STUDY ON THE USE OF RECYCLED RUBBER TYRES CHIPS IN CONCRETE CONSTRUCTION

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***Abstract* — This study investigates the potential of incorporating recycled rubber tyre chips into ordinary portland cement (OPC) concrete. This report presents the workability, strength and durability properties of concrete incorporating rubber chips as a partial replacement for the coarse aggregate in the concrete. Plain rubber aggregate and rubber aggregate coated with cement paste were used. The results showed that concrete incorporating rubber aggregate has lower workability and unit weight and exhibited a notable reduction in compressive strength. However, the rubberized concrete did not exhibit a typical failure mode of plain concrete and a beneficial effect on flexural strength was observed.**

***Keywords*— Rubber aggregate, Mineral aggregates, rubberized concrete**

I. INTRODUCTION

The disposal of waste tyres is becoming a major waste management problem. As rubber tyres are extremely durable and not naturally biodegradable. They will remain in landfill with very little degradation over time, presenting a continuing hazard. There is an urgent need to identify alternative solutions. This promotes recycling ahead of disposal and energy recovery. One of the Largest potential recycling routes is in construction, but usage of waste tyres in civil engineering is currently very low. This is due to the lack of high volume application and products involve recycled tyres

II. RESEARCH SIGNIFICANT

The previous studies have shown that the inclusion of rubber aggregate as a full or partial replacement for natural aggregates reduces the compressive strength of the concrete. This strength reduction can be expected primarily because rubber aggregate is much elastically deformable than the surrounding cement paste. Secondly, the bonding between the rubber aggregate and the cement past is highly likely to be weak, So that elastically deformable rubber aggregate may b viewed as voids in the concrete mix. It has also been recognised that, in general, the strength of concrete depends greatly on the density, size and hardness of the coarse aggregate. In addition, the previous studies have shown that the workability of concrete containing rubber aggregate is reduced. In the present study, the effect of coating the aggregate particles with cement paste was investigate as a potentially simple method of improving the performance of the material, thereby avoiding the use of additional or costly additives which may adversely affect the production costs.

III. EXPERIMENTAL PROCEDURE

The following tests were carried out to establish the mechanical properties of rubberised concrete

A. Compressive Strength

The compressive strength of concrete specimen was determined after 7 and 28 days of standard curing.

The test results are summarised in table 1 presented in figures 1 and 2. For rubberised concrete, the results show that the addition of rubber aggregate resulted in a significant reduction in concrete compressive strength compared with the control concrete. This reduction increased with increasing percentage of rubber aggregate. It can also be seen that the compressive strength of rubberised concrete containing rubber aggregate coated with cement paste and rubberised containing plain rubber aggregate exhibits not much difference in their strengths. Compressive strength test sample for rubberised concrete are shown in figures 3 and 4.

TABLE 1 COMPRESSIVE STRENGTH OF RUBBERISED CONCRETE

Group	Specimen	Strength (N/Mm^2)	
		7 Days	28 Days
CONTROL	Normal	17.44	20.49
COATED RUBBERISED CONCRETE	5%	16.13	22.67
	10%	15.26	17.88
	15%	10.90	17.00
AGGREGATE RUBBERISED CONCRETE	5%	16.56	23.59
	10%	13.08	16.56
	15%	10.90	16.13

