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To analysis mechanical properties in a different composition of a cylindrical block

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ABSTRACT

The hardness of the cylinder block is studied using Brinell-Hardness testing machine. Tooling problem occurred castings were collected for analysis. From which hardness testing carried by Brinell hardness testing machine and the hardness values observed with higher side against the specification. Followed by micro structure evaluation comparing with the ASTM A 247 standard. And the graphite form present Type D and E instead Type A graphite. Knowing the constituents present in it, properties of every single metal present in it, is studied and modifying the alloying elements; Copper (Cu) & Tin (Sn), as Pearlite structure and hardness greatly depends on it, the hardness of the cylinder block is improved. Hence, this could be easily distinguished by being compared as, before and after. The Before criteria, states a failure sample with a higher Cu and Sn composition along with the alloy composition, whereas, the After criteria, states an optimised sample with reduction of Cu and Sn composition along with the alloy composition of the analysed diesel engine block.

Keywords— *Brinell-Hardness, ASTM, Casting, Spectrometer*

1. INTRODUCTION

Today Hinduja Foundries is India's biggest foundry bunch with the ability to create chamber square and head extending from 25 kgs to 500 kgs. Hinduja Foundries sharpens its aptitudes by upgrading its formative capacities with the most unpredictable castings. The indigenous skill that drives the association empowers it to stay up with the continually changing necessities of the market. It has won much-pined for quality accreditations including ISO 9000, QS 9000 and ISO 14001 affirmations that underwrite its capacities. D. S. Padan [2012] was investigated on a practical approach of inoculation process amendatory step in gray iron melting. In cast iron metallurgy, it is an unavoidable process. Inoculation plays a distinct role in modification of graphite morphology and improvement in mechanical properties of gray cast iron. It facilitates the nucleation process by formation of additional heterogeneous nuclei insisting solidification to take place at higher temperature. This results formation of high degree of desired graphite morphology, freedom from mottled and chilled (white iron) casting edges, uniformity and consistency in microstructure, high strength etc. in both flake and spheroidal graphite irons. Various types of inoculants consisting of different elements either Alone or in combined form are used, of which silicon-based inoculants are most Common for its effectiveness as well as low cost. The type of inoculant, quantity, time of addition, fading tendency etc. controls the final property of the casting. Inoculation directs cast iron melt to solidify with desirable graphite structure. It avoids chilling in thin section and at casting edges. Trials should be carried out before establishing norms for type of inoculant, quantity and size of inoculant, method of addition etc. Nucleation level of bath at melting stage should be considered before finalising the inoculation process for better end result. Metal stream inoculation is found to be much effective method to achieve consistency in product and is most suitable for high.

2. EXPERIMENTAL PROCEDURE

The present investigation is an attempt to investigate the possibility of improvement in the microstructure and mechanical properties of gray cast iron through inoculant melt treatment of a sand moulding process. Influence of different types and different percentage of inoculation on tensile strength and hardness has been studied and correlated with microstructure. The addition of special additives to improve mould ability of sand and casting finish. As sand is packed in sand mould box to make cope and drag as shown below, it develops strength and becomes rigid within the flask. Green sand moulding is most commonly used for production of gray iron casting. The moulding sand mixtures use should have sufficient clay to provide high Compression and shear strength and should be able to absorb sand expansion. It should also have sufficient moisture to activate the binder and provide requisite good permeability. Silica sand of AFS grain fineness number: 60 to 75, Clay content: 6 to 8 % , Moisture content: 3.5 to 4 % , Green compressive strength: 1.2 to1.35 kg/cm2, Permeability: 80 to 100.

