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Review- Sustainable Use of Foundry Sand Partial Replacement to Fine Aggregate For Concrete

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Abstract **: Now a day's production of by product have been increasing day by day. Due to large production of this by product it harmful to the environment and solid waste management creating bother of concern over its safe disposal. Foundry sand is by product obtained from both ferrous and non ferrous metal casting industry containing high quality silica. Use of foundry sand not only reduced the disposal problem but also makes the concrete economical. Literature survey has shows that utilization of foundry sand could be possible for manufacturing of concrete which helps in controlling the environmental pollution due to solid waste disposal. This paper presents a review of some of the research published on use of foundry sand in concrete and its effect on mechanical properties of concrete such as compressive strength, split tensile strength, flexural strength and shrinkage are presented.**

Keywords: **Foundry Sand, Compressive Strength, Flexural Strength ,Split Tensile Strength.**

I. INTRODUCTION

Waste foundry sand (WFS) is a byproduct from the production of both ferrous and nonferrous metal castings. It is high quality silica sand. In the casting process, molding sands are recycled and reused many times. Eventually, when, recycled sand degrades to a level that it can be no longer is reused in the casting process. When it is not possible to further reuse sand in the foundry, it is removed from the foundry and is termed as waste foundry sand. The physical and chemical characteristics of foundry sand depend upon the type of casting process and the type of industries [1].The physical and chemical characteristics of foundry sand depend on the type ofcasting process and the industry sector from which it originates.The automotive industries and its parts are the major generators of foundry sand. Foundries purchase high quality size-specific silica sands for use in their molding and casting operations [2]. Used foundry sand can be reused in various applications as an alternativeto sending it to landfill, and reuse options are well establishedin England, Europe and North America. Reuse options includecement manufacture, asphalt, concrete, bricks and free flow fillfor certain construction applications. Some of these alternatives are starting to be adopted in India, but is still in early stage. Overseasexamples show that it is not only better for the environment but is profitable for the foundry to use the sand alternatively. Application of used-foundrysand in concrete will lead to diversion of large amounts of used foundry sand from land filling to manufacturing of concrete [3].

Compressive Strength: Figure-01 depicted the relation between compressive strength with respect to percentage of foundry sand content replacement in concrete cubes and cylinder.

