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WASTE TYRES AS A PARTIAL REPLACEMENT OF COARSE AGGREGATE

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ABSTRACT

It is estimated that more than 270 million scrap-tyres weighing more than 3 million tons are produced in the United States each year. This waste being non biodegradable poses severe fire, environmental and health risks. Aside from tyre derived fuel, the most promising use of recycled tyres is in engineering applications as artificial reefs, erosion control and aggregates for asphalt and concrete. The use of ***recycled tyre rubber*** *as partial aggregate in concrete has great potential to positively affect the properties of concrete in a wide spectrum. It is a perfect way to modify the properties of concrete and recycle rubber tyres at the same time. The objective of this research is to test the properties of concrete when recycled rubber from automotive tyres is used as a partial aggregate. Special attention is being given to the use of modified surface rubber. Pre-treating the rubber with a sodium hydroxide (NaOH) solution modifies its surface, affecting the interfacial transition zone (ITZ) and allowing the rubber to better adhere with the cement paste. The quantities of concrete produced worldwide for such applications could ensure the viability of this product. Therefore, this type of concrete shows promise for becoming an additional sustainable solution for tyre rubber waste management.*

I.INTRODUCTION

The use of recycled tyres as partial aggregate in concrete has been considered for several years. Previous research conducted show dramatic changes **in the mechanical properties of concrete when rubber is introduced to the mix**. A tyre is a composite of complex **elastomer** formulations, fibers and steel/fiber cord. Rubber is the principal element of tyre, making up about 85% of the tyre where both synthetic and natural rubbers may be used. Natural rubber is an elastic hydrocarbon polymer which occurs as a milky colloidal secretion in the sap of several varieties of plants. Rubber can also be produced synthetically, as a thermo set polymeric material in which individual monomer chains are chemically linked by covalent bonds during polymerization. Previous research has shown that the use of rubber particles in concrete mixes decreases the compressive strength of hardened concrete. It has been reported that the mechanical properties of concrete rubber containing concrete takes place due to the weak adhesion between the rubber particles and the cement paste. In order to address this issue, the modification of the rubber particles surface has been suggested in this project. Sodium hydroxide (NaOH), also known as lye or caustic soda, is a caustic metallic base due to its causticity; it is a perfect substance to modify the surface of rubber in order to **improve the interfacial transition zone (ITZ) in the concrete matrix.** However, one thing is clear; **the introduction of recycled rubber aggregate changes the properties of concrete.**

II.SOME FACTORS

Rubber filled concrete tends to have a reduction in slump and density compared to ordinary Portland cement concrete (OPC). Reduction of around 85% on slump has been reported when comparing traditional aggregate concrete with mixes containing recycled rubber. These values include mixes prepared using partial replacement of natural aggregates by rubber particles treated with sodium hydroxide (NaOH) solution.

Higher air content in concrete mixtures containing rubber when compared to control mixtures, even without any air-entrainment admixtures being introduced, has been reported. This behavior may be due to the non-polar nature of rubber particles and their tendency to entrap air on the particles surface.

The compressive and tensile strength of rubber containing concrete is affected by the size, shape, and surface textures of the aggregate along with the volume being used indicating that the strength of concretes decreases as the volume of rubber aggregate increases. However, discrepancies have been reported on **the effect of recycled rubber size aggregate on the compressive strength of concrete**. Concrete containing rubber aggregate has a higher energy absorbing capacity referred to as toughness. The investigation on the comparison of the toughness of a control concrete mixture with that of a rubber containing concrete mixture. Data showed that **the presence of rubber in concrete increases toughness**.

III.WASTE TIERS MOUNT

“If this situation continues and it “**Leads to the disaster**”

IV.EXRIMENTATION

All mixes prepared for testing had a water to cement ratio of 0.45. The same natural aggregates and rubber were used for two test programs, **Test program I** consisted of four concrete mixes: one control mix with no recycled shredded tyre and three mixes with 10%, 15% and 20% replacement of natural aggregate by volume. The recycled shredded tyre used in test program I was not subjected to any surface modification treatment.

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Test program II consisted of three concrete mixes prepared with partial replacement of natural aggregate on the amount of 10%, 15%, and 20% by volume.

The recycled tyre aggregate used for this test program was of the same origin as test program I, but it was pretreated with a saturated sodium hydroxide (NaOH) solution to modify the surface of the particles and improve the adhesion between the cement paste and the rubber particles. Pretreatment consisted of soaking the recycled tyre particles in a NaOH solution for a period of 20 minutes, then washed under running water and left to air dry at room temperature.The workability of all fresh mixes was then assessed using the slump test. The specimens were then placed in moulds and compacted.

It should be noted that some difficulties were experienced during hand compaction of the samples (using a **standard rammer**) due to the tyre aggregates generating some spring action. Moreover, when using mechanical compaction (**vibrating table),** the finishing on the higher percentage samples (30% and 40%) containing coarse rubber aggregate was very poor with the top surface of the sample becoming irregular as the lighter material (rubber) was surfacing during compaction.

The compacted specimens were de-moulded 24 hours after casting and placed in a steel tub of water, to cure at a minimum temperature of 20oC for 7 and 28 days respectively.

A number of tests on the hardened mixes were then performed, including cube compressive strength (100mm and 70mm cubes), split-cylinder tensile strength, static modulus of elasticity of beams in compression and flexural strength test. The **stress-strain behaviour** of the cube samples was also continuously monitored during the compression tests, using a load cell and a displacement transducer connected to the ram. To assess repeatability, three specimens were tested for each mix.

On adding rubber mix to the concrete all the **properties of the concrete** is **changed** such as, density, split tensile strength, workability, modulus of elasticity, compressive strength etc.

For example take compressive strength of concrete while adding the rubber following changes may occurred,

Table1. Percentage decrease of compressive strength for concrete mixes used in test program I

Age percentage shredded rubber tyre (days) (by volume)			
	10%	15%	20%
7	-37.68	-54.03	-55.29
14	-43.59	-55.17	-61.57
28	-38.58	-53.87	-59.22

Table 2. percentage decrease of compressive strength of concrete mixes used in test II

Table 3. percentage increase in compressive strength by modifying surface treatment on rubber tyre particles

Percentage shredded rubber tyre (by volume)			
	10%	15%	20%
7	-34.11	-53.52	-25.92
14	-39.15	-43.64	-29.15
28	-29.59	-49.38	-36.46

Tables 1 and 2 shows the percentage change in compressive strength with respect to control mix, by addition of untreated and treated shredded recycled tyre respectively.

Table 3 shows the percentage **increase in compressive strength** for each mix by modifying surface treatment of the rubber particles compared to concrete containing untreated rubber particles.

V.CONCLUSION

From the present experimental study and literature review it can be concluded that despite the observed lower values of the mechanical properties of concrete there is a potential large market for concrete products in which inclusion of **rubber aggregate would be feasible.**

These can also include non primary structural applications of medium to low strength requirements, benefiting from other features of this type of concrete.

Even if rubber tyre aggregate was used at relatively low percentages in concrete, the **amount of waste tyre rubber could be greatly reduced** due to the very large market for concrete products worldwide.

Therefore the use of discarded tyre rubber aggregates in concrete shows **promise for developing an additional route for used tyres.**

Hence this rubber concrete would play a vital role in both **economic aspects** and **strength aspects**, and we sure that this project would helps the future in **control of the environmental pollution**.

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