rock dust	Natural sand	Test method
Specific gravity	2.54-2.60	2.6	IS 2386 (Part III) 1963
Bulk relative density (kg/m^3)	1720-1810	1460	IS 2386 (Part III) 1963
Absorption (%)	1.20-1.50	Nil	IS 2386 (Part III) 1963
Moisture content (%)	Nil	1.5	IS 2386 (Part III) 1963
Fine particles less than 0.075mm (%)	Dec-15	6	IS 2386 (Part I) 1963
Sieve analysis	Zone II	Zone II	IS 383 - 1970

(b) Chemical Properties

Chemical properties of quarry dust and natural sand are mention in below table-2.

TABLE 2: CHEMICAL PROPERTIES OF QUARRY DUST & NATURAL SAND

Constituent	Quarry rock dust (%)	Natural sand (%)	Test method
SiO_2	62.48	80.78	IS 4032-1968
Al_2O_3	18.72	10.52	
Fe_2O_3	06.54	01.75	
CaO	04.83	03.21	
MgO	02.56	00.77	
Na_2O	Nil	01.37	
K_2O	03.18	01.23	
TiO_2	01.21	Nil	
Loss of ignition	00.48	00.37	

(c) Physical Properties of Polypropylene

Polypropylene is a strong fibre. The physical properties of polypropylene are given below.

1. **Tenacity:** 3.5-8 gm/den
2. **Density:**.91 gm/cc
3. **Elongation at break:** 10-4.5%
4. **Elasticity:** Very good
5. **Moisture regain:** 0%
6. **Resiliency:** good
7. **Melting Point:** 170 C
8. **Ability to protest friction:** excellent
9. **Colour:** white
10. **Ability to protest heat:** moderate
11. **Lusture:** Bright to light

(d) Chemical properties of polypropylene

The chemical propeties of polypropylene are given below.

1. **Acids:** Acid does not affect on polypropylene
2. **Basic:** Basic does not affect on polypropylene
3. **Effect of bleaching:** It has enough ability to prevent the harmful action of bleaching agent under 65 C
4. **Organic solvent:** Organic solvent does not cause harm to polypropylene during action
5. **Protection ability against light:** It loses energy by sunlight
6. **Protection ability against mildew:** good
7. **Protection ability against insects:** It does not affected by insects
8. **Dyes:** Difficult to dye polypropylene because it moisture regain is 0% But pigment dyeing is possible

MIX DESIGN

The mix design was according to the weight method. The mix proportion was to be assumed as **1 : 1.5 : 3 (Cement / sand / aggregate).**

EXPERIMENTEL RESULTS

COMPRESSIVE STRENGTH TEST

The compressive testing was done at Gujarat Energy Research Institute (GERI), Godhra. As the proportion of Quarry dust increased, the compressive strength also increased as shown in following table.

Table 4: Compressive Strength at 7 days and 28 days

% of Quarry dust	% of Fibre	7 days Strength	28 days Strength
0%	**0.5**	35	48
10%	**0.5**	57	70
20%	**0.5**	52	79
30%	**0.5**	55	82
40%	**0.5**	56	68
50%	**0.5**	52	64

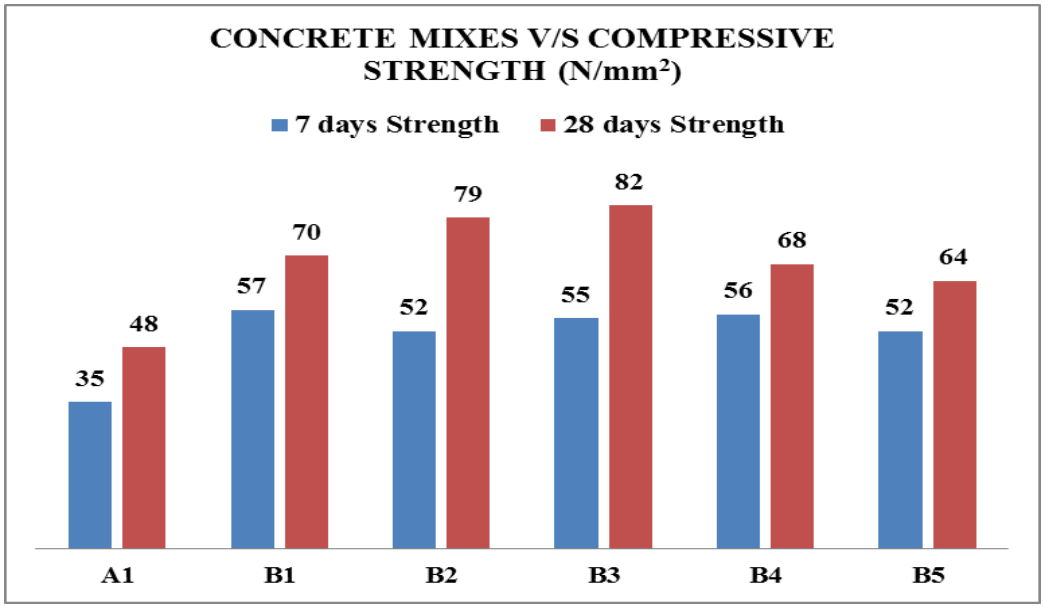

Figure 6: concrete mixes v/s compressive strength at 7 days and 28 days

CONCLUSON

Replacement of sand by quarry dust gives higher compressive strength for the following mix proportions,

1. Compressive stress obtained is much higher for M20 mix concrete.
2. An observation of compressive strength at 7 days and 28 days indicate that after 28 days the increase in compressive strength.
3. However, at the end of 28 days, 30% quarry dust proportion and fibre 0.5% (82) concrete has highest strength.
4. According to result at the end of 7 days 0.5% fibre and 10% replacement of quarry dust has higher strength.

5. According to result at the end of 28 days 0.5% fibre and 30% replacement of quarry dust has higher strength.

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