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"Green Concrete: Using Industrial Waste of Marble Powder, Quarry Dust and Paper Pulp"

Ms. Monica C. Dhoka
Department of Civil Engineering, Bharati Vidyapith College of Engineering, Pune

ABSTRACT: *The challenge of the present century is to make a transition to the new form that can sustain the natural system. This requires a threadbare rethinking on ways and means of providing shelter and infrastructure for the community. Perhaps there is a necessity of making a concerted movement for developing innovative and alternative novel material for construction.Green Concrete is capable for sustainable development is characterized by application of industrial waste such as marble powder, quarry dust, wood ash, paper pulp, etc, to reduce consumption of natural resource and energy and pollution of the environment. Use of such waste material saves 14%-20% amount of cement. The concrete resistance to sulphate attack and alkali-aggregate reaction is greatly enhanced. Application of green concrete is an effective way to reduce environment pollution and improve durability of concrete under severe condition. This trend in new cement and techniques will continue in all phases of infrastructure constructability and rehabilitation. The versatility of green concrete and its performance derivatives will satisfy many future needs.*

KEY WORDS*: Green Concrete, Sulphate attack, Alkali Aggregate reaction, Green Environment, Durability of Concrete*

I. INTRODUCTION

Currently India has taken a major initiative on developing the infrastructures such as express highways, bridges, power projects and industrial construction, etc, to meet the requirements of globalization, in the construction of buildings and other structures concrete plays an important and rightful role and a large quantum of concrete is being utilized. Concrete is an affordable and reliable material, which is extensively used throughout in the infrastructure of a nation's construction, industrial, transportation, defence, utility and residential sectors, it has become a huge industry.India produces about more than 170 million cubic meters of concrete annually. The most of economy is invested in construction sector. With growing industry waste proportion is being increased. World's more than 7% co_2 emission is attributed to concrete industry. There is extreme need to find alternative technique to produce cost effective concrete material. Thus for sustainable development it is recognized that considerable improvements are essential in productivity, product performance, energy efficiency and environmental performance. Green concrete has nothing to do with colour. It is not in green colour. It is concept of thinking environment into concrete considering every aspect from raw materials manufacture over the design to structural design, construction and service life. At about more than 300 million tonnes of industrial waste are produced by industries like paper and pulp, mining, marble dust. This waste is used as a substitute for cement for producing green concrete. Green concrete is very often also cheap to produce. Waste can be used to produce new product or can be used as a admixture so that natural sources are used more efficiency and the environment is protected from waste deposits. To avoid pollution and reduce the waste material, the present study is carried out.

II. RAW MATERIAL:

CEMENT:

Ordinary Portland Cement (43 Grade) with 28% normal consistency with specific surface 3300 cm^2/g conforming to IS 8112-1989 is used.

FINE AGGREGATE:

Medium size sand of passing through IS sieve of size 4.75 mm.

COURSE AGGREGATE:

Crushed course aggregate passing through sieve of size 5-20mmand normal continuous grading is used. The content of flaky and elongated particles is <3% and specific gravity is 2.7.

WATER:
Water used for manufacturing of Green concrete is potable and uniform, simply a tap water.

WASTE PAPER PULP:

Paper pulp from paper industry, marble powder from marble cutting and artistic thing of marble, quarry dust from mining industry are being used in green concrete. About 300 kg of pulp waste is produced for each tone of recycled paper [7]. By adjusting the mixture to an equivalent density, concrete mixtures containing the residuals can be produced that are equal in slump and strength to a reference concrete without residuals. Pulp and paper mill residual solids are composed mainly of cellulose fibers, moisture, and papermaking fillers (mostly kaolinitic clay or calcium carbonate). Utilization of the widely spread industrial wastes in the civil construction practice may lead to a real possibility of significant decrease in the environment pollution by paper and lime production waste and perceptibly economize the price of civil construction.

QUARRY DUST:

The consumption of cement content, workability, compressive strength and cost of concrete made with quarry dust were studied by researcher Babu K.K. *et al*.[2]. The mix design was proposed by Nagraj *et al.* [] shows the possibilities of ensuring the workability by wise combination of rock dust and sand reported significant increase in compressive strength, modulus of rupture and split tensile strength when 40% of sand is replaced by Quarry Dust in concrete.

