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# Experimental Investigation On Use Foundry Sand And Crumb Rubber In Concrete

**Mr. Shubham Garud[1], Mr. Suraj Kawar[2], Mr. Akshaykumar Desai[3], Mr. Rahul Hirave[4]**

**Ms. Shital Patage[5]**

Student, Civil Engineering, Anantrao pawar college of engineering and research, Pune, India[1-4]

Assistant Professor, Civil Engineering, Anantrao pawar college of engineering and research, Pune, India [5]

**Abstract**: The disposal of used tyres and waste foundry sand is a major environmental problem throughout the world which causes environmental hazards. Crumb rubber and foundry sand is a waste material that is ideal for use in concrete applications. The aim of the study is achieved to use of crumb rubber and foundry sand as a partial replacement of fine aggregate to produce M25 concrete. An experimental investigation is carried out on concrete containing crumb rubber and foundry sand in the range of 0, 5, 15, and 25% by weight of fine aggregate are cast and test for compressive strength and split tensile strength. Material was produced, tested and compared with conventional concrete in terms of workability and strength. These test were carried out on standard cube of 150*150*150mm and cylinder of 150*300mm for 7 and 28 days to determine the mechanical properties of concrete. The aim of this research is to know the behavior and mechanical properties of concrete after addition of industrial waste in different proportion by tests like compressive strength and split tensile.

## 1.INTRODUCTION

In recent decades, worldwide growth of automobile industry and increasing use of car as a means of transport has tremendously boosted tire production. his has generated massive stockpiles of used tires. Big amounts of used rubber tires accumulate in the world each year-275 million in the United States and 180 million in European Union. About 33 million vehicles are being added to Indian roads in last three years. About80 million tires are part of these 33 million vehicles which include two, three, four and six wheelers. After the use of these tires they are thrown away and cause environmental mal-effects. One of the most popular methods of disposal is to pile used tires in landfills, as due to low density and poor degradation they cannot be buried in the landfills. These tires are also been placed in dump, or basically piled in a large hole in the ground. However, these dumps serve as a great breeding ground for mosquitoes which cause diseases. In India the usage of tires for burning in cement kilns is up to 20000 tons per year. In industry large amount of waste tires are utilized as fuel, pigment soot, in bitumen pastes, roof and floor covers and for paving industries.

Metal industries use foundry sand w hich is uniform sized, high quality silica sand that is bound to form a mold for casting of ferrous and non-ferrous metal. Finer sand than normal sand is used in metal casting process. The burnt sand after the casting process of metal is reuse for many times but when it cannot be longer used it is removed from foundry as a waste for disposal known as "Waste foundry sand". Use of waste foundry sand as a partial replacement or total replacement by fine aggregate in concrete leads in production of economic, light weight and high strength concret.

The phenomenon of reusing UFS in applications other than landfills is quite well established in places like Europe, England and North America, where UFS is utilized in manufacturing of cement, concrete, asphalt, bricks & controlled low strength material (CLSM). Some of these reuse options are beginning to be adopted in some developing countries like India. Metal industries use foundry sand w hich is uniform sized, high quality silica sand that is bound to form a mold for casting of ferrous and non-ferrous metal. Finer sand than normal sand is used in metal casting process. The burnt sand after the casting process of metal is reuse for many times but when it cannot be longer used it is removed from foundry as a waste for disposal known as "Waste foundry sand". Use of waste foundry sand as a partial replacement or total replacement by fine aggregate in concrete leads in production of economic, light weight and high strength concrete.

## 2. LITERATURE REVIEW

In every paper and article author gives many objectives of use of crumb rubber and foundry sand in concrete. These objectives are very important for studying usefulness of crumb rubber and foundry sand in concrete which reduce the major environmental problem of disposal of used tyres and waste foundry sand the world.

### 2.1. COLLECTION OF DATA

- **Evaluation of Concrete Compressive Strength by incorporating Used foundry sand.**

Khuram Rashid, Prof. Dr. Muhammad Akram Tahir. **(JUNE 2012)**

**Key Words:** Used Foundry Sand, FBC FSS.

After 28 days the difference of strength between concrete mixtures with 10% UFS and control mixture was least distinct. Strength loss in UFS concrete mixtures was due to presence of anti-binder in the form of very fine powder of carbon and clay in the UFS, which resulted in lack of contacts between the aggregates and cement paste**.** FPR concrete mixtures showed somewhat favorable strength results as compared to FBC and FSS concrete mixtures. It achieved almost same strength as CC mixture at 63 days of curing. FSS concrete mixture showed lower strength values than FPR and FBC concrete mixture..

- **A Study on Foundry Sand: Opportunities for Sustainable and Economical Concrete.**

Dr. Jayeshkumar Pitroda, Jaydev JAGMOHANDAS Bhavsar **(OCT 2013)**

**Key Words:** Sustainable Development, Greener Concrete

It stated that for 1 $m^3$ M20 grade of concrete consumption of fine aggregate is 538.45 kg. Here in specimen M-4 we replace fine aggregate by 162 kg of foundry sand for 1m3 M20 grades of concrete. So, we can say that up to 30% foundry sand utilized for economical and sustainable development of concrete. Uses of foundry sand in concrete can save the metal industry disposal costs and produce a 'greener' concrete for construction. An innovative supplementary Construction Material is formed through this study.

