International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online)
Vol. 7, Issue 2, pp: (113-115), Month: October 2019 - March 2020, Available at: www.researchpublish.com

Research paper on properties of ductile iron casted using Freeze molding technique

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Abstract: **In the present time where we are constantly looking for better materials to work with we are also working hard on modifying the old ones we have using different methods. Doing the same thing scientist ended up finding Spheroidal Graphite iron which has mechanical properties better than that of malleable iron. This is a type of cast iron where unlike grey cast iron graphite provides continuity of structure and plasticity. Its higher mechanical properties are making it to be the best replacement for steel in the manufacturing business. The properties of the S.G. iron can be further increased/modified by heat treatment processes. Studies and various experiments are being conducted to understand the structure and the properties of S.G. iron in various places. In this paper we are determining different material/mechanical properties of ductile cast iron which is casted using a non conventional casting method (freeze molding technique) which is also eco friendly with various other advantages including being as effective as our conventional molding method.**

1. INTRODUCTION

The S.G. iron is the fancy name for ductile iron which is also called nodular cast iron in many literature references is a form of cast iron which has graphite in a rich amount. S.G. iron was discovered by Keith Millis in 1943. Now the question arrives why this kind of iron has so much hype build up around it. It's mostly because of its mechanical properties. [1] This type of iron has high impact and fatigue resistance, due to its nodular inclusion. Its good machinability makes it's a good material to be used at various structures for machines, grade 8 trucks, tractors (agricultural), water pumps and at various construction structures, etc. Ductile iron is also used at various places where plastic could be too light and fragile and use of steel is not really necessary like in the underground piping system. Where PVC, HDPE, LDPE can't be used without sufficient outer protection to keep them from any damage. The main part of this type of iron is the structure of graphite present in it. [2] In SG cast iron graphite is present in Spheroidal nodules (shape) instead of flake shaped like in grey cast iron which increases the brittle nature of the material where as in SG iron the Spheroidal cast iron increases the irons ability to withstand distortion. [3]

The SG cast iron also has lower cast temperature than steel which means it can have higher surface finish and more complex shapes can be attained in it as well. The manufacturing cost of SG iron is also lower than that of steel. Like every other materials SG iron also comes in various grades which can be defines by the alloys and the heat treatment processes applies on it to give various degrees of tensile strength and elongation.[4]

2. THEORY

The specimen used here is a Spheroidal graphite cast iron made by using freeze mold technique under ambient conditions. This test is conducted to find out all the properties of graphite cast iron and determine all the places it can be used to make things cost effective.

Reduced pressure Freeze mold technique

This is a little different from our usual mold casting method. This form of mold casting uses silica sand, water (as binding agent) and a low pressure aspirator for the freezing part of the process. In this the sand is mixed with water to create the

mold which is later frozen to get a solidified mold this form type of molding process does has some advantages over our normal process which are listed below.

1. It provides smooth movement to the molten metal when its poured in which in turns allows us to decrease the size of risers.

2. The sand can be reused without any sand treatment process.

3. No use of other binding agents means there is no emission of any kind of gas.

4. This process also generates comparatively