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THE INFLUENCE OF COPPER ELEMENT UPON MECHANICAL PROPERTIES OF SPHEROIDAL GRAPHITE CAST IRON (SGI)

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Abstract— This study impact on the effect of one of the important non ferrous element **'Copper'** on Spheroidal Graphite cast iron (SGI).The samples of Spheroidal Graphite cast iron (SGI) melted in the induction furnace with number of different melts with different percentages of copper element like 0.25%,0.50%,0.75%,1.0%,1.5%, and 2%, respectively and study the changes of different mechanical properties like Tensile Strength, Elongation (%) & Hardness after adding some specific amount of copper elements in Spheroidal Graphite cast iron (SGI). It is also focus on which is the perfect percentage of Copper in the melt of Spheroidal Graphite Cast Iron (SGI).The changes in Different Mechanical Properties Explained by Different Tables and Charts on the Basis of Test Reports Readings.

Index Term (Keyword-) — Spheroid Graphite Cast Iron, copper, Tensile Strength, Percentage Elongation, Hardness

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I. INTRODUCTION

The essential concoction component, for example, carbon, silicon, manganese, magnesium, copper and so on assumes a critical part in SGI (Spheroidal Graphite Iron) castings prepare. The conduct of these components in liquid metal of the flexible iron assumes an alternate part in light of their distinctive mechanical and concoction properties. On the off chance that we administer such creation that will be ideal by excellence of its investigation of consequences for castings. As we probably am aware, there is little change in the concoction arrangement, the wide impacts on the mechanical properties and their microstructure. The concoction pieces in pliable iron are constantly considered in the range. With the goal that it is hard to accomplish the focused on mechanical properties and the microstructure according to the given determination it generally influences at last utilization of the item.

Ductile cast iron (SGI) was first announced by the foundry Industry as a new engineering material at the 1948 annual meeting of the American Foundrymen's society. This revolution material discovered independently by the British Cast Iron Research Association (BCIRA) and International Nickel Company (INCO) Essentially, ductile cast iron consists of graphite spheroids dispersed in a matrix similar to that of steel. The only significant difference between Gray cast iron and ductile cast iron is in the shape of the graphite phase and the matrix can be similar. as shown in (**Fig 1.1 Microstructures of Gray cast iron and Ductile cast iron)** ,During the solidification most of the carbon forms as graphite spheroids which exert only a minor influence on the mechanical properties in contrast to the effect of flake graphite in gray cast iron.Ductile cast iron is a family of alloys which combines the principle advantages of gray irons (Low melting point, good fluidity, Castability, Excellent machineability, and good wear resistance) with the engineering advantages of steel high strength, toughness, ductility, hot workability, and hardenability etc.

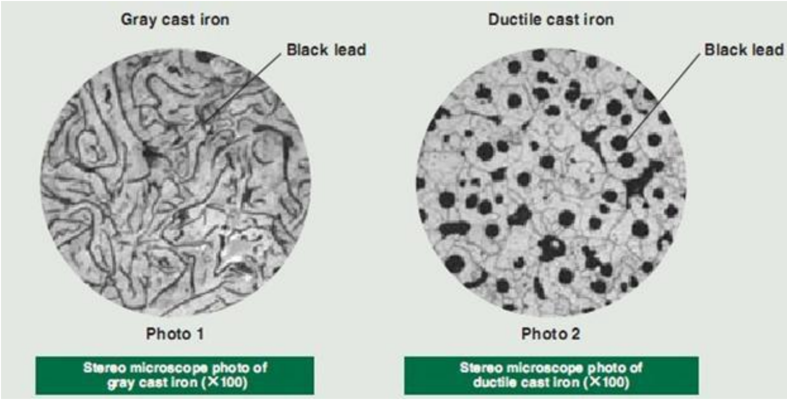

Fig 1.1 Microstructures of Gray cast iron and Ductile cast iron

Types of Ductile Iron:

The different types of ductile iron are as follows:

Depending upon the matrix phases, SG iron can be classified into four groups.