Fig. 1: Image of Casting Specimen

The pattern resembles the real casting part to generate cavity inside the mould. The pattern material is cylindrical bar wooden material. In present experiment 300 mm long and 26 mm diameter cylindrical bar is use. The cupolas furnace as show in fig 3.4 and the induction furnace as show in fig 3.5 issued for melting of gray irons. The letter is used were high grad irons of precise chemical control and with high degree of superheated are requiring. The slag was removing in charge material of liquid form in furnace by adding flux. The temperature range of 1260 ℃ to1450 ℃ is depending upon the compositions, section thickness and size of the casting poured, use for gray iron castings is less critical then for other metals. Gates used for gray iron castings are usually 50 to 80 % smaller than those required of steel, Cu and Al alloy. Little or no risering is needed for the purpose of feeding shrinkage of gray iron casting. Sometime use for proper runner can solve the purpose of feeding the casting. This includes all operations to the removal of sand, scale and excess metal from the Casting. To remove the sand on the casting surface by shot blasting process. The casting is separated from the moulding sand after it has solidification and transport to the cleaning department. The specimen was prepared into 14 pieces each of a specific size according to ASTM standards. Fourteen test bars were prepared out of which seven test specimens are used for tensile testing. Another seven specimens are some portions cut by hacksaw machine the specimens. For use of hardness test and microstructure analysis test made by sand casting.

3. RESULT AND DISSCUSSION

3.1 Hardness Test Specs

Brinell testing is typically done on iron and steel castings using a 3000 Kg test force and a 10 mm diameter carbide ball. Accordingly the run of the mill scope of Brinell testing in the USA is 500 to 3000 kg with 5 or10 mm carbide balls. All Brinell tests utilize a carbide ball indenter. All Brinell tests use a carbide ball indenter. The indenter is pressed on the sample surface by an accurately controlled test force. The power is kept up for a particular abide time, ordinarily 10 – 15 seconds. After the dwell time is complete, the indenter is removed leaving a round indent on the sample surface. The size of the indent is resolved optically by estimating two diagonals of the roundindent utilizing either a convenient magnifying lens or one that is coordinated with the heap application gadget.

3.2 Tensile Test

The tractable testing machine is done by applying longitudinal or pivotal burden at a particular augmentation rate to a standard ductile example with realized measurements till disappointment. The applied elastic burden and augmentation are recorded during the test for the figuring of anxiety.

Fig. 2: Image of Tensile Test Specimen and Fracture Specimen

According to ASTM, Standards the ratio of gauge diameter to gauge length should be 1:5. Hence turning was done to get the required specifications, Gauge Length 70 mm, Gauge Diameter: 20 mm, Total Length 225 mm, Grip Diameter 26 mm. Specification and hence was directly used. The process is as followed: The specimen's dimensions (thickness/gauge length/total length in mm etc.) were measured accurately by Vernier caliper. The details were fed into the testing machine. The specimen was inserted into the machine and gripped by the jaws. Maximum load was set to 700 KN and loading was done till the specimen failed. The corresponding readings generated for Ultimate Tensile Strength was noted.

3.3 Microstructure Analysis

To gather data regarding the microstructure, a cutting machine, cold mount material, apolishing machine, chemicals, a light microscope, an automated table and image analysis software were used. The small samples were cut from test bars by hand hacksaw and hacksaw machine. To prepare samples surface finishing by grinder machine Then to polishing by polishing machine by using a series of emery papers from 100 to600 grade and finally polished on velvet cloth. Then after polished surface samples are placed on the lance table of the light microscope and show microstructures of polished surface samples to 100 xx lance.

Fig. 3: Grinder Machine and Polishing Machine

Alumina and water are the liquids used to reduce the frictional heat attained during polishing. Operations include deburring, polishing, paint removal, corrosion removal, sizing, etc. This is accomplished by moving the abrasive-coated paper, with some pressure, against the object being processed. Emery sheets vary from E120 (min) to E1000 (max). And also show the type of graphite flags, the graphite morphology, ASTM Class of graphite flags, then after etchant natal solution will be used on polished surface sample. To analyse presence of ferrite, pearlite, carbide, eutectic cell size and eutectic cell morphology different macros for the software, "METAL CAST" were used. They were all analysed at the same surface size inoculant microstructure, strontium and zirconium base inoculant microstructure of gray cast iron in cast condition of different percentage of inoculation use for sandcasting process.

