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Experimental Investigation on Partially Replacement of Coarse Aggregate with Waste Terracotta Tiles

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Abstract: *Owing to globalization industries are developing rapidly throughout the whole world. Since construction industry is the back bone of all other industries, during the last century concrete has developed into the most important building constituent in the world. Production of concrete amounts to 1.5 to 3 tons per capita per annum in the industrialized world. Terracotta Tile Company is one of the leading industries in the world with an annual production rate of seven million items per year and generates approximately 24 tons of waste per month. The present work is an experimental investigation to check the suitability of using terracotta tiles as a substitute for coarse aggregate in the construction of concrete. Various concrete mixes with different percentages of terracotta tiles waste were prepared for the investigation. Test on fresh concrete, hardened concrete and test on durability were conducted on each mix and compared with the conventional concrete mix. From the test results it was found that terracotta tiles waste may be effectively used as a partial substitute for coarse aggregate with respect to strength.*

Keywords: *Coarse aggregate , Terracotta tiles, Concrete.*

1. INTRODUCTION

Concrete is produced from natural materials available in all parts of the globe and partly due to the fact that concrete is a versatile material giving architectural freedom. The production of concrete amounts to 1.5–3 tones per capita per annum in the industrialized world. This makes the concrete industry, including all of its suppliers a major player in the building sector. Thus improving the sustainability of the concrete industry will automatically lead to significant improvements in the building sector as a whole. The consumption pattern and growth reflect the effort made in industrial development.

The components of building block of traditional materials such as brick, stone, Natural River sand, Ordinary Portland cement, wood, paints, steel etc. have some environmental effects during their life cycle from manufacturing, transportation, etc. The continuous use of traditional materials reduce the natural resources day by day.

Moreover, the spiraling cost of such traditional building materials makes the housing unaffordable or a distant dream for an average income salaried person in a tier-2 or tier-3 cities, forgetting about the tier-1 and Metros. This leads to have more and more research to find out alternative low cost, energy saving, eco-friendly, recyclable solid wastes from industries, agricultures, mines for effective utilization as a partial or full replacement of such components for uses in buildings and infrastructure.

In recent years, remarkable efforts have been taken in the domain of concrete engineering and technology to research and study the utilization of by-products and waste materials in the production of concrete. The successful utilization of these materials will result in the reduction of global warming and environmental loading, waste management cost and concrete production cost, besides enhancing the properties of concrete in both fresh and hardened state.

The practice of dumping or the inadequate management of waste from the various manufacturing sectors have a notable impact on the receiving environment, leading to water, soil, air and noise pollution, amongst other complications, and adding to existing environmental problems. At the same time, these practices represent an economic cost. However, if waste is managed correctly it can be converted into a resource which contributes to savings in raw materials, conservation of natural resources and the climate, and promotes sustainable development, all of which complies with strategies for sustainable development within the European Union and Spain.

2. GENERAL

The results of the experimental investigation carried out based on the tests mentioned in the previous section are analyzed in this chapter. The test results covers effect of replacement of coarse aggregate with terracotta tiles waste in concrete construction with respect to mechanical properties and durability

Table 1: *Workability Details of Concrete*

NAME OF MIX	COMPACTION FACTOR	SLUMP VALUE
MIX_1	0.90	50
MIX_2	0.91	50
MIX_3	0.93	60
MIX_4	0.92	50
MIX_5	0.92	50
MIX_6	0.92	60
MIX_7	0.93	60

From the table it is understood that replacement of coarse aggregate with terracotta tiles waste has not much effect on workability of concrete. However it is found that as percentage of terracotta tiles waste increases up to 20%, there is a slight increase in the workability and then the workability decreases and remains the same. However considering the compaction factor results, it was observed that again there is a slight increase in the workability of concrete

3. COMPRESSIVE STRENGTH OF CONCRETE

Cubes size of 150mm and cylinders size of 150mm×300mm were tested for compressive strength after 3rd, 7th, 28th, 56th and 90th days of water curing. The results of compressive strength are shown in the table 2.

Table 2: *Compressive Strength of Concrete*

NAME OF MIX	COMPRESSIVE STRENGTH(N/MM²)				
	3rd day	7th day	28th day	56th day	90th day
MIX_1	24.1	38	55	60	65
MIX_2	26.8	38	57	62	67.5
MIX_3	30	40	60	62.5	67
MIX_4	30.5	40.8	61.2	63	68
MIX_5	28.8	40	58	60	61.5
MIX_6	20	34.65	50.05	52.5	55
MIX_7	18	30	44.5	47.78	50.5

Table 3: *Flexural Strength of concrete*

NAME OF MIX	FLEXURAL STRENGTH (N/mm²)
MIX_1	10.00
MIX_2	10.50
MIX_3	11.00
MIX_4	11.05
MIX_5	6.25
MIX_6	5.20
MIX_7	3.10

4. CONCLUSION

From the present experimental investigation, the following conclusions are arrived at:

1. Replacement of coarse aggregate with terracotta tiles waste has not much effect on the workability of concrete. However there is slight increase in the workability up to 20% replacement of coarse aggregate with terracotta tiles waste.
2. Compressive strength of concrete mixes up to 40% replacement of terracotta tiles waste is greater than conventional concrete mix. Maximum compressive strength was obtained for 30% replacement.
3. From the above observations, it was understood that concrete mix with 30% terracotta tiles waste is most suitable with respect to both strength and durability

5. SCOPE OF FUTURE WORK

From the present scope of study, more research is needed in the area of terracotta tiles waste concrete. The following are few suggestions for the future work:

- Studies can be done in waste concrete beams to find out their resistance against deflection and crack
- Studies can be extended to find out the suitability of terracotta tiles waste for the construction of reinforced cement concrete
- Studies to find out the suitability of replacing fine aggregate with terracotta tiles waste can also be done by crushing them into finer size
- More durability studies can be conducted to find out the suitability of terracotta tiles waste concrete in adverse weathering conditions

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