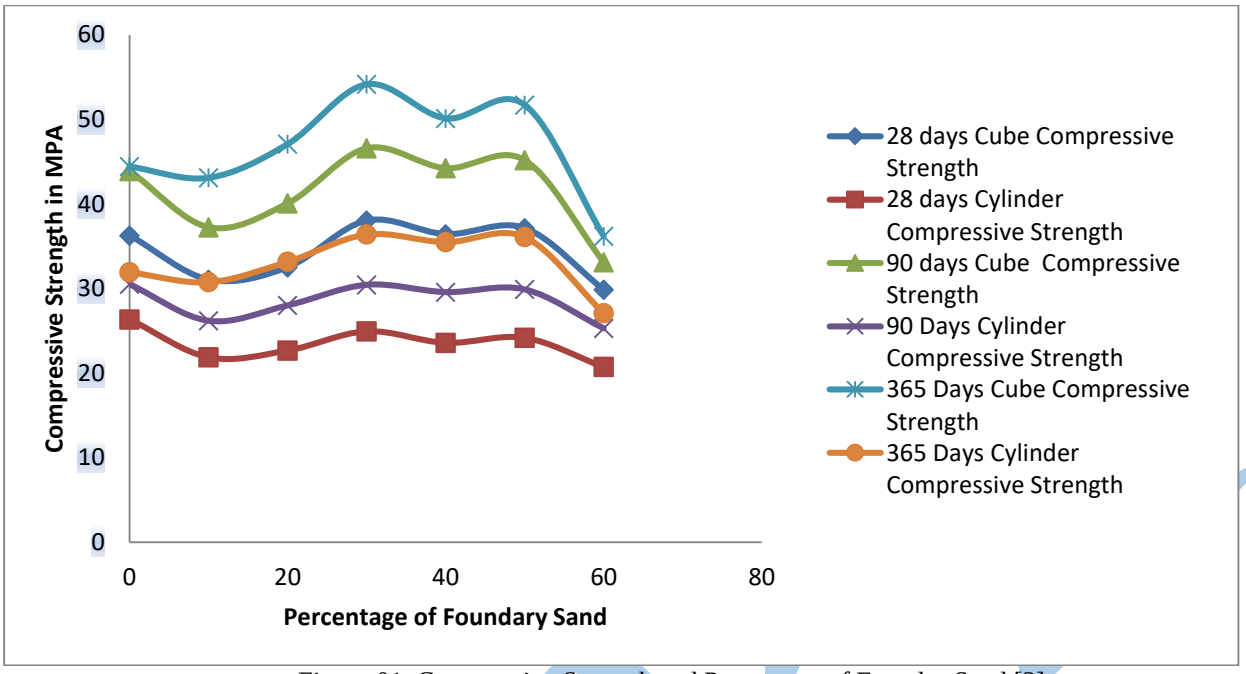

Figure-01. Compressive Strength and Percentage of Foundry Sand [3]

There is increase in compressive strength of cubes and cylinder at 25 to 30% replacement of foundry sand with fine aggregate, after 30% replacement the compressive strength of cubes and cylinder is start decreasing . As the duration increases the compressive strength is increasing. The highest compressive strength is observed at 30% replacement at 28 days and it is up to 50 to 55 Mpa [3].

From Fig-02 It has been shown that as the duration increases the compressive strength is increasing. The compressive strength of cubes is found out at 7, 28, 56 and 90 days. The maximum compressive strength is observed is between 38 to 42 Mpa at 30% replacement of foundry sand at 90 days. After 30% replacement the compressive strength of cubes is start decreasing [4] [5].

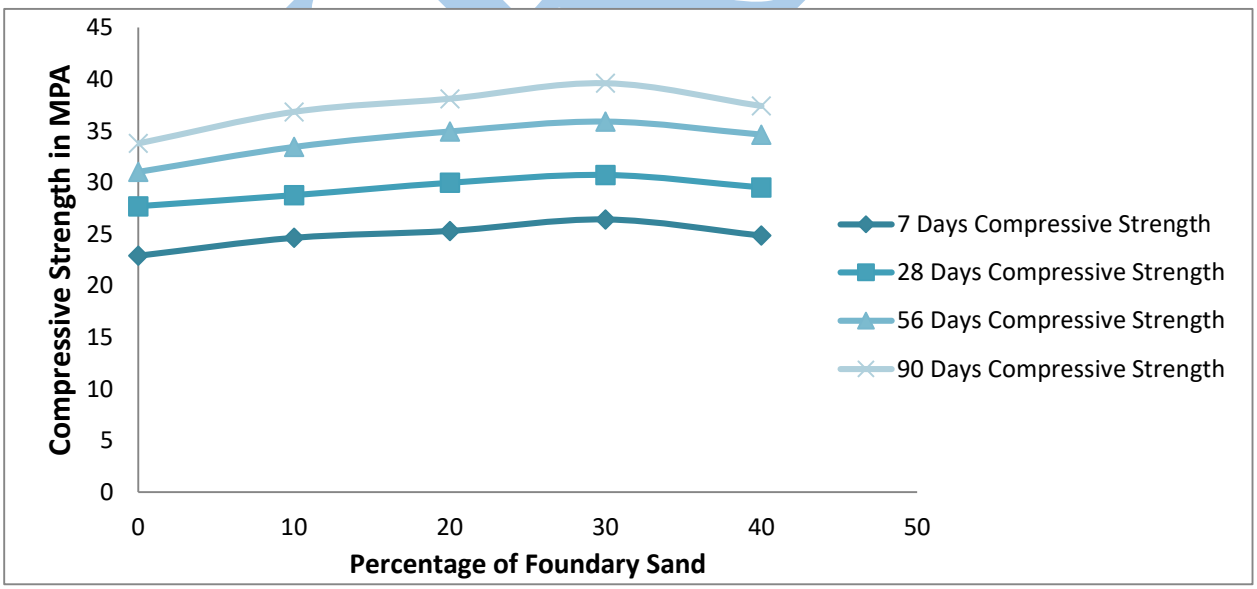

Figure-03. Percentage Variation of Compressive Strength for different foundry sand contents.[4]

