

## International Journal of Innovative Research in Science, Engineering and Technology

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# Durability and Bond Behaviour of Treated Used Foundry Sand Concrete

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**ABSTRACT:** Concrete is a born to the construction industry. In concrete fine aggregates are obtained from natural river bed. Due to high cost of natural sand, the partial replacement of natural sand is done by the industrial by products. One of the waste by-products obtained from foundry industry which is foundry sand. Foundry sand is obtained from foundry industry was treated and used as a partial replacement for fine aggregate. In India, many foundries dump this waste in nearby area which creates an environmental problem. After the usage of sand about 3 to 4 times, it is dumped on land that sand is called used foundry sand. Used-foundry sand is a byproduct of ferrous and non-ferrous metal casting industries. Foundries successfully recycle and reuse the sand many times in foundry. The partial replacement of TUFs in concrete is examined through bond behaviour and durability tests. The concrete specimens were casted tested at the age of 28days and 90days. The results obtained are compared with the control concrete.

**KEYWORDS:** Treatment of used Foundry Sand (TUFs), USPv, Fire resistant test, Fine aggregate Compressive Strength

### I. INTRODUCTION

Foundry sand is high quality silica sand with uniform physical characteristics It is a by-product of ferrous and nonferrous metal casting industries, where sand has been used for centuries as a molding material because of its thermal conductivity. Foundries successfully recycle and reuse the sand many times in a foundry. When the sand can no longer be reused in the foundry, it is removed from the foundry and is termed foundry sand. In modern foundry practice, sand is typically recycled and reused through many production cycles. In United States alone, this foundry Industry estimates that approximately 100 million tons of sand is used in production annually, of that 6–10 million tons are discarded annually and are available to be recycled into other products and are used in other industries. Foundries purchase high quality size specific silica sands for use in their molding and casting operations.

Although there are other casting methods including die casting, investment casting, and permanent mold casting, sand casting is by far the most prevalent casting technique. Sand is used in two different ways in metal casting: as a molding material, which forms the external shape of the cast part, and as cores, which form internal void spaces in products such as engine blocks. Since sand grains do not naturally adhere to each other, binders must be introduced to cause the sand to stick together and hold its shape during the introduction of the molten metal into the mold and the cooling of the casting.

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## II EXPERIMENTAL PROGRAMME

### A. Materials Used

#### a. Cement

Cement is a powdered material that serves as a binder in mortar or concrete after reactions of lime or lime compounds have taken place with appropriate medium-usually water. Portland cement is one of such materials, composed largely of calcium and aluminium silicates, in which the former upon reaction with water produces the new compound capable of imparting stone like quality to the mixture. While the specific gravity of Portland cement ranges from 3.12 to 3.16, its unit weight varies with the degree of compaction

#### b. Fine aggregate

Sand is naturally occurring granular material composed of finely divided rock and mineral particles. The most common of sand is Silicon di- Oxide, usually in the form of Quartz. Normally river sand is used as fine aggregate for preparing concrete. An Individual particle in this range is termed as sand grain. These sand Grains are between Gravel (2 mm – 64mm) and silt (0.004mm – 0.0625mm). Aggregate most of which passes 4.75mm IS sieve is used. Locally available river sand Zone III having a specific gravity of 2.62, fineness modulus of 2.75 is used. Replace of Fine aggregates by TUFs by 10%, 20%, 30% & 40%.

#### c. Coarse aggregate

Aggregates are the most mined material in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete the aggregate serves as reinforcement to add strength to the overall composite material. Gravel of Size 20mm is sieved and used. Crushed granite coarse aggregate of maximum size 20 mm and having a specific gravity of 2.387, fineness modulus of is used.

#### d. Water

Mixing water should contain no substances that can have an appreciably harmful effect on the process of hydration or upon the durability of concrete during its service period. Water having appreciable amounts of impurities-silt, oil, acids, alkalies, salts of alkalies, organic matter and sewage may have an injurious effect upon concrete. The reduction in strength of concrete through the use of water suspected of undesirable substances could be as high as 10%.

