Compressive Strength of Concrete using Waste Tyre Rubber

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Abstract

At present the disposal of waste tyres is becoming a major waste management problem in the world. It is estimated that 1.2 billion of waste tyre rubber produced globally per year. Tyres tend to re-emerge in time from the dump and micro-organisms may take more than 80 years to biodegrade them. In this context, our present study aims to investigate the optimal use of waste tyre rubber. This research paper explores a detailed study of compressive strength of concrete by using waste tyre rubber as percentage replacement of coarse aggregate. Conventional mix M-25 and M-30 are designed as per IS 10262:2009. The waste tyre rubber is chipped according to specified shape so as to ideally replace coarse aggregate (2.5% & 5%). Total 54 concrete cube specimens were casted including specimen with and without replacement of coarse aggregate.The compressive strength test were conducted after 7days, 14 days and 28 days of curing. The replacement of coarse aggregate was effective and compressive strength was increasing in the case of 2.5% replacement in both mix (M-25 and M-30). The use of waste tyre rubber in the concrete results into benefits of better disposal of waste rubber and also increased the characteristics strength of concrete.
Keywords: Compressive Strength, Eco-friendly Concrete, M-25 and M-30, PPC, Waste Tyre Rubber

I. INTRODUCTION

An estimated 1000 million tyres reach the end of their useful lives every year. At present enormous quantities of tyres are already land filled. Tyre land filling is responsible for a serious ecological threat. Mainly waste tyres disposal areas contribute to the reduction of biodiversity also the tyres hold toxic and soluble components. Secondly although waste tyres are difficult to ignite, this risk is always present. Once tyres start to burn down due to accidental cause's high temperature take place and toxic fumes are generated besides the high temperature causes tyres to melt, thus producing oil that will contaminate soil and water.
Millions of tyres are just being buried all over the world. Tyre rubber wastes are already used for paving purposes; however, it can only recycle a part of these wastes. Some research has already been conducted on the use of waste tyre as aggregate replacement in concrete showing that a concrete with enhanced toughness and sound insulation properties can be achieved. Rubber aggregates are obtained from waste tyres using two different technologies mechanical grinding at ambient temperature and cryogenic grinding at a temperature below the glass transition temperature.

II. OBJECTIVE

The objectives of this study are:
1) An alternative way of recycling rubber by incorporating them into concrete construction.
2) To introduce an eco-friendly technology by incorporating rubber into concrete, which can benefit the society and the nation.
3) To study effect of rubber on compressive strength of concrete.

III. METHODOLOGY

Mix were design after conducting tests on materials like specific gravity, consistency, final and initial setting time and sieve analysis. Specimens were casted and tested for compressive strength and results were compared with nominal mix. For 2.5% replacement of waste tyre rubber the compressive strength of concrete is increased.

IV. EXPERIMENTAL INVESTIGATIONS

A. Tests on Material:

Tests were conducted on cement, fine aggregate and coarse aggregate which are shown in following tables.
Portland Pozzolana cement was used as per IS 1489: 1991

Table – 1
Test on Cement

Test	*Results*
Specific Gravity	*2.92*
Consistency	*34%*

Natural sand were used as fine aggregate confirming to IS 383- 1970.

Table – 2
Test on Fine Aggregate

Test	*Results*
Specific Gravity	*2.64*
Gradation	*Zone 2*

Coarse aggregate of size 20 mm maximum as per IS 383-1970.

Table – 3
Test on Coarse Aggregate

Test	*Results*
Specific Gravity	*2.76*
Aggregate impact value	*30.33%*
Aggregate crushing value	*17.87%*

Rubber chips of size 15mm*15mm and thickness 5mm each.

Total four composition of concrete mix were casted with different proportion of rubber (2.5% and 5%) and experimental investigation is carried out in the table shown below

Table – 4
Mix Proportions

MIX		*PROPORTIONS*
		PPC +FA + CA
MIX (M25)	*MIX A*	*PPC +FA + CA + 2.5% RUBBER*
	MIX B	*PPC +FA + CA + 5% RUBBER*
MIX (M30)	*MIX C*	*PPC +FA + CA + 2.5% RUBBER*
	MIX D	*PPC +FA + CA +5% RUBBER*

B. Abbreviations

PPC: - Portland Pozzolana Cement, FA: - Fine Aggregate, CA: - Coarse Aggregate.

1) Test on Hardened Concrete

Compressive strength test was conducted to evaluate the strength of concrete at 7days, 14 days and 28 days of different compositions and following results were obtained.