3.4 Spectrometer Test

Widest wavelength ranges from 130 nm - 780 nm. Arc spark OES (spark OES) is the analysis method used by portable and mobile metal analyzers the principle of the analysis method of portable and mobile metal analyzers is optical discharge spectroscopy (curve sparkle OES or flash OES). Test material is disintegrated with the testing test by a bend sparkle release. The iotas and particles contained in the nuclear fume are energized into discharge of radiation. The radiation emitted is passed to the spectrometer (arc spark OES) optics via an optical fibre, where it is dispersed into its spectral components. From the scope of frequencies discharged by every component, the most appropriate line for the application is estimated by methods for a CCD. The radiation force, which is relative to the grouping of the component in the example, is recalculated inside from a put away arrangement of alignment bends and can be demonstrated legitimately as percent fixation.

4. COMPARISON AND ANALYSIS

4.1 Effects of alloying elements in grey cast iron engine blocks

4.1.1 Without reduction of Copper and Tin

1 CHEMICAL COMPOSITION :

ELEMENT	SPEC	ACTUAL	JUDGE.
C	3.1-3.5 %	3.29	OK
Si	1.8-2.4 %	2.08	OK
Mn	0.5-1.0 %	0.69	OK
Cr	0.15-0.40 %	0.16	OK
P	0.15 % Max	0.04	OK
S	0.15 % Max	0.056	OK
Cu	0.3-1.0 %	0.65	OK
Sn	0.02-0.1 %	0.089	OK

2. HARDNESS

DETAIL	SPEC	ACTUAL	JUDGE.
Bore centre	179-248BHN	255,260,262	Not ok

3.1 MICROSTRUCTURE PHOTO

BEFORE ETCHING: 100x	AFTER ETCHING: 100x
	

3 MICROSTRUCTURE

DETAIL	SPEC	ACTUAL	REMARKS
Graphite	Type 'A' graphite predominantly, 'B and D' shall be 5% Max	Type E graphite observed	Not ok
Size	4-6	7 to 8	
Matrix	Pearlite 94 % Min	98.00%	
	Ferrite 3 % Max	2.00%	
	Cementite 3 % Max	NIL	

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	SPEC	ACTUAL	REMARKS
TENSILE STRENGTH	26.0 Kg/mm^2 min	28.10 Kg/mm2	OK

4.1.2 with reduction of Copper and Tin

1 CHEMICAL COMPOSITION :

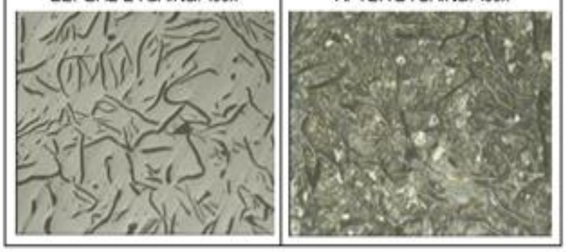
ELEMENT	SPEC	ACTUAL	JUDGE.
C	3.1-3.5 %	3.39	OK
Si	1.8-2.4 %	2.09	OK
Mn	0.5-1.0 %	0.66	OK
Cr	0.15-0.40 %	0.16	OK
P	0.15 % Max	0.049	OK
S	0.15 % Max	0.072	OK
Cu	0.3-1.0 %	0.42	OK
Sn	0.02-0.1 %	0.058	OK