1. Ferritic
2. Ferrito- Pearlitic
3. Pearlitic
4. Martensitic .

2. Summary of Literature.

A combination of cast iron and copper (Fe-Cu) has been created utilizing a blend cast handle. The compositional, miniaturized scale basic portrayal and wear property of the created Fe-Cu compound were done with the guides of X-beam diffractometer, checking electron magnifying lens (SEM) and stick on Disk machine. The mechanical properties, for example, hardness and effect vitality were explored. Wear direct conditions were produced with the guides of MATLAB straight fitting. The outcomes uncovered that the nearness of copper (99% unadulterated) in the soften of dim cast press hindered the development of cementite. Be that as it may, the effect vitality of the dark cast press expanded with %weight (wt) of copper expansion. Consequently, the hardness and wear resistance of the created Fe-Cu composite were yielded. Consequently, the created Fe-Cu combination is an incredible material which can be utilized as a part of the vibration damping application particularly in the safeguard. The Cu-rich particles contained in the composite coatings assume a critical part in the antifriction properties, which can be credited to the development of defensive Cu movies on the rubbing surface. [2]

Exchanged bend warm info importantly affects the combination of composite coatings. At a low warmth contribution of 202 J/mm, a twofold layer structure with both a Cu-rich layer and a Fe-rich layer is watched

The Cu-rich particles contained in the composite coatings assume a critical part in the antifriction properties, which can be credited to the development of defensive Cu movies on the rubbing surface. [3]

In this review, the small scale isolation impact of copper amid cementing of A356.2 aluminum throwing composite was assessed by utilizing hardening reproduction and a progression of exploratory works. Electron test miniaturized scale investigation (EPMA) and the computational reproduction uncovered obviously that copper as a solute component isolates amid hardening and it turns out to be more huge as the cementing approaches its finishing.[4]

It is found that a copper substance of around 0.6 wt. % is as far as possible over which just little measures of ferrite could be gotten aside from at low cooling rates. This is likely identified with the bringing down of the temperature for ferrite and the related diminished energy for austenite deterioration in the steady framework. [5]

3. Experimental Set Up:

Specimen Preparation

- We required specific system for the adding and mixing of different elements in furnace.
- The answer is **Heat Sheet.**
- This heat sheet is one kind of system which helps to decide required weight, Percentage and quantity of different elements in the molten metal.
- We prepared Different Mould of Different Melts
- Each melt Have Different Copper Percentages shown in Table
- The First Melt is Standard Grade of SG Cast iron **450/10**
- In this melt of 450/10 we add Different Percentages of Copper by Ladle Treatment.

The larger addition causes a significant changes in the metal like Structure of metal, properties of metal, chill depth, Graphite production this treatment should be called Ladle addition, ladle treatment rather than inoculation.

In our experiment we add copper as an inoculant with different percentages to achieve our desire chemical composition in the metal.

Material	**Weight In Kg**	**C%**	**Mg%**	**Si%**	**P%**	**Su%**
CRC Scrape	155	0.2%	__	0.3%	__	__
Remelt	80	1.26%	__	0.85%	__	__
Farrow Silicon	3	__	__	0.95%	__	__
Charcoal	13	2.40%	__	__	__	__
Total In Melt	251	3.67%	__	2.1%	__	__

Table 3.1 Heat Sheet for Normal S.G.I. Melt (Grade 450/10

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Material	**Weight in Kg**	**C%**	**Mg%**	**Si%**	**P%**	**Su%**

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Farrow Silicon	3	__	__	0.95%	__	__
Charcoal	13	2.40%	__	__	__	__
Total In Melt	251	3.67%	__	2.1%	__	__