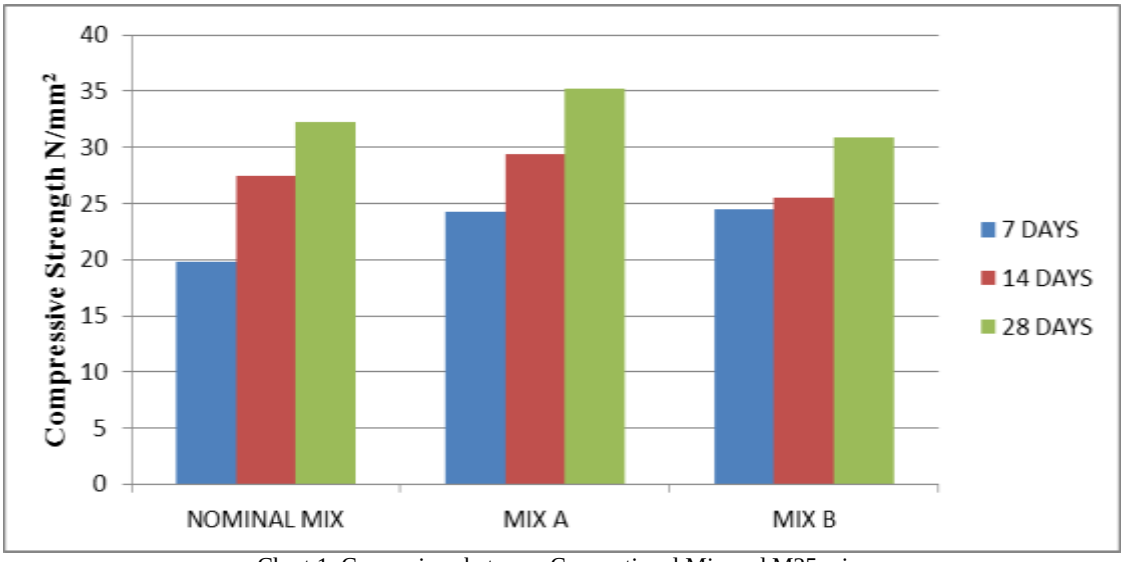

Chart 1: Comparison between Conventional Mix and M25 mix.

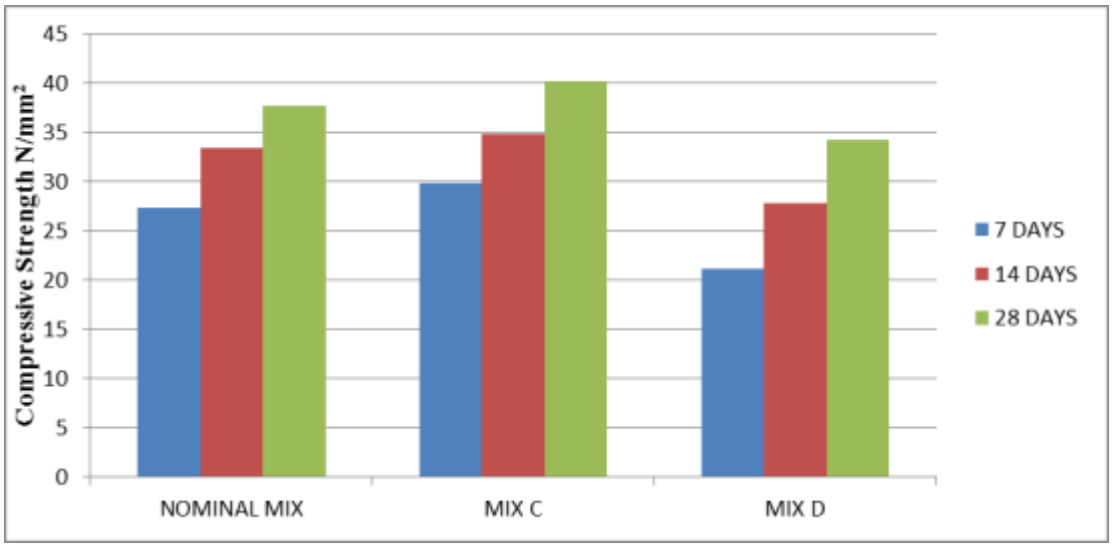

Chart 2: Comparison between Conventional Mix and M30 mix.