In the present study, effect of foundry sand as fine aggregate replacement on the compressive strength of concrete having mix proportions of 1:1.45:2.20:1.103 was investigated. The percentages of replacements were 0%, 10 %, 20% and 30 % by weight of fine aggregate. Tests were performed for compressive strength for all replacement levels of foundry sand at different curing periods (28-days & 56-days).

- **Use of Foundry Sand in Conventional Concrete. (JUNE 2013)**

Pranita Bhandari, Dr.K. M. Tajne.

**Key Words:** Foundry sand, Compressive strength.

The above graph shows that the compressive strength of concrete gradually increases with the increase in % off foundry sand only up to 20% replacement and the strength goes on decreasing rapidly after further increase in foundry sand percentage. The initial strength of the concrete for 20% replacement is 1.11 N/mm2 more compared to that of conventional concrete and 13.89 N/mm2 more compared to that of the 30% replaced block. The final strength of the 40% replaced sample is 67.6 % less compared to that of 20% replacement. The final strength of the concrete for 30% and above is found to be less than the initial strength of the conventional concrete.

- **Rubberized concrete: Needs of good environment ( MARCH 2013)**

Parveen Jangra, Sachin Dass

**Key Words:** Crumb Rubber, Rubberized concrete.

The test results of this study indicate that there is great potential for the utilization of waste tires in concrete mixes in several percentages, ranging from 5% to 20%. Based on present study, the following can be concluded: Concrete with higher percentage of crumb rubber possess high toughness The slump of the modified concrete increases about 1.08%, with the use of 1 to 10% of crumb rubber. Energy generated in the modified concrete is mainly plastic. Stress strain shows that concrete with a higher percentage of crumb rubber possess high toughness, since the generated energy is mainly plastic .Failure of plain and rubberized concrete in compression and split tension shows that rubberized concrete has higher toughness. The split tensile strength of the concrete decreases about 30% when 20% sand is replaced by crumb rubber. The flexural strength of the concrete decreases about 69% when 20% sand is replaced by crumb rubber. The compressive strength of the concrete decreases about 37% when 20% sand is replaced by crumb rubber.For large percentage of crumb rubber the compressive strength gain rate is lower than that of plain concrete. With the addition of the crumb rubber, the reduction in strength cannot be avoided. However, these data provide a preliminary guideline of the strength-loss of locally produced modified concrete in comparison with the conventional concrete of 30 MPa targeted strength.

- **Use of used foundry sand in concrete. (FEB 2014)**

Kacha Smit, Abhay V Nakum, Ankur Bhogayata.

**Key Words:** Workability, Durability.

Based upon above literature review it could be concluded that all researchers gave their findings with concrete up to 30-40% replacement of fine aggregate with foundry sand in which compressive and tensile strength is increased up to 20% whereas not much change occurs in modulus of elasticity. Also workability is decreases with the increase of foundry sand content because of very fine particles. However, all researchers noted that concrete made with foundry sand can be suitably used in making structural grade concrete. But, very few researchers go up to 100% replacement where strength and durability criteria needed to be studied further effectively in future.

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❖ **Application of Waste Foundry Sand for Evolution of Low-Cost Concrete**

Pathariya Saraswat, Rana Jaykrushna , Shah Palas. **(JAN 2016)**

**Key Words:** foundry sand, Tensile Strength, Compressive strength

Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete. In this study, maximum compressive strength is obtained at 60%replacement of fine aggregate by waste foundry sand. Split tensile strength decrease on increase in percentage of waste foundry sand Use of waste foundry sand in concrete reduce the production of waste through metal industries i.e. it's an eco-friendly building material. The problems of disposal and maintenance cos of land filling is reduced. Application of this study leads to develop in construction sector and innovative building material.) The result of percentage cost change reduces upto 3.5 for 60% replacement of waste foundry sand. This shows that the concrete produced is economical.

❖ **Recycled Rubber as an Aggregate Replacement in Self-Compacting Concrete.**

Robert Buši´c, Ivana Miliˇcevi. **(AUG 2018)**

**Key Words:** Crumb Rubber, Aggregate Replacement.

Waste tire rubber can be used as a replacement aggregate material in self-compacting concrete. Many scientists conducted their experimental work by replacing fine aggregate with rubber aggregate, likely because of the better results that were obtained from experiments with fine aggregate replacement as compared to results obtained with coarse aggregate replacement. On behalf of future investigations, it can be suggested that experimental investigations of concrete properties should be investigated with fine aggregate replacement, perhaps with even smaller rubber particles such as waste tire powder. From relationship between overviewed fresh and hardened properties of concrete with number of analysed test results for each property depending on concrete type it can be concluded that further experimental work on properties of self-compacting rubberized concrete still needs to be conducted, because of its high potential to be used in structural applications.