### B. Experimental Procedure

#### a. Coefficient of water absorption test

The Coefficient of Water Absorption Test was carried out as per ASTM C642-97. This was assessed by the degree of uptake of water by dry concrete in a period of 1 h. The concrete cube specimen were dried in an Oven at 110°C for seven days until constant weight was attained as shown in figure 1 and the permitted to cool a concealed of one day the quality of water absorption during the first 60 min was estimated. Coefficient of water absorption values of concrete specimen after 28 & 90 days of moisture

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Fig .1 Oven Heating @ 110°C for 1 hour

### **b. Ultrasonic pulse velocity test**

This test is done to assess the quality of concrete by ultrasonic pulse velocity method as per IS: 13311 (Part 1) – 1992. The USPV test is depicted in figure 2. The method consists of measuring the time of travel of an ultrasonic pulse passing through the concrete being tested. Comparatively higher velocity is obtained when concrete quality is good in terms of density, uniformity, homogeneity etc. Apply couplant to the surfaces of the transducers and press it hard onto the surface of the material. Table I shows the Ultrasonic pulse velocity ranges. Do not move the transducers while a reading is being taken, as this can generate noise signals and errors in measurements. Continue holding the transducers onto the surface of the material until a consistent reading appears on the display, which is the time in microsecond for the ultrasonic pulse to travel the distance 'L'. The mean value of the display readings should be taken when the unit's digit hunts between two values.

Table 1 USPV ranges

Pulse Velocity (km/s)	Concrete Quality (Grading)
Above 4.5	Excellent
3.5 to 4.5	Good
3 to 3.5	Medium
Below 3	Doubtful

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Fig .2 USPV Testing machine



Fig 3 Indirect testing



Fig .4 direct testing

### c. Fire resistant test

The concrete cubes were subjected to elevated temperature of 300°C for two hours duration. Afterwards they were tested under Compression Testing Machine to determine their residual strength as, generally, the compressive strength of the concrete will be reduced after it is heated. The objective of this study here is to determine whether the TUFs is highly resistant to fire as compared to conventional concrete

### d. Alternate wet & dry test

This test was carried out to study the effect of salt water on the durability of foundry sand concrete. The specimens included 150mmX150mmX150mm. Out of the 20 specimens cast in each set, three were used as control specimens and remaining, three sets were used for 10, 20, 30, 40 percentage loss in mass and reduction in compressive strength. The specimens immediately after 28 & 90 days of curing were weighed and marine water prepared in the lab and were subjected to alternate wet & dry. Another set specimen were kept in ordinary water for 28 & 90 days. Figures 5 and 6 show the cured in ordinary water and the cured in marine water respectively.

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Fig.5 Cured in ordinary

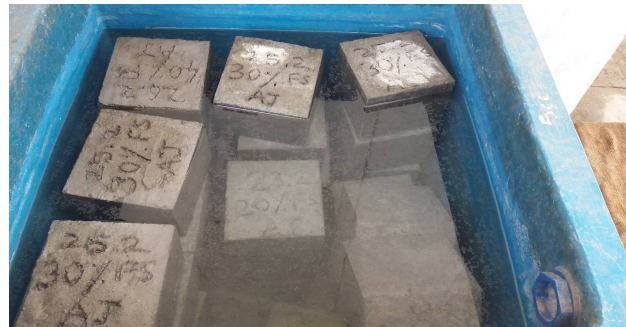


Fig.6 Cured in marine water

### e. water permeability test

Basic procedure of such a test is to apply water under pressure to one surface of the specimen for a specific time and then split the specimen perpendicular to the injected face and determine visually the depth of penetration. The test is carried out according to concrete specimens of size 150x150x150 mm, at an age of 28 days & 90 days. The test cell assembly being used had the provision for testing six cubes at a time.