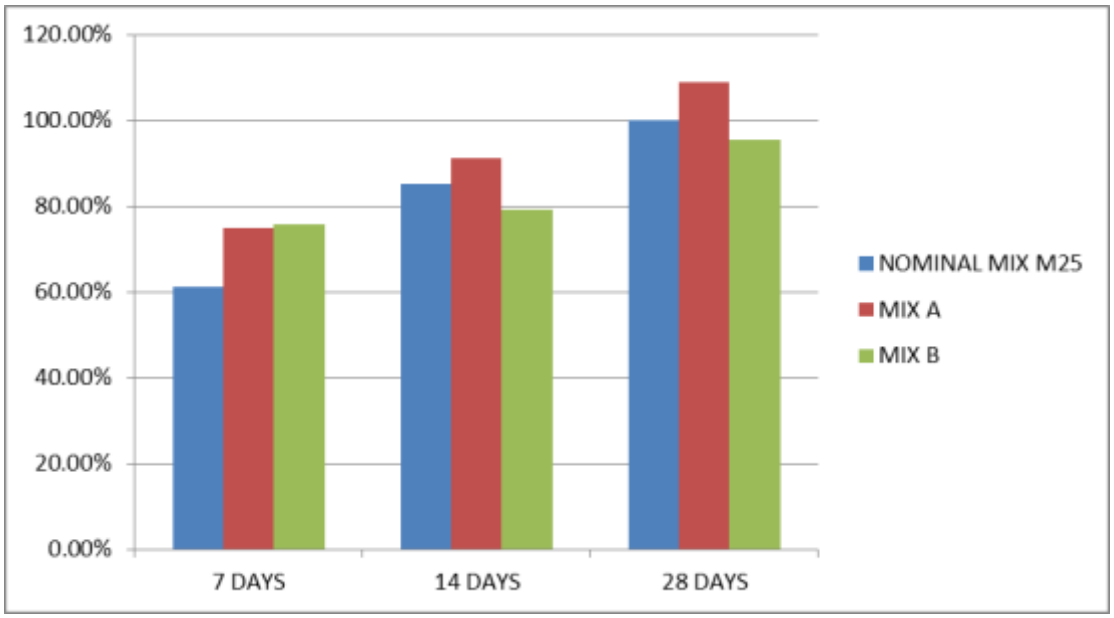

Chart 3: Percentage gain of 28 days nominal mix strength of various mixes at different stages.

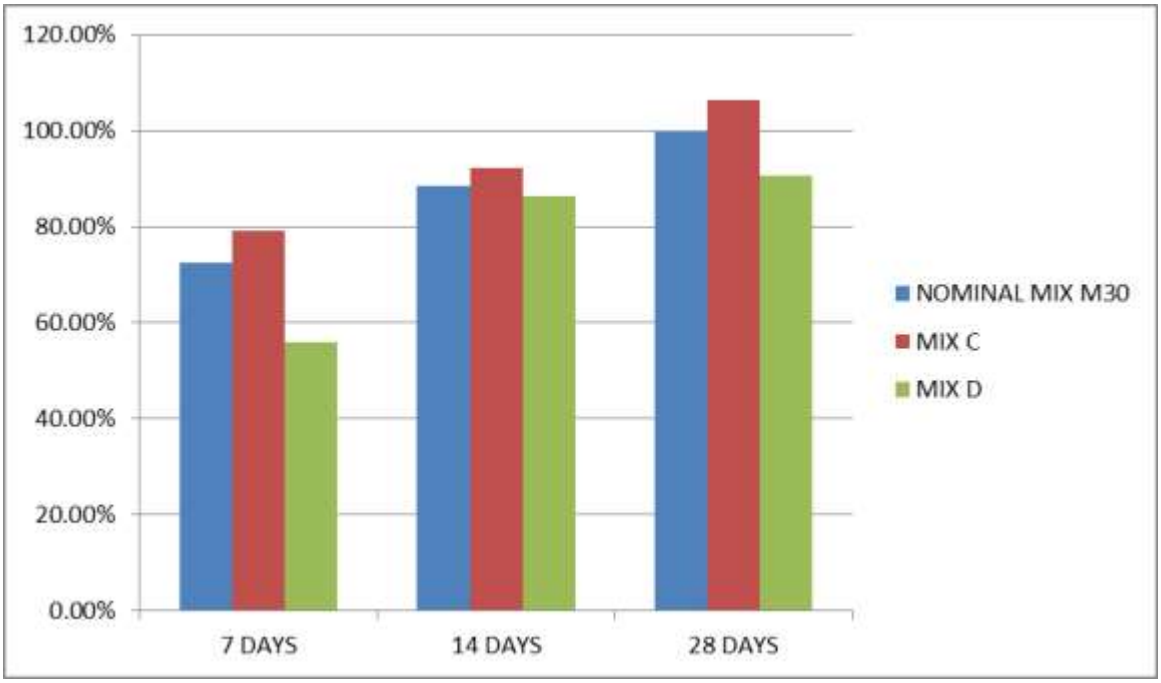

Chart 4: Percentage gain of 28 days nominal mix strength of various mixes at different stages

V. CONCLUSION

Based on the experimental results the following points are summarized with respect to the effect of rubber on the compressive strength of concrete:

- Compressive strength of concrete is increased with the addition of 2.5 % rubber.
- Results are more effective for Mix M25 as compared to Mix M30 for a replacement of 2.5% coarse aggregate by rubber.
- Compressive strength of concrete is slightly decreased with addition of 5% of rubber.
- Using rubber as a replacement of coarse aggregate is one of the economical way for their disposal in an eco-friendly manner.

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