Effect of Crumb Rubber Material on Concrete Mix

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Abstract - *This study describes the effect of tire rubber crumb on concrete. This research helps to understand the use and effect of rubber tire crumb in concrete structures. Improving the recycling of waste materials in accordance with the principle of sustainable development. The procedures used in this research used experiments such as, slump cone test, water absorption test etc. Disposal of waste tire rubber has become a major environmental problem in all parts of the world which poses a very serious threat to the environment. So far only a small fraction is recycled and millions of tires are simply stockpiled, landfilled, or buried. This paper reviews tests conducted using rubber tire waste concrete samples to determine compressive strength. It was found that the compressive strength rubberized concrete was lower than the control mixture, while it exhibited better results in abrasion resistance. Fine aggregates are partially replaced by crumb rubber to form crumb rubber concrete. Finally, crumb rubber was introduced into the concrete mixture after pre-treatment by six modifiers.*

Key Words: **Crumb Rubber, Aggregates, Compressive strength, Water, Concrete.**

1.INTRODUCTION

India accounts for 6-7% of global total waste tires. As the local tire industry is growing at a rate of 12% annually, the volume of waste tires is increasing. More than 1 billion tires are manufactured worldwide every year and the same number of tires from waste vehicles are removed permanently. The US is the largest producer of waste tires, about 290 million a year. In China and India, the volume of tire waste is increasing at a high rate due to the rapid increase in the sales of new vehicles. Since tires are made to last longer, the same things that make them durable also make them difficult to dispose of which has a long-term impact on the environment. India produced 90000 MT of reclaimed rubber from waste tires in 2011. It takes thousands of years for a tire to completely decompose alone. In many cases it burns, releasing toxins and pollutants into the air, water, and soil. Stockpiling or illegal dumping or landfilling are traditional methods of disposing of waste tires, but these are short-term solutions. Recycling of vehicle tires is essential as disposing of waste tires is not an easy task Tires are among the largest and most problematic sources of waste, due to mass production and their durability Tires are among the largest and most problematic sources of waste.

2. METHODOLOGY

1.1 Materials Used

1 Cement: Ordinary Portland cement, 43 grade confirming IS 12269-1993. The compressive strength measured in the standard mortar at 28 days was 24 MPa.

Fig -1: Cement

2 Coarse Aggregate: The aggregates which is retained over IS Sieve 4.75 mm is termed as coarse aggregate.

Fig -2: Coarse aggregate

3 Fine Aggregate: The aggregate passing from 4.75 mm and retained on 75µ mm IS sieve.

Fig -3: Fine aggregates

4 Water: Potable water is used which is Free from silts, salts and shall fulfill the requirement as per IS 456:2000.

5 Tire Rubber Crumb: Crumb rubbers are obtained by grinding. Recycled Tire Crumb particle size ranging in from 4.75 mm to 0.075 mm.

Fig -4: Tire Rubber Crumb

1.2 Details of Mix Proportion

1. The concrete mixes are prepared to achieve target strength of 25N/mm².
2. The specimens cubical in shape shall be 15 X 15 X 15 cm.
3. The blocks were kept in normal curing condition for 7 days, 14 days, and 28 days in water.

Table -1: Quantity of materials used in concrete mix

Preparation of Mix proportion for 15cm×15cm×15cm Block			
Constituents	Trial Mix 1	Trial Mix 2 (5%)	Trial Mix3 (10%)
Cement (kg)	1.15	1.15	1.15
Water(liter)	0.52	0.52	0.52
Chemical admixture(kg)	0.005737	0.005737	0.005737
Fine Aggregates(kg)	2.84	2.698	2.556
Coarse Aggregates(kg)	3.9	3.9	3.9
Crumb Rubber	0	0.142	2.414

3. RESULT AND DISCUSSION

The specimen for the compressive strength of concrete test were cured for 7, 14, and 28 days. The result shows that crumbed rubber generally decrease the compressive strength.

Table -2: compressive strength for conventional concrete blocks (M25 Grade)

Trial Mix 1(0%)	Curing Duration	Load (KN)	Compressive strength (N/mm²)	Average Compressive Strength (N/mm²)
Block1	7 days	436.3	19.3	20
Block2		470.7	20.9	
Block3		446.5	19.8	
Block4	14 days	469.6	20.8	23
Block5		561.2	24.9	
Block6		525.7	23.3	
Block7		546.1	24.2	
Block8	28 days	558.6	24.8	24.23
Block9		535.3	23.7	

The result for the compressive strength test for conventional concrete blocks of trial mix no. 1 normal design mixes for 7, 14 and 28 days are tabulated above in the table-2.

Table -3: compressive strength for conventional concrete blocks with 5% replacement (M25 Grade)

Trial Mix 2 (5%)	Curing Duration	Load (KN)	Compressive strength (N/mm^2)	Average Compressive Strength (N/mm^2)
Block1	7 days	340.6	15.1	16.83
Block2		446.5	19.8	
Block3		351	15.6	
Block4	14 days	399.7	17.7	20.73
Block5		485.0	21.5	
Block6		518.8	23.0	
Block7	28 days	539.7	23.9	22.6
Block8		488.2	21.6	
Block9		503.8	22.3	

The result for the compressive strength test for conventional concrete blocks of trial mix no. 2 5% of tire crumb rubber design mixes for 7, 14 and 28 days are tabulated above in the table-3.

Table -4: Compressive strength for conventional concrete blocks with 10% replacement (M25 Grade)

Trial Mix 3 (10%)	Curing Duration	Load (KN)	Compressive strength (N/mm^2)	Average Compressive Strength
				(N/mm^2)
Block1	7 days	261.3	11.6	11.8
Block2		227.0	10.0	
Block3		311.6	13.8	
Block4	14 days	361.9	16.0	15.43
Block5		327.9	14.5	
Block6		357.2	15.8	
Block7	28 days	331.2	14.7	14.43
Block8		285.1	12.6	
Block9		360.2	16.0	

The result for the compressive strength test for conventional concrete blocks of trial mix no. 3 10% of tire crumb rubber design mixes for 7, 14 and 28 days are tabulated above in the table-4.

The average result for the compressive strength test for conventional concrete blocks of trial mix no. 1, trial mix no. 2, trial mix no. 3 design mixes for 7, 14 and 28 days are summarized graphically in Chart-1.

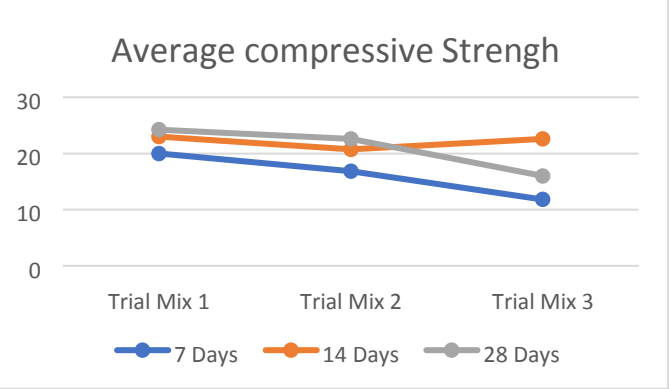

Chart -1: Average compressive strength for conventional concrete blocks

3. CONCLUSIONS

Based on the results obtained from the experiment, the following conclusions could be drawn:

With increasing quantity of the crumb rubber, the compressive strength tends to decrease. A maximum of 88% strength is observed for the mix with 5% replacement of crumb rubber.

With increasing quantity of the crumb rubber, the compressive strength tends to decrease. A maximum of 64% strength is observed for the mix with 10% replacement of crumb rubber.

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