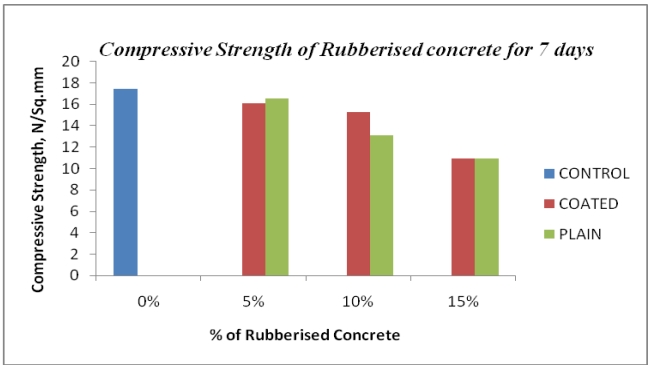

Figure 1 Compressive Strength of Rubberised concrete for 7 days

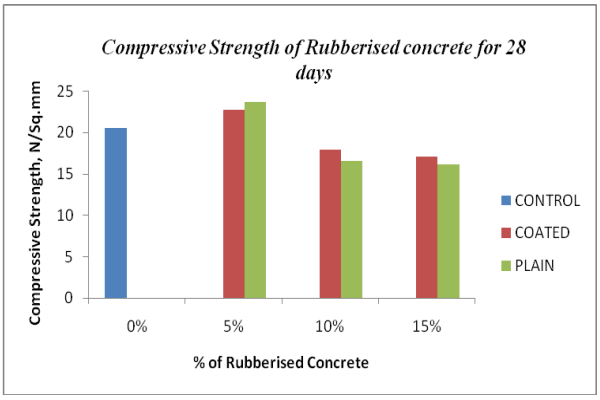

Figure 2 Compressive Strength of Rubberised concrete for 28 days

Figure 3 Rubberised Cube Under Compressive Test

Figure 4 Rubberised Cube after Compressive Test

B. Splitting Tensile Strength

The Splitting tensile strengths of concrete specimens were determined after 14days of standard curing. From the maximum applied load at failure the splitting tensile strength is calculated as follows

$$\alpha = 2F/\pi ld$$

where,

α= Splitting tensile strength, N/mm^2

F= Maximum applied load in N

L= Length of cylinder in mm

d= Diameter in mm

The results of the splitting tensile strength tests of a concrete mix is summarised in table 2 and presented in figure 5. For rubberised concrete, the results show that the splitting tensile strength decreased with increasing rubber aggregate content in a similar manner to that observed for the compressive strength. The splitting tensile strength of rubberised concrete containing plain rubber aggregate also shows nearly the same strength.

The Splitting tensile strength test samples for control and rubberised concrete are shown after testing in figure 6 and 7 for rubberised concrete. It can be observed that, as for 5he compressive strength tests, the rubberised concrete does not exhibit typical compressive failure behaviour. The control concrete shows a clean split of the sample into halves, whereas the rubber aggregate tends to produce a less well defined failure.

TABLE 2 SPLITTING TENSILE STRENGTH OF RUBBERISED CONCRETE AT 14 DAYS

Group	Specimen	Strength (N/Mm^2)
		14 Days
CONTROL	Normal	2.22
COATED RUBBERISED CONCRETE	5%	2.08
	10%	1.67
	15%	1.38
AGGREGATE RUBBERISED CONCRETE	5%	2.91
	10%	1.67
	15%	1.53

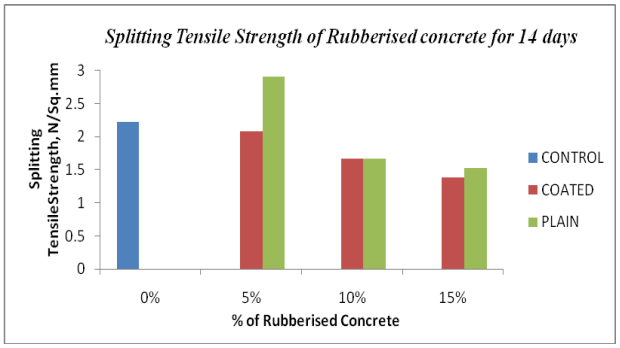

Figure 5 Splitting tensile Strength of Rubberised Concrete for 14 days

Figure 6 Splitting Tensile Smaples for Control Concrete

Figure 7 Splitting Tensile Smaples for rubberised Concrete

C. *Flexural Strength*

The flexural strength of concrete specimen was determined after 7 and 28 days of standard curing. Using standard beam formula, the failure stress can be calculated from the beam dimensions and the failure load.

