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The Engineering Properties of Light Weight Concrete Containing Recycled Tire Rubber Powder in Jaresh City

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Abstract:- Solid waste materials are one of the most significant environmental problems all over the world. Therefore in-order to avoid environmental pollution it is important to reuse these scrap tires. There for in this study experimental works have been done to evaluate the influence of adding tire rubber powder in concrete in terms of compressive strength and workability. The rubber powder were used to replace 0%, 1%,5%,15% and 25% of the total minerals of cement volume in concrete. Results revealed that the average compressive strength at age 28 days was decreased up to 10.9%, 13.31 %, 25.1%, 32.2%, 48.3% by adding rubber powder 1%, 5%, 15% and 25% respectively. So that adding rubber powder has significant effect of reducing the compressive strength. The slump test for sample without rubber is 90 mm, it was also observed that the slump is reduced by increasing the amount of rubber to the concrete, so that adding rubber 25% of cement gives slump of 73 mm. According to this study it was not recommended to use rubber powder as cementation material in concrete because it observed that adding more rubber results in decreasing the compressive strength of concrete and these phenomena is not preferable.

Keywords:- *Rubber powder, environmental pollution, compressive strength, concrete.*

I. INTRODUCTION

Solid waste materials are one of the most significant environmental problems all over the world. Therefore in-order to avoid environmental pollution it is important to reuse these scrap tires. Therefore using tire rubber in construction's elements is an alternative way to recycle this residue. The main objective of this research is to protect natural resources. Another aim of this study is to evaluate and compare the engineering properties of concrete blocks with and without rubber in terms of workability and compressive strength.

II. LITERATURE REVIEW

There were many researchers reported about the effect of using waste rubber in concrete. Recent technological advances in crumb rubber production have enabled the manufacture of smaller particle sizes, resulting in expanded applications in molded rubber and composite products [(1)]. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, size and proportions of mix, method of compaction and curing.[(2)] The adoption of light weight concrete gives an outlet for industrial waste such as scrap rubber tires, flash, clinkers etc. which otherwise creates problem for disposal of waste. Scrap tire rubber and flash are two major industrial wastes which are accumulating in huge volume every year. Disposal of these organic and inorganic wastes is a serious problem due to severe environmental problems.[(3)] With the development of technology, construction industry has opened a gateway for handling these industrial wastes. Recycling of non-degradable wastes, particularly discarded rubbers tire has become a major issue since these materials have been banned from landfills and also incineration of these wastes is not environmental friendly. Rubber-modified asphalt uses stress absorbing membranes that reduce the reflective cracking because of its elastic properties. With less cracks, there are fewer repairs, so crumb rubber assists in reducing maintenance costs. [(4,5)] The pavement has an increased lifespan because after multiple uses and exposure to different elements, regular asphalt loses elasticity over time. The use of the artificial rubber resists the formation of cracks and has an anti-aging effect that keeps the asphalt in a better condition.

III. RESEARCH APPROACH

The engineering properties of concrete cube mixed with recycled rubber were prepared. The properties of material that used in the study are obtained and some tests are conducted such as sieve analysis tests for course aggregate and slump tests for fresh concrete with and without recycled tire rubber. To achieve the previous objectives an experimental research program has been carried out where the influences of adding tire rubber on concrete mixed component are studied. In this study the following ratio of tire rubber that added to concrete mixed component are (0%, 1%, 5%, 15% and 25 % of cement ratio). The following experimental tests are conducted during the research period:

- Sieve analysis test for aggregate material
- Slump test for fresh concrete with and without rubber
- Compressive test (concrete cube with and without rubber at age of 7 day, 14 days and 28 days)

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IV. WORK PLAN AND EXPERIMENTAL STUDY

After determination of engineering properties (grain size distribution, specific gravity,) of basic materials such as (course/fine aggregate and sand), a mix design is conduced to prepare the specimen according to the categories mention above. The mix design ratio that used in this study is (1:2:2.6), whereas the rubber powder ratio is added according to these categories:

- 0% ,Null rubber powder
- 1% of cement ratio
- 5% of cement ratio
- 15% of cement ratio
- 25% of cement ratio

The following table gives the details of course/fine aggregate and cement ratio that used for samples preparation.

Rubber Powder (kg)	Fine Aggregate (kg)	Corse Aggregate (kg)	Cement (kg)	Water (kg)	Rubber (%) / cement
0	14.883	18.933	7.1680	4.374	0 %
0.0716	14.883	18.933	7.0963	4.374	1 %
0.1433	14.883	18.933	7.0246	4.374	5 %
0.7168	14.883	18.933	6.4512	4.374	15 %
1.0752	14.883	18.933	6.0928	4.374	25 %

Table 1. Illustrate the Mix Design Ratio Details of Specimens

V. EXPERIMENTAL RESULTS AND DISCUSSION

The average compressive strength of the sample without rubber at the age of 7 days is 21.33 MPa and this value is reduced by 10.74% , 19.1%, 36.1%,36.7% and 52.1 % when added rubber ratio of 1%,5%,10%,15% and 25% respectively. So that adding rubber has significant effect of reducing the compressive strength. At the age of 14 days, the average compressive strength of the specimen without rubber is 24.04 MPa and this value is reduced by 1.04%, 25.4%, 29.5%, 35.5% and 50.3% due to adding rubber ratio of 1%, 5%, 10%, 15% and 25% respectively. . Figure 1 shows the average compressive strength of samples with different rubber ratio and table 2, illustrates test results for all samples.