## III. RESULTS AND DISCUSSION

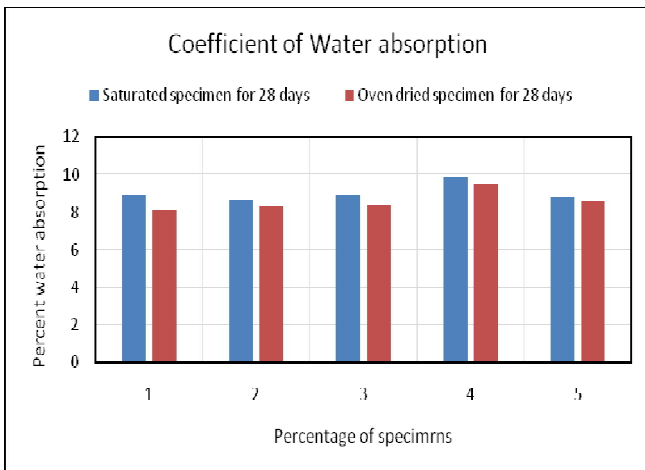


Fig.7 Coefficient of Water absorption @28 days

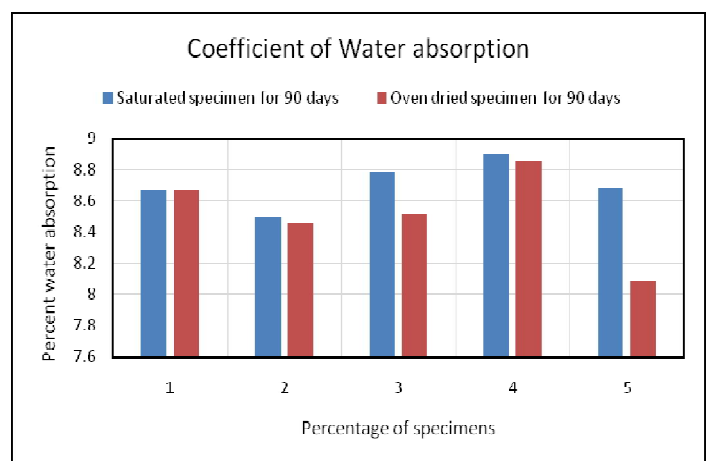


Fig.8 Coefficient of Water absorption@ 90 days

Figure 7 & 8 shows Co-efficient of water absorption of Fine aggregates by TUFs by 10%, 20%, 30% & 40%. This typical arrangement made for the test report shown in Figure 9 & 10.

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## Ultrasonic pulse velocity test