Table 3.2 Heat Sheet For Copper element with 0.25 % in Melt 1-A, B, C

4. Study of Mechanical Properties

4.1. TENSILE TESTING.

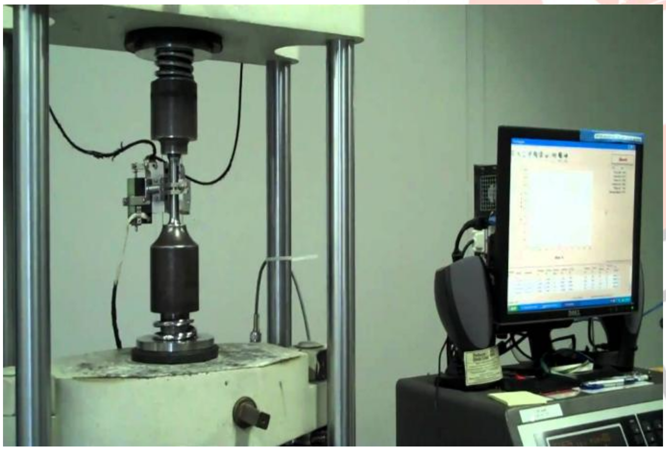


Fig 4.1.1 Tensile test Machine

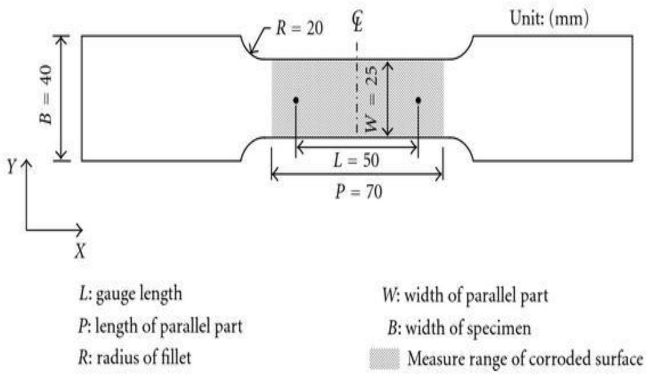


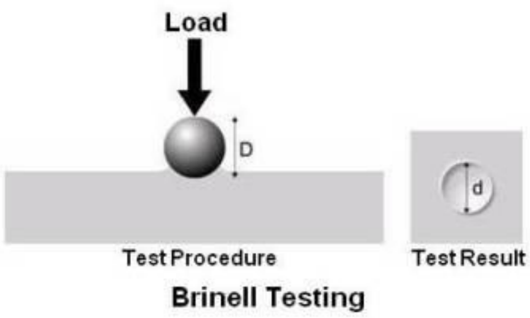
fig 4.1.2 Tensile test Specimen

4.2. Percentage elongation:

$$\text{Percentage Elongation} = \frac{\text{Final Length} - \text{Original Length}}{\text{Original Length}} \times 100$$

4.3. Brinnel hardness Number:

The Brinnel hardness test is usually used to decide the hardness of materials like metals and composites. The test is accomplished by applying a known load to the surface of the tried material through a solidified steel. bundle of known distance across.