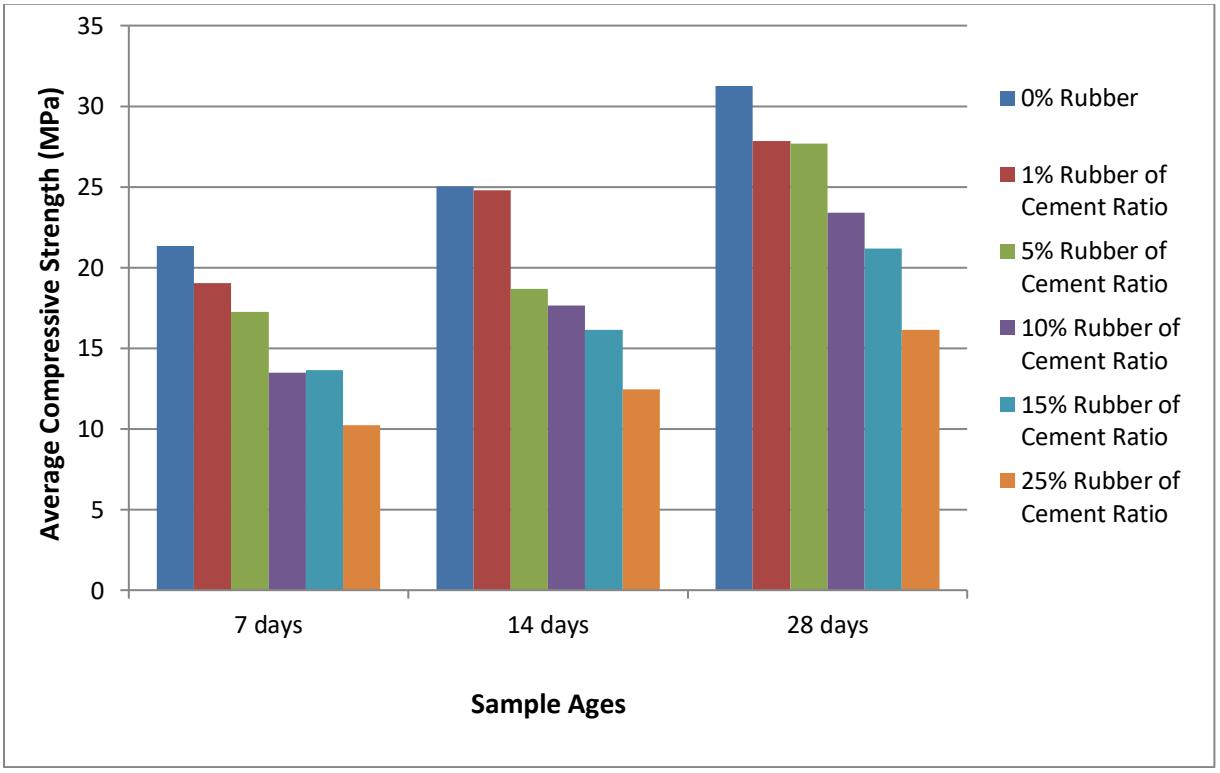

Fig 1:- Shows the average compressive strength of samples with different Rubber Ratio

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In addition, The average compressive strength of the sample without rubber at the age of 28 days is 31.26 MPa and this value is reduced by 10.9% , 13.31%, 25.1%,32.2% and 48.3 % when added rubber ratio of 1%,5%,10%,15% and 25% respectively. So that adding rubber has significant effect of reducing the compressive strength, so that the reduction ratio reaches until 48%. The following Figure shows the test result of the average compressive strength of samples with different rubber ratio. Figure 1 shows the average compressive strength of samples with different rubber ratio and table 2, illustrates test results of all samples.

Sample Type	Sample Composition Rubber Powder (%)	Sample Age (Days)	Average Compressive Strength (MPa)	Standard Error	Specific Compressive Strength (MPa/Kg/m^3)
cube	0	7	21.33	0.181	9.7
-	1	7	19.04	0.604	8.6
-	5	7	17.26	0.319	7.8
-	10	7	13.05	0.098	5.9
-	15	7	12.03	0.276	5.5
-	25	7	10.23	0.181	4.6
Cube	0	14	25.04	0.456	11.4
-	1	14	24.78	0.363	11.3
-	5	14	18.67	0.357	8.5
-	10	14	17.63	0.381	8.0
-	15	14	16.15	0.452	7.3
-	25	14	12.44	0.373	5.6
Cube	0	28	31.26	0.378	14.2
-	1	28	27.85	0.637	12.6
-	5	28	27.7	0.802	12.6
-	10	28	23.41	0.582	10.6
-	15	28	21.2	0.617	9.6
-	25	28	16.15	0.377	7.3

Table 2. Illustrates Test Results for All Samples

VI. CONCLUSION

- The results show that for all the tests, the use of the rubber effect on the workability of the concrete. Although the flow test showed that the use of tire rubber decrease the mix workability, there is less difference between the specimens with and without tire rubber.
- The mechanical properties such as compressive strength, gives significant decreases when adding rubber. It has been observed that the reduction of compressive strength reach until 50%, when adding 25% rubber. According to this investigation it is recommended that the use of the rubber should be range between (1%-5% or less of cement ratio).
- The standard error for all samples range between 0.18 - 0. 8, which indicated of the accuracy of the average value of compressive strength.

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