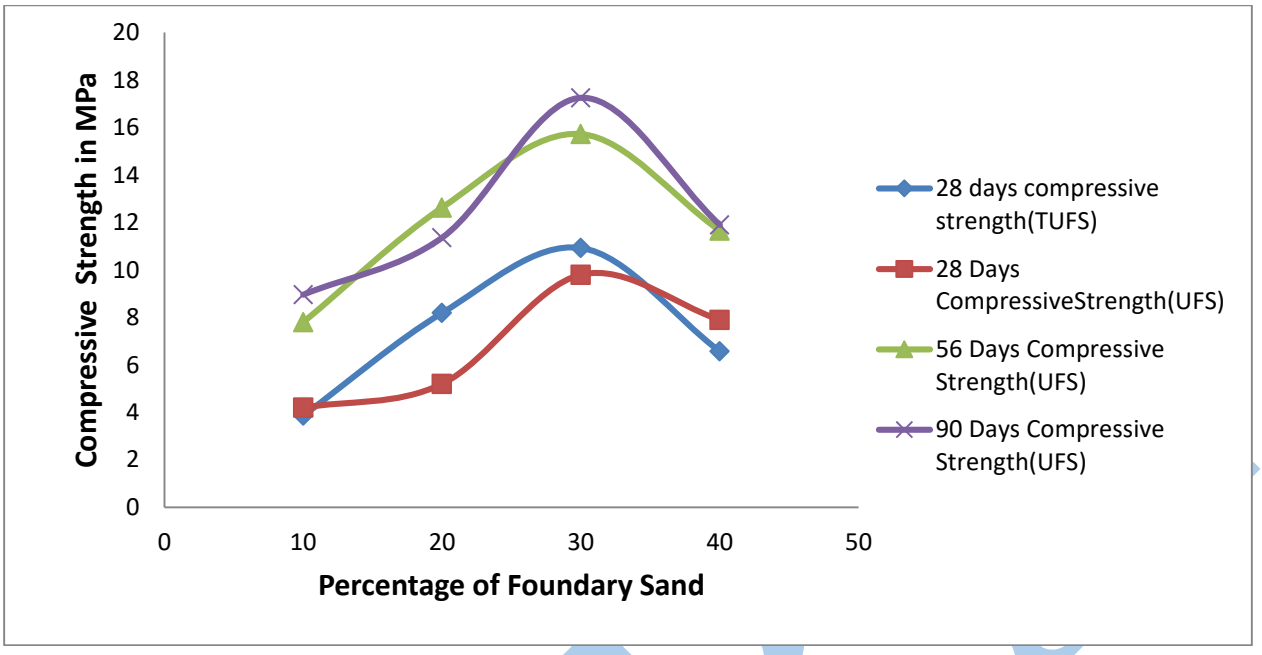

Figure-02. Compressive Strength and Percentage of Foundry Sand [4]

In Figure 03- The compressive strength test is found out for both TUFS(Treated used foundry sand) and UFS (Used foundry sand) at 28 days. It has been observed that the compressive strength of TUFS is start increasing from 10 to 30% replacement, at 30% replacement it is maximum, after 30% replacement compressive strength starts decreasing rapidly. In case of UFS, at 30% replacement it is maximum, after 30% replacement compressive strength starts decreasing gradually. In case of UFS the compressive strength is obtained at 56 and 90 days. The maximum compressive strength of UFS is observed in between 15 to 17 Mpa at 30% replacement of foundry sand at 90 days.

Flexural Strength: In Figure- 04 The flexural strength is obtained upto 40% replacement of foundry sand at 7,28,56 and 90 days. It has been observed that the flexural strength is start increasing from 10 to 30% replacement, at 30% replacement it is maximum, after 30% replacement flexural strength starts decreasing rapidly. The increase in the strength observed at various days (7, 28, 56 and 90) is gradual. The maximum flexural strength is observed in between 4.5 to 5.2 Mpa at 30% replacement of foundry sand at 90 days.

