Effect of Chemical Composition on Total Carbon Equivalent in Grey Iron Casting- A review paper

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ABSTRACT: The properties of grey iron castings are affected by their chemical composition and the rate of cooling of the work piece under casting process, which is influenced by the thickness of section of job along with shape of the casting. With the prevalent reception of SI units, there has been a junction of national stipulation for grey cast iron based on minimum tensile strength measured in N/mm² (MPa) on a test piece machined from a separately cast, 30 mm diameter bar, corresponding to a relevant wall thickness of 15 mm. There is no requirement in terms of concerto and the foundry man is free to make his own alternative based on the necessities of the particular casting. Type A is a random distribution of flakes of consistent size, and is the ideal type for engineering applications. This type of graphite structure forms when a high degree of nucleation exists in the liquid iron, promoting solidification close to the equilibrium graphite eutectic.

Index Terms --- Casting, Graphite flank Type A, carbon equivalent.

I INTRODUCTION

1.1 Casting

Casting is the process of producing metal into a determined shape by melting solid metal into liquid form, pouring it into a mold and letting it solidify into the desired shape. The mold is a negative copy of the shape of the casting. There are many other methods of shaping metals, such as machining, forging, welding, stamping and hot working. Casting has many advantages over the other methods of metal shaping for producing some particular shapes of metal and types of metal:

The rapid progress of technology requires improve the mechanical and operational properties of the main casting alloy - cast iron. In this respect continuous casting iron is in exceptional position by its properties [1]. Continuous casting has its peculiarities, which, first of all predetermine grey cast iron microstructure and properties [2]. It is well known that the quality and properties of cast products are strongly related to the microstructure developed during solidification. This especially can be seen in the cross-sections of the cast iron ingots, where anomalous, intermediate and normal structural zones can be obtained. This is the result of specific ingot cooling and solidification conditions [3, 4].

The Casting Process

The casting process starts from receiving an order from a customer which may include the design, dimension, physical properties, etc., then the foundry must plan how to make the castings, what methods must be used, then produce a prototype of the casting, modify the casting methods to get rid of the defects, produce the product, and last of all, the send the final product to the customer.[5]

1.2 Carbon equivalent.

The three constituents of cast iron which most affect strength and hardness are total carbon, silicon and phosphorus. An index known as the 'carbon equivalent value' (CEV), combines the effects of these elements. The grey iron eutectic occurs at a carbon content of 4.3% in the binary Fe–C system.

Carbon equivalent value is given by following relationship,

$$(\text{CEV}) = (TC\ \%) + \frac{(\text{Si\%} + \text{P\%})}{3}.\ [6]$$

II Experimental Data

2.1 Relationship between tensile strength and carbon equivalent value for various bar diameters

As per figure 1, experiment was carried out by taking two bars of same length and different diameters 15 mm and 30 mm to observe relationship between carbon equivalent and tensile strength for two bars made of grey iron casting. As we can observe from graph plotted in figure 1 as for carbon equivalent 4.5 the tensile strength is high for smaller diameter. Also if carbon equivalent reduced simultaneous tensile strength reduces.

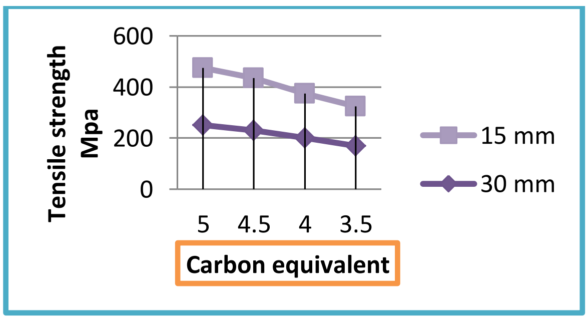


Figure 1 Relationship between tensile strength and carbon equivalent value for various bar diameters

III Effect on graphite Flank

3.1 Types of Graphite Flank

The properties of grey iron castings are influenced by the shape and distribution of the graphite flakes. The standard method of defining graphite forms is based on the system proposed by the American Society for the Testing of Metals, ASTM Specification A247 which classifies the form, distribution and size of the graphite.[3]

3.2 Total Carbon equivalent

There are total six trial had been carried out for to get total carbon equivalent 4.3 as shown in table 1 from trial 3.