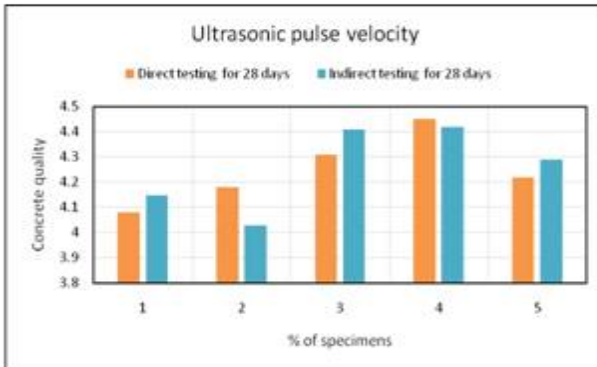


Fig 9 USPV@ 28 days

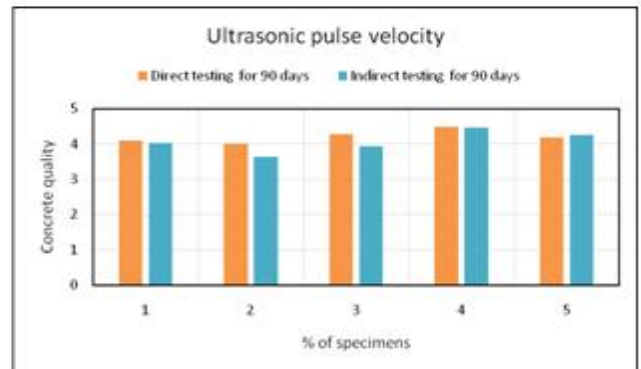


Fig.10 USPV @ 90 days

## Fire Resistant Test

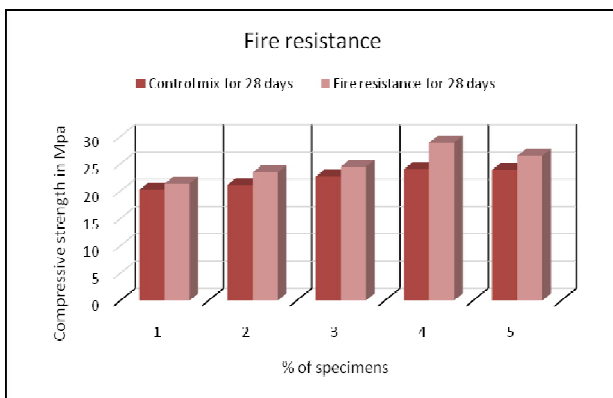


Fig 11 Fire resistant @ 28 days

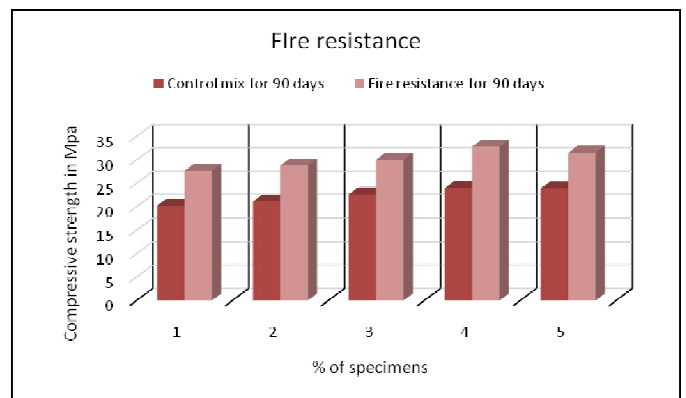


Fig 12 Fire resistant @ 90 days

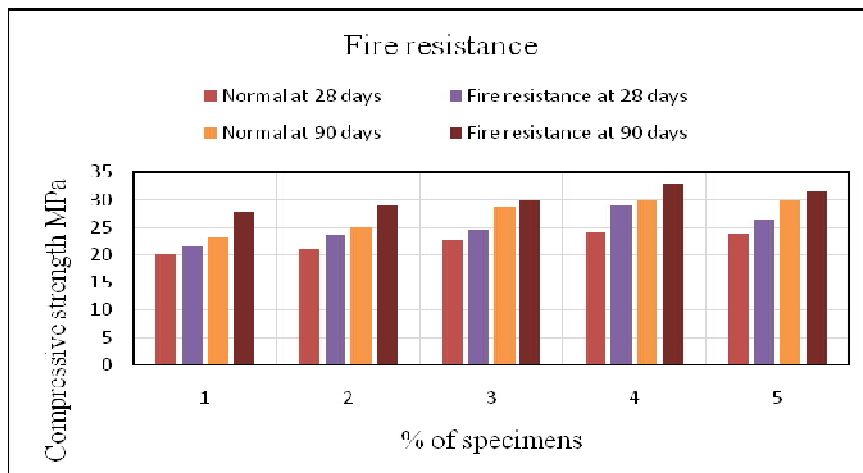


Fig .13 Comparison of normal and Fire resistant @ 28 & 90 dayS

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## IV. CONCLUSION

The investigation has resulted in the following conclusions:

- ✓ Coefficient of Water absorption higher in 30% comparing to control specimen.
- ✓ Fire resistance test, it was observed that the loss in mass of TUFs concrete was found to be lesser than control mix.
- ✓ Alternate wet & dry of concrete TUFs specimens increased in weight in Ordinary Water & Marine Water, when compared with control specimens.
- ✓ Ultrasonic pulse velocity results in ultrasonic pulse to travel the distance comparing to control specimen, TUFs 30% is better.
- ✓ Finally by using TUFs in concrete shows better durability and pullout behavior as compare to control concrete So TUFs can be used in construction field.

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