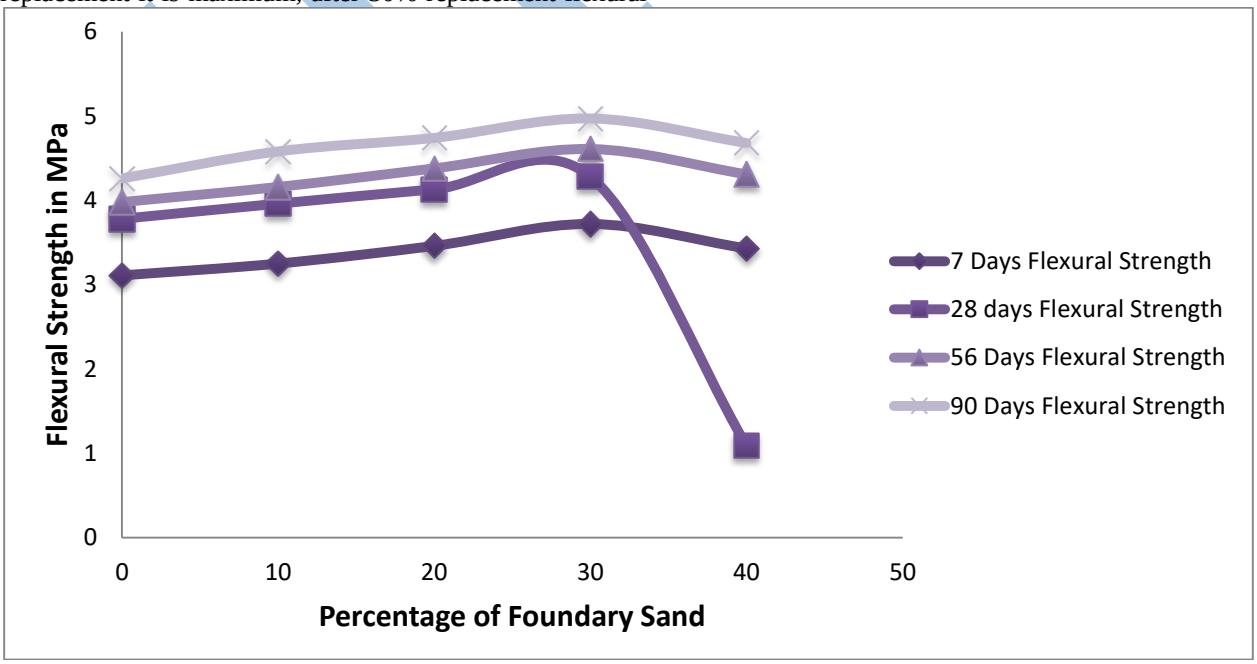

Figure-04.Flexural Strength and Percentage of Foundry Sand [4]

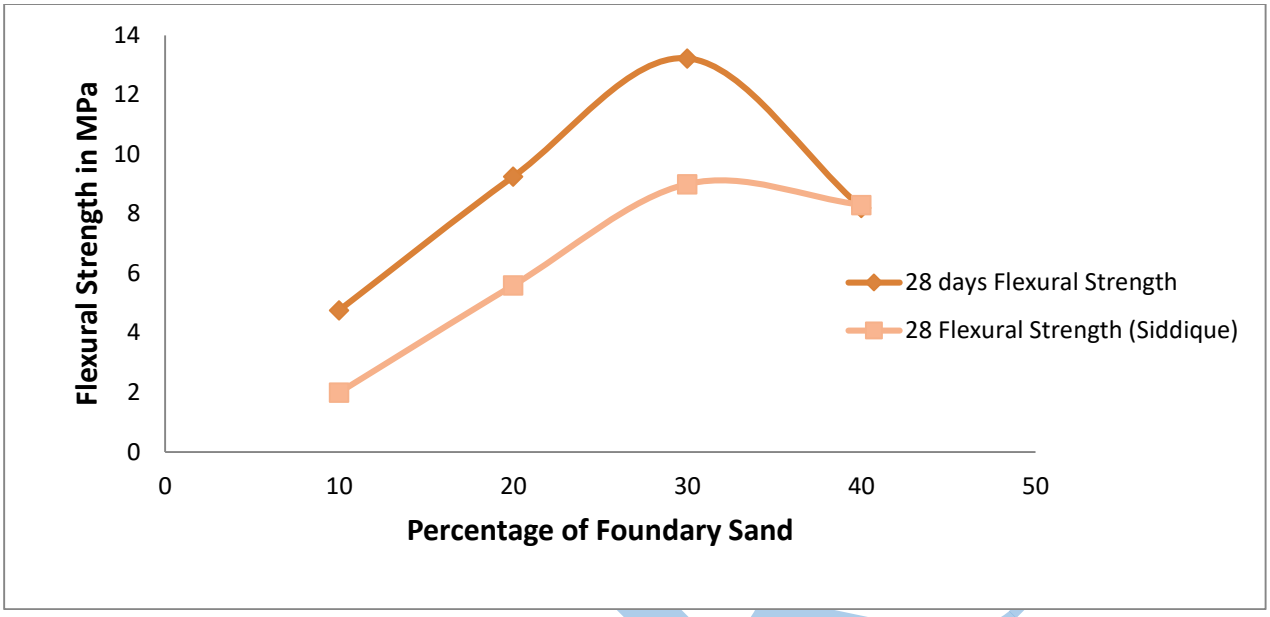

Figure-05. Percentage Variation of Flexural Strength for different foundry sand contents [3]