❖ **Rubber concrete: Mechanical and dynamical properties. (JUNE 2018)**

Samer A. Fawaz Camille A. Issa Najib N. Gerges.

**Key Words:** Dolomite Particles , Powdered Rubber.

The concrete cylinders without rubber failed by splitting into two halves during the splitting tensile tests as shown in Fig. 14, whereas the rubberized concrete cylinders displayed a more cohesive behavior that is failing without splitting as shown in Fig. 15. The replacement of sand by powdered rubber has increased the occurrence of concrete to crack starting under the impact drop load. The failure occurs rapidly in rubberized concrete. Therefore, it could be deduced that the rubber with small size (no particle bridging) has a little effect in delaying the crack spirit in concrete. All the specimens are split into separate parts under the effect of the impact force. No visible cracks were noticed in each of the separated parts and no dislocated dolomite particles were found across the fractured surface. This may be due to the good bond between the mortar and the dolomite. Therefore, the favorable crack path is across the dolomite particles not around the surface of the particles. There is no particle bridging found in the case of rubberized concrete because the small size of the powder rubber.

Concrete with higher percentage of crumb rubber possess high toughness The slump of the modified concrete increases about 1.08%, with the use of 1 to 10% of crumb rubber. Energy generated in the modified concrete is mainly plastic. Stress strain shows that concrete with a higher percentage of crumb rubber possess high toughness, since the generated energy is mainly plastic Failure of plain and rubberized concrete in compression and split tension shows that rubberized concrete has higher toughness. The split tensile strength of the concrete decreases about 30% when 20% sand is replaced by crumb rubber.

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❖ **Experimental investigation on durability performance of rubberized concrete.**

Erhan Güneyisi, Mehmet Gesoğlu, Süleyman İpek. **(JUNE 2019)**

**Key Words:** Rubberized Cconcrete, Silica.

Based on the findings presented in this study, the following conclusions can be drawn. the water absorption of rubberized concrete was observed to be decreased by utilization of silica fume. However, at 25% rubber content level, silica fume had a tendency to lose its effectiveness. The gas permeability coefficients of rubberized concrete were also reduced by silica fume addition. Moreover, after 5% rubber content, gas permeability test failed due to high amount of porosity. Water permeability of rubberized concrete reached the 150 mm, which is the dimension of test specimen, in both concrete with and without silica fume at 25% rubber content. However, silica fume had distinguishable effect on water permeability of concretes containing less than 25% rubber content

The strength reduction may be attributed to two reasons. First, because the rubber particles are much softer (elastically deformable) than the surrounding mineral materials, and on loading, cracks are initiated quickly around the rubber particles in the mix, which accelerates the failure of the rubber–cement matrix. Second, soft rubber particles may behave as voids in the concrete matrix, due to the lack of adhesion between the rubber particles and the cement paste.

❖ **Experimental Investigation of the Mechanical and Durability Properties of Crumb.**

Hanbing Liu Xianqiang Wang Yubo Jiao **(APRIL 2019)**

**Key Words:** Crumb Rubber, Modulus of elasticity.

In this paper, crumb rubber concretes with different replacement forms and replacement levels were produced. The effect of the volume content of crumb rubber and pre-treatment methods on the performances of concrete was investigated. The following conclusions have been obtained. Adding crumb rubber into concrete resulted in a significant decrease of the mechanical properties, but increased the durability. The effect caused by replacing the mixture with crumb rubber as higher than that caused by fine aggregate replacement. Compressive strength, splitting tensile strength, axial compressive strength and the modulus of elasticity were reduced with the increasing percentage content of crumb rubber, while freezing-thawing resistance and sulphate resistance were improved.

## 3.METHODOLOGY

1. The conventional sand will be replaced by waste foundry sand in M25 grade of concrete.
2. For compressive strength 3 cubes of size 150x150x150 mm will be casted for 7 and 28 day's strength.
3. For tensile strength 3 cylinders of diameter 150 mm and height 300 mm will be casted for 7 and 28 day's strength
4. The percentage replacement of conventional sand will be 5% 15% and 25%. To study the above mentioned properties.
5. For compressive, tensile and flexural strength IS 516 [2018] – PART IV – [testing of hardened concrete] will be used.
6. For determination of properties such as specific gravity, fineness modulus, initial and final setting time of cement, water absorption etc. IS 4031[1988] – PART VI will be used.
7. For mix design of the concrete mix IS 456 [2000] and IS 10262 [2009] will be considered

## 4. CONCLUDING REMARK

1. By replacing fine aggregate by 5% Foundry Sand & Crumbed Rubber the cost of concrete get economized without compromising with quality.
2. We determine the compressive strength and tensile strength of cubes & cilenders. and compare it with the conventional concrete.
3. It is concluded that when the percentage of foundry sand & Crumbed Rubber is increased it Decreased the Compressive strength of the concrete. So we can do replacement upto 5% only to get good results.

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