2. HARDNESS

DETAIL	SPEC	ACTUAL	JUDGE.
Bore centre	179-248 BHN	229,230,236	OK

3.1 MICROSTRUCTURE PHOTO

BEFORE ETCHING: 100x | AFTER ETCHING: 100x



3 MICROSTRUCTURE

DETAIL	SPEC	ACTUAL	REMARKS
Graphite	Type 'A' graphite predominantly, 'B and D' shall be 5% Max	Type 'A' graphite predominantly & 'B'<1%	OK
Size	4-6	4 to 6	
Matrix	Pearlite 94 % Min	97%	
	Ferrite 3 % Max	2-3%	
	Cementite 3 % Max	NIL	

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	SPEC	ACTUAL	REMARKS
TENSILE STRENGTH	26.0 Kg/mm^2 min	27.40 Kg/mm2	OK

5. CONCLUSION

- There were two samples being taken. Sample 1: Failure sample with higher Cu & Sn % Sample 2: Optimized sample with reduced Cu & Sn %
- From chemical composition tables of before and after, we compare and analyse the variation in chemical composition.
- From hardness composition tables of before and after,we observe the improvement in hardness of the selected 1.6L cylinder block that is used.
- From tensile strength tables of before and after, improvements in tensile strength and mechanical properties of gray cast iron cylinder block can be seen.
- From micro-structural analysis, the difference in micro-structure is found.

6. REFERENCES

[1] Best practice guide for foundry sector of India for the BEE-GEF-WorldBank ProjectFINANCING ENERGY EFFICENCY AT MSMEs A joint activity by:Bureau of Energy Efficiency (BEE) &Institute for Industrial Productivity (IIP) Prepared by: MB Associates, UKMarch 2012.

[2] Effect of inoculation on microstructure and mechanical properties of gray cast iron a dissertation submitted to u. v. Patel college of engineering, ganpat university in partial fulfilment of the requirement for the degree of master of technology in mechanical engineering with specialization in advanced manufacturing techniques (amt) submitted by chandraprakash k rajdeep (roll no. m11amt12) under the guidance of prof. v.p. patel prof. n.a. modi december-2013.
[3] Manufacturing Processes and Engineering Materials Used in Automotive Engine Blocks by Hieu Nguyen - School of Engineering- Grand Valley State University -Term Paper-EGR250 – Materials Science and EngineeringSection B, Instructor: Dr. P. N. AnyalebechiApril 8, 2005.
[4] Materials engineeringCast Irons-Anyagtudomany Es Technologia Tanszek.
[5] Paper presentation by HINDUJA FOUNDARIES LTD. Sriperumbudur, Chennai, India.
[6] The effectof tin on the mechanical and physical Properties of gray cast iron byCharles Joseph Messina-A ThesisPresented to the Graduate Committeeof Lehigh University-in Candidacy for the Degree ofMaster of ScienceinMetallurgy and Materials ScienceLehigh University1975.
[7] The Effect of Copper Addition on the Mechanical and Wear Properties of Grey Cast Iron J. O. Agunsoye, S. A. Bello, S. B. Hassan, R. G. Adeyemo, J. M. OdiiDepartment of Metallurgical and Materials Engineering, University of Lagos, Lagos, Nigeria-Received 27 May 2014; revised 8 July 2014; accepted 17 July 2014.
[8] The Fundamentals of Green Sand Preparation And Control The Effect of Copper Addition on theMechanical and Wear Properties of GreyCast IronJ. O. Agunsoye, S. A. Bello, S. B. Hassan, R. G. Adeyemo, J. M. Odii-Department of Metallurgical and Materials Engineering, University of Lagos, Lagos, NigeriaReceived 27 May 2014; revised 8 July 2014; accepted 17 July 2014.
[9] The Green Sand Management – Role & Application of Carbonaceous
[10] Additives and Concept of total Carbon in a Green Sand System
[11] Deepak Chowdhary.
[12] TheIndian Foundry Industry-VIKAS GARG-President Designate -The Institute of Indian Foundrymen.
[13] TheIndian Standard GUIDELINES FOR CONTROLLINGFOUNDRY REJECTION IS 12880: 1989(Reafl'iiaed 199s).