The test results strength of a mix are summarised in table 3 and presented in figure 8 and figure 9 for aggregate coated with cement paste and plain rubber aggregate for 7 days and 28 days respectively.

The results show that the flexural strength increased compared to the control mix for rubber aggregate contents up to 5%. The Flexural strength of rubberised concrete containing rubber aggregate coated with cement paste was found to have nearly the same strength as rubberised concrete containing plain rubber aggregate. For rubber aggregate contents of 15% a flexural strength reduction is observed compared to the control mix, indicating that flexural strength are limited to relatively small rubber aggregate contents. The Flexural strength sample for rubberised concrete is shown in figures 10. The figures show clearly that the development of cracking from the tension zone in the lower portion of the beam.

TABLE 3 FLEXURAL STRENGTH OF RUBBERISED CONCRETE

Group	Specimen	Strength (N/Mm^2)	
		7 Days	28 Days
CONTROL	Normal	1.195	1.355
COATED RUBBERISED CONCRETE	5%	1.578	1.910
	10%	1.562	1.458
	15%	1.036	1.275
AGGREGATE RUBBERISED CONCRETE	5%	1.452	1.750
	10%	1.386	1.200
	15%	1.020	1.120

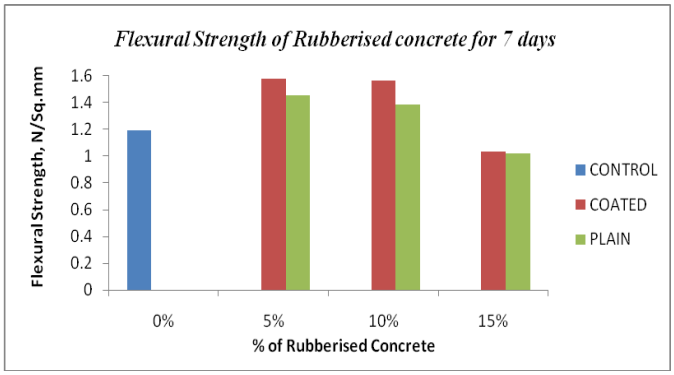

Figure 8. Flexural strength of Rubberised concrete for 7 days

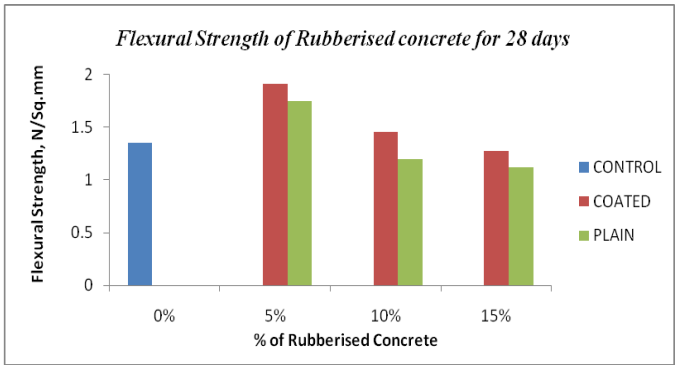

Figure 9. Flexural strength of Rubberised concrete for 28 days

Figure 10 Failure of rubberised Concrete beam

IV. CONCLUSION

1. In the workability test result, it was observed that as the percentage of rubber increased the workability decreased.
2. It was concluded from the present study that less percentage of rubber can only be used in concrete mix.
3. It is found that for both coated and plain rubber exhibited mere difference in the strength behavior.

4. There was comparatively decrease in compressive and splitting tensile strength of rubberized concrete that that of the controlled concrete.
5. It was observed in flexural test that rubberized concrete showed better result while comparing to the controlled concrete. But its strength got decreased as the percentage of rubber increased.

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