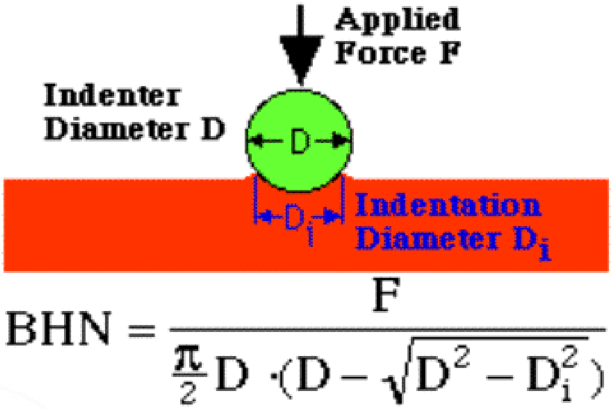


Fig. 4.3.1 **Brinnel testing Procedure** **fig. 4.3.2 Brinnel testing Equation**

5. Result & Discussion

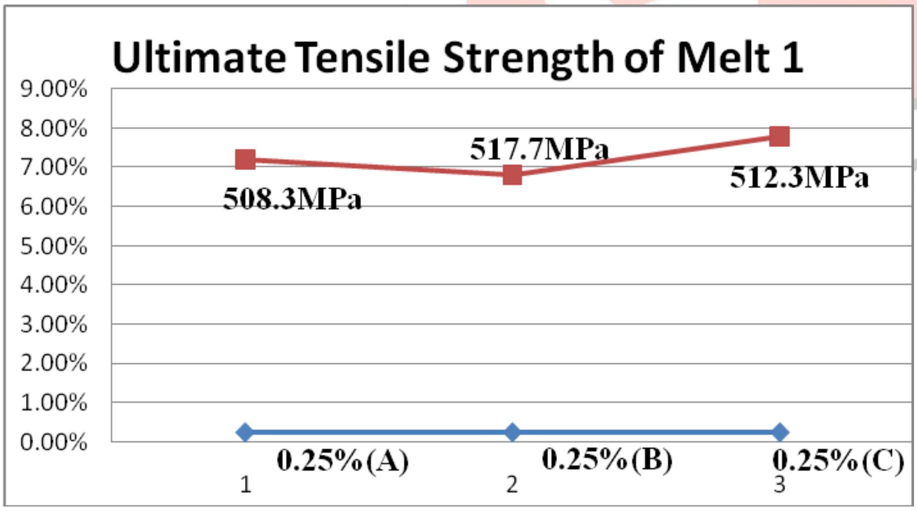


Fig 5.1. Ultimate Tensile Strength Chart of melt 1

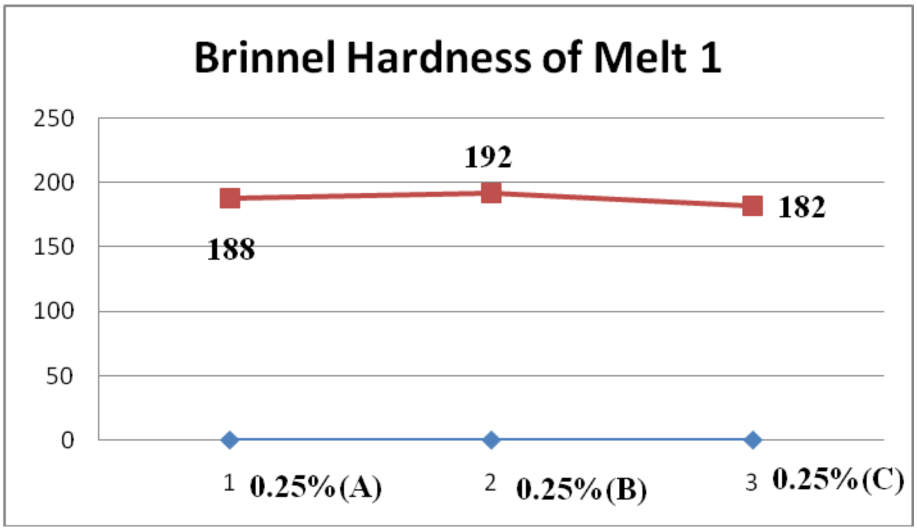


Fig 5.2 Brinnel Hardness Chart of melt 1

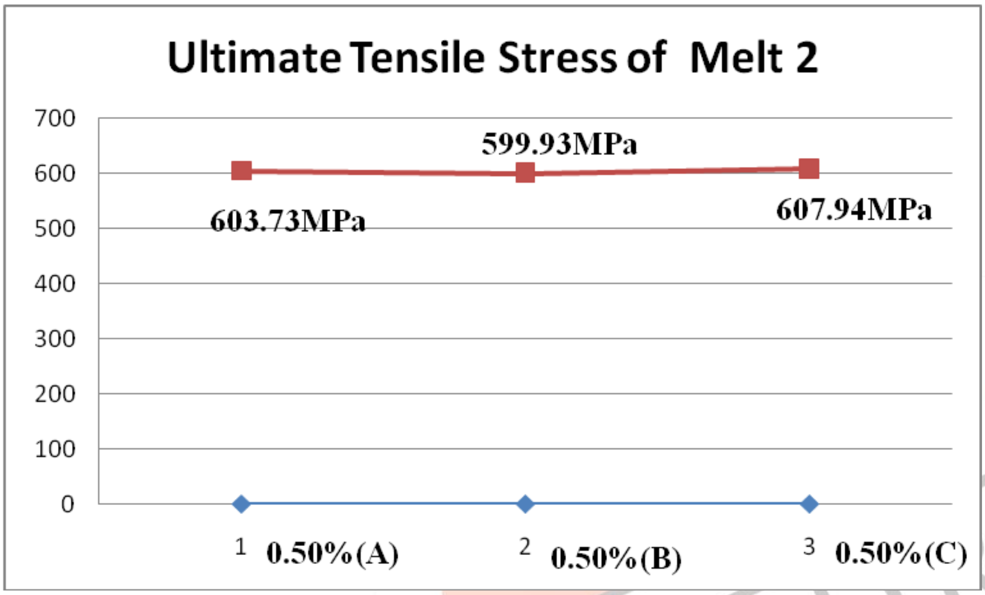


Fig 5.3 Ultimate Tensile Strength Chart of melt 2

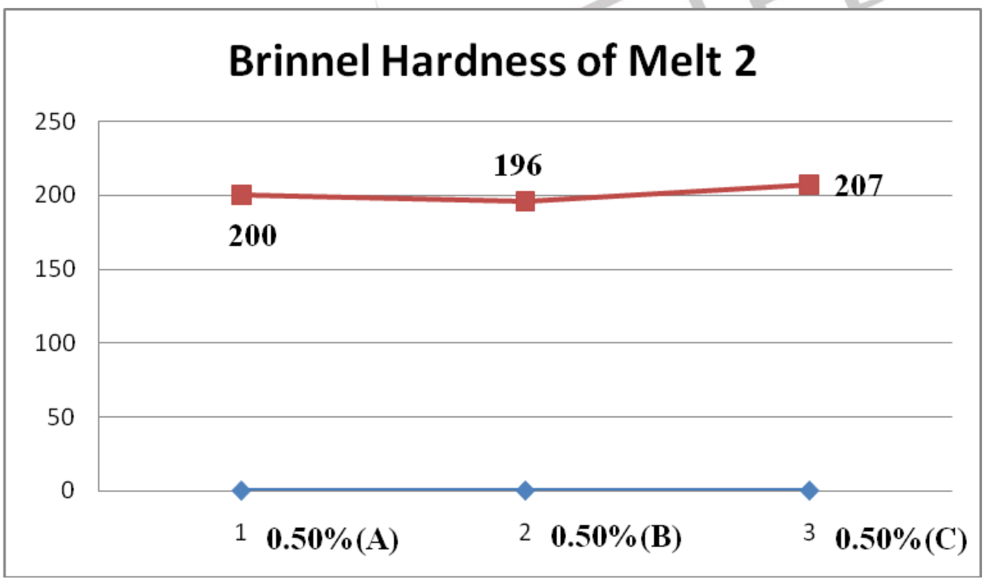


Fig 5.4 Brinnel Hardness Chart of Melt 2

6. Conclusion:

- Hardness, tensile strength and, Percentage Elongation was measured to find the optimum mechanical properties due to copper effect as can be seen in different Test Reports.
- Comparative Observation Tables & Graph Represent that Percentage of Copper increase from 0.25% to 1% The Tensile Strength & Hardness increase respectively but Percentage Elongation Decrease.
- As Percentage of Copper increase from 1% to 2% the Tensile Strength and Hardness becomes decrease respectively & Percentage Elongation Increases.
- The Breakeven point of mechanical Properties is at 1% of Copper in SGI.
- After this Level of Copper % in the melt different Mechanical Properties in Different Number of Melts become Change.

So the 1% 0f Copper in Spheroidal Graphite Cast Iron (SGI) perfect percentage which helps to get the required properties if SGI

7. References:

(1) Martin Selin1,a, Daniel Holmgren1,2,b, and Ingvar L. Svensson1, **''Effect of Alloying Elements on Graphite Morphology in CGI''**Materials Science Forum Vol 649 (2010) pp 171-176

(2) J. O. Agunsoye, S. A. Bello, S. B. Hassan, R. G. Adeyemo, J. M. Odii **'The Effect of Copper Addition on the Mechanical and Wear Properties of GreyCast Iron'** Journal of Minerals and Materials Characterization and Engineering, 2014, 2, 470-483