Table 1: Chemical Composition of various batch metals

Batch No.	Total Carbon %	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorus (%)
1	3.1	2.1	0.6	0.16	0.2
2	3.15	2.2	0.6	0.17	0.21
3	1.9	2.2	0.65	0.15	0.25
4	3.3	2.3	0.69	0.15	0.3
5	3.4	2.4	0.7	0.15	0.2
6	3.5	2.4	0.8	0.16	0.22

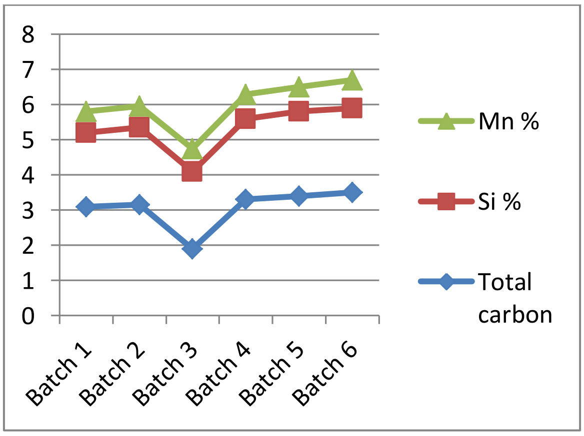
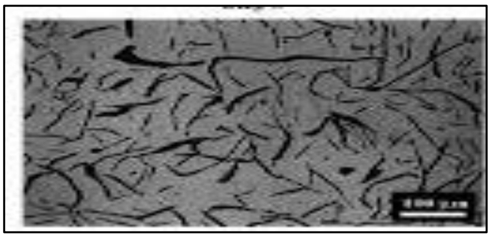


Figure 2: Graph Batch No Vs Batch Composition

Table 2: Total carbon equivalent

Batch No.	TC %	Si %	P %	(Si+P) %	(Si+P) %/3	TCE=TC +(Si+P)/3
1	3.1	2.1	0.2	2.3	0.77	5.4
2	3.15	2.2	0.21	2.41	0.8	5.56
3	1.9	2.2	0.25	2.45	0.82	4.35
4	3.3	2.3	0.3	2.6	0.87	5.9
5	3.4	2.4	0.2	2.6	0.87	6
6	3.5	2.4	0.22	2.62	0.87	6.12



4. EXPERIMENTAL DATA FOR IMPELLER

The component for casting process is impellor for the centrifugal pump made of gray iron material. The required grade for the casting is as per IS: 210 ,1999FG 260 by sand casting process. The pouring temperature, pouring time, runner weight and riser weight all the details cover under following table 3 as shown below.

Figure 3: A type graphite under batch 3

As per table 1 six batch (10 per batch) trail had been carried out with different chemical composition

The detailed specification of as cast impellor is shown in table 3.

Table 3: Specification of impellor

Sr. No.	Parameter	Value
1	**Pouring temp**	1360^{0}C
2	**Composition of casting**	C-2.50%, Si-2.55%, Mn-0.0.25%,
		Si-2.6%, P-0.031%
3	**Part No.**	E02
4	**Material**	C.I FG-260, IS:210 1999

5	**Weight**	3.5 Kg
6	**Bath Metal**	C-2.5to 3.50,Si-1.5 to 2.7,Extra add Mn-350gms
7	**Runner riser total weight**	3 kg
8	**Pouring Time**	5.0 Sec
10	**Density**	7000 kg m^-3
11	**Co. of Thermal exp.**	1.1e-005 C^-1
12	**Specific Heat**	447 J/kg C
13	**Thermal Conductivity**	52 W/m C
14	**Resistivity**	9.6 e-008 ohm m
15	**Mould size**	228.6 X 330.2 mm

As shown in fig.3 is finished casting product which is desirable.

Fig 4: Finished as cast impellor

CONCLUSION:

From above Experimental Results We can say that by adopting chemical composition of batch 3 in order to get 4.3 total carbon equivalents to promote A type graphite.

VII. .REFERENCES:

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