Figure 05- Depicts the flexural strength which is obtained for UFS (as per siddique) and TUFS (N. Gurumoorthy a, K. Arunachalam). The flexural strength is obtained for replacement of 10, 20, 30, and 40%. The increase in Flexural strength upto 30% is gradual for both UFS and TUFS. At 30% replacement of foundry sand the maximum flexural strength is obtained between 8.2 to 8.6 and 12.2 to 12.6 for UFS and TUFS respectively. Between 30 to 40% replacement of foundry sand content the flexural strength is decreasing gradually for UFS and rapidly for TUFS.

Split Tensile Strength: According to Figure 06- The split tensile strength is obtained at 28, 90, 365 days for the replacement from 0 to 60%. At 10% replacement the value of split tensile strength is lower as compare to 0% replacement and its start increasing from 10 to 30% replacement. From 30 to 60 % replacement split tensile strength is decreasing gradually. As the day's increases the split tensile strength is increasing. The maximum split tensile obtained is between 3.2 to 3.6 Mpa at 30% replacement of foundry sand.

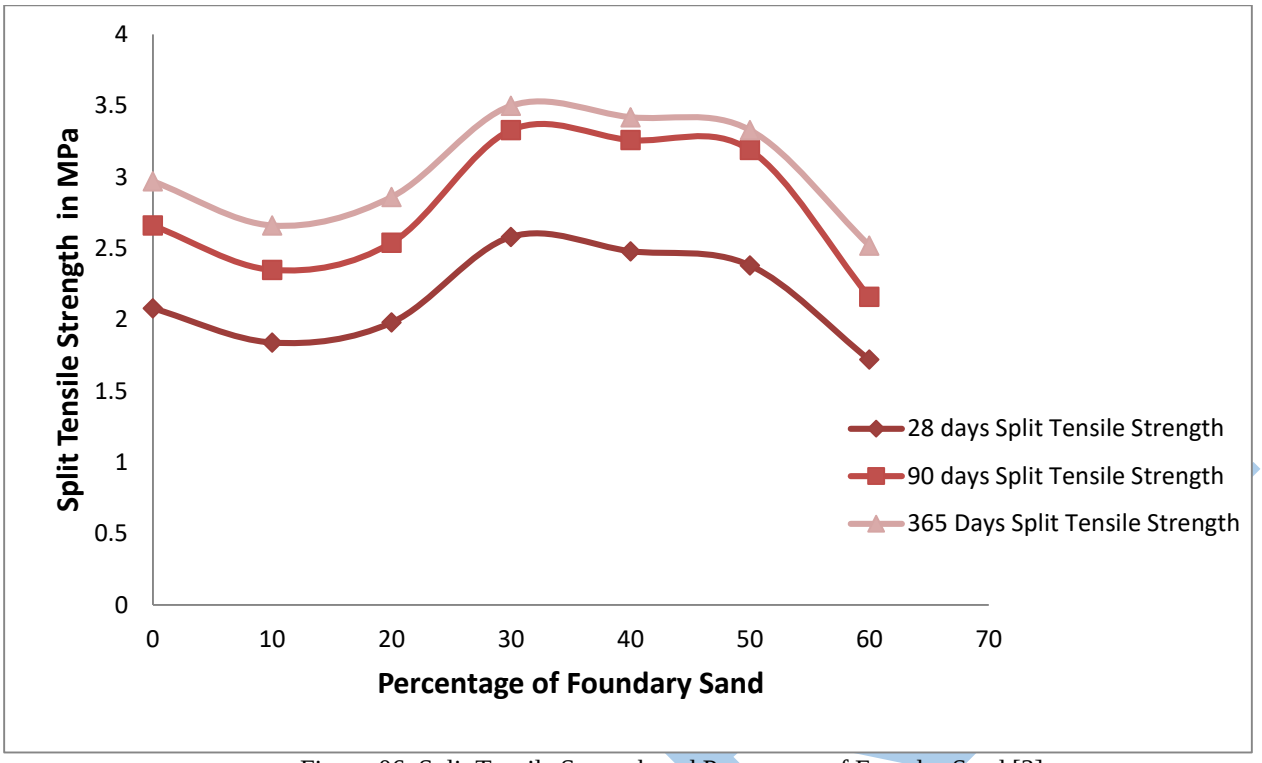

Figure-06. Split Tensile Strength and Percentage of Foundry Sand [3]

Figure 07- depicts the split tensile strength at various percentage of foundry sand at different days of curing. The percentage replacement of foundry sand is vary from 0 to 40% and split tensile strength is taken at 7, 28, 56 & 90 days of curing. There is gradual increase in split tensile strength from 0 to 30% replacement after 30% there is gradual decrease in strength. The maximum split tensile strength is obtained to be is between 3.2 to 3.8 Mpa at 30% replacement at 90 days.

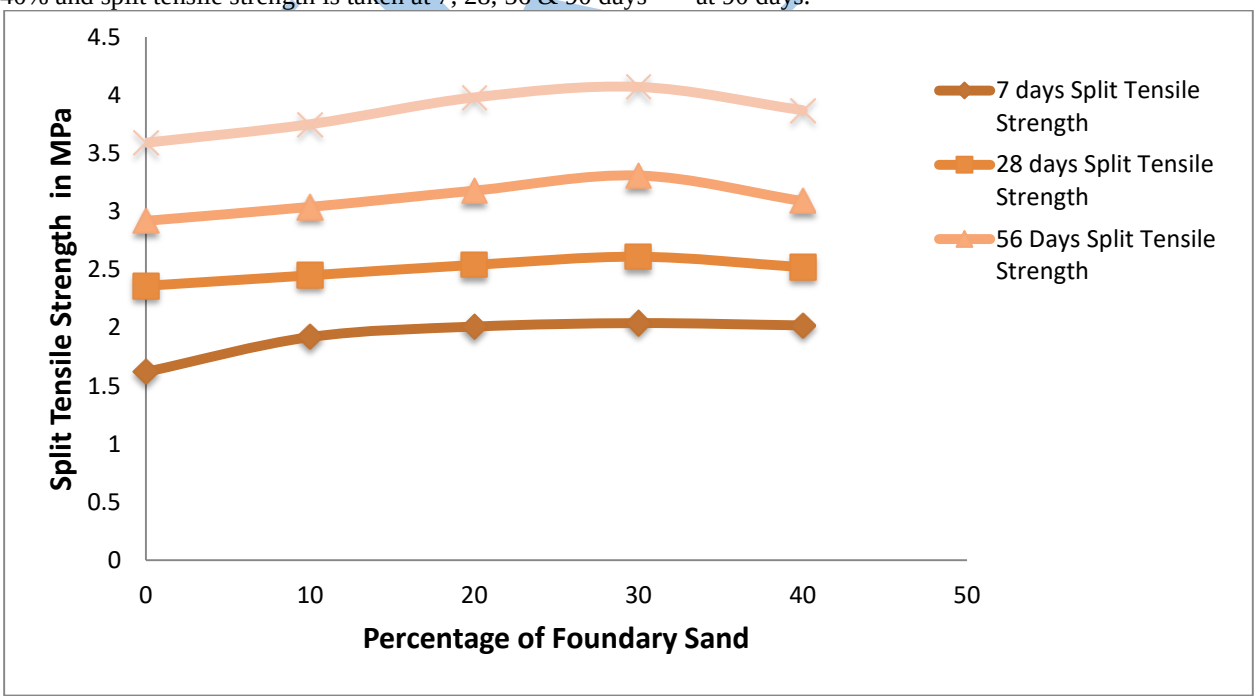

Figure-07. Split Tensile Strength and Percentage of Foundry Sand [4]