(3) Hang Zhao, Jianjun Li, Zhizhen Zheng, Aihua Wang, Dawen Zeng, Yafeng Miao '**The microstructures and tribological properties of composite coatings formed via PTA surface alloying of copper on nodular cast iron'** Surface & Coatings Technology 286 (2016) 303–312

(4) J. I. Cho1, a, X. Yan2, b, C. S. Kang1, c, I. H. Oh1, d, J. S. Lee1, e, H. T. Son1, f and J. C. Bae **'Microsegregation Effect of Copper in Solidification of A356 Alloy'** Materials Science Forum Vols 539-543 (2007) pp 452-456

(5) J. Sertucha and P. Larrañaga **'EXPERIMENTAL INVESTIGATION ON THE EFFECT OF COPPER UPON EUTECTOID TRANSFORMATION OF AS-CAST AND AUSTENITIZED SPHEROIDAL GRAPHITE CAST IRON'**Copyright © 2010 American Foundry Society

(6) Natalia Stepanova a, Elena Lozhkina, Alexey Razumakov **'Effect of Copper on the Friction Properties of Gray Cast Iron Applied Mechanics and Materials'** Vol. 698 (2015) pp 364-368

(7) M. Nili-Ahmadabadi∗ , M. Mosallaiee-Pour **'Homogenization of ductile iron using partial melting aided by modelling'** Materials Science and Engineering A 373 (2004) 309–314

(8) A.Ahussein, M. Risbet, A. Bastien, J.P. Chobaut, D. Balloy, J. Favergeon**'Influence of silicon and addition elements on the mechanical behaviour of ferritic ductile cast iron'**Materials Science & Engineering A 605 (2014) 222–228

(9)http://www.dura-barms.com/images/dura-bar-65-45-12-microstructure-center-close-up.jpg

(10).http://www.ndt.net/article/ecndt98/nuclear/245/fig2.jpg

(11) .http://www.iron-foundry.com/blog.files/cast%20iron%20microstructure.jpg

(12) .http://static4.olympusims.com/data/Image/appnotes/cast_iron_sample.jpg?rev=D4B2