MARBLE POWDER:

In India the extractive activity of decorative sedimentary carbonate rocks, commercially indicated as Marble and Granite is one of the most thriving industry. Marble waste powder is an industrial waste containing heavy metals in constituent. Marble powder has a very high Blaine fineness value of about $1.5m^2/g$ with 90% of particles passing 50 µm sieves and 50% under 7 µm [8]. The maximum compressive and flexural strength were observed for specimens containing a 6% waste sludge when compared with control and it was also found that waste sludge up to 9% could effectively be used as additive material in concrete.

CHARACTERIZATION OF WASTE:

Physical Properties of Raw material:

Properties / Material	Bulk Density (kg/m^3)	Fineness Modulus	Specific Gravity	Dry moisture content (%)
Marble Powder	1118	2.04	2.212	1.59
Quarry Dust	1750	2.35	2.54-2.6	2.10

Chemical Properties of Raw material:

Properties / Material	Fe_2O_3	MnO	Na_2O	MgO	K_2O	Al_2O_3	CaO	SiO_2
Marble Powder	11.99	0.08	2.08	8.74	2.33	4.45	1.58	64.86
Quarry Dust	1.22	0.07	3.0	0.33	5.34	13.63	1.28	75.25
Ordinary Portland Cement	0.55	0.85	0.85	2.15	0.85	5.5	63.5	21.5

MIX PROPORTION:

Material	Mix 1 (Normal M20)	Mix2 (Using Marble Powder & Quarry Dust)	Mix 3 (By 10% replacement of cement with Paper Pulp)
Cement in kg	378.61	378.61	340.74
Paper Pulp (% replaced)	0	0	10% (34.074kg)
Fine Aggregate (kg)	586.56	0	586.56
Course Aggregate (kg)	1209.87	1209.87	1209.87
Marble powder (kg)	0	293.28	0
Quarry Dust (kg)	0	293.28	0
Water in litres	186.71	186.71	186.71
Cement/Aggregate Ratio	0.21	0.21	0.19
C.A/F.A ratio	2.06	2.06	2.06

TEST AND METHODOLOGIES:
The workability and consistency of fresh concrete is measured by slump test according to IS:1199-1959[10].

Test on fresh concrete:

Specification of concrete block	Slump in mm
Normal concrete	185
Concrete with Marble powder & Quarry dust	215

Test on hardened concrete:
According to IS 516-1959 [11], test of compressive strength and split tensile strength were performed on hardened concrete.

Specification of concrete block	Compressive strength (N/mm^2)		Split tensile strength (N/mm^2)	
	7 days	28 days	7 days	28 days
Normal concrete	17.26	25.33	1.98	4.22
Concrete with marble powder & quarry dust	19.38	27.29	1.86	5.29

Result and Conclusion:
All the experimental data shows that the addition of the industrial wastes improves the physical and mechanical properties. These results are of great importance because this kind of innovative concrete requires large amounts of fine particles. Due to its high fineness of the marble sludge powder it provided to be very effective in assuring very good cohesiveness of concrete. From the above study, it is concluded that the quarry rock dust and marble sludge powder may be used as a replacement material for fine aggregate.

- The replacement of fine aggregate with 50% marble sludge powder and 50% Quarry rock dust (Green concrete) gives an excellent result in strength aspect and quality aspect. Increase the marble sludge powder content by more than 50% improves the workability but affects the compressive and split tensile strength of concrete.
- Green concrete induced higher workability and it satisfy the self compacting concrete performance which is the slump flow is 657mm without affecting the strength of concrete. Slump flow increases with the increase of marble sludge powder content. V-funnel time decreases with the increase of marble sludge powder content.
- Test results show that these industrial wastes are capable of improving hardened concrete performance. Green concrete enhancing fresh concrete behavior and can be used in architectural concrete mixtures containing white cement.
- Permeability test results clearly demonstrate that the permeability of green concrete is less compared to that of conventional concrete.
- The water absorption of green concrete is slightly higher than conventional concrete.
- The durability of green concrete under sulphate is higher to that of conventional concrete. From the results after 90-day immersion, the mortar specimens with green concrete in 7.5% sulphate solution have similar effect with those immersed for 28 days, but for those in 7.5% magnesium sulphate, the influence of addition on anti corrosion factor is not obvious.

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