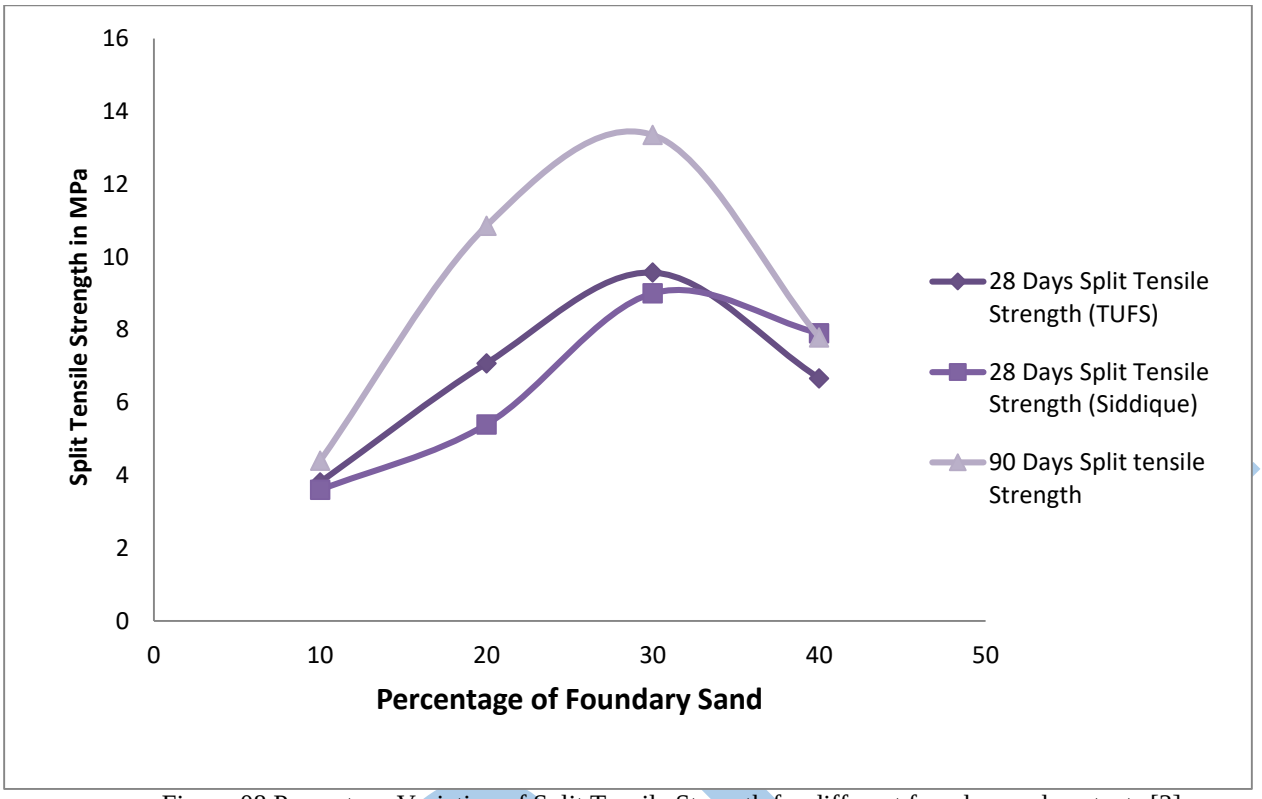

Figure-08.Percentage Variation of Split Tensile Strength for different foundry sand contents [3]

The results depicted in Figure - 08 reveals that the split tensile strength is obtained for both TUFS (N. Gurumoorthy a, K. Arunachalam) and UFS (as per siddique) at 28 days. In case of UFS and TUFS from10 to 30% replacement, there is rapid increase in split tensile strength, From 30 to 40% there is rapid decrease in split tensile strength. The split tensile strength is more for TUFS as compare UFS, It is 8.8Mpa for TUFS & 8.6Mpa at 30 % replacement at 28 days. For 30% replacement the maximum split tensile strength is obtained between 13 to 13.5 Mpa at 90 days.

II. CONCLUSION

1) The optimum replacement of foundry sand with regular sand in concerte is 30% of toal quantity of sand required for making refrence concrete mix. Beyond 30% the strength properties start decresing.
2) The optimum replacement of foundry is 30% for compressive strength test,split tensile strength,flexural strength,it will increse these strength properties upto 9.8% at 28 days of curing.
3) The waste foundry sand from foundry industries is most suitable in replacing the sand in concrete. The treated used foundry sand (TUFS) also gives better strength made by 5% HCL adding to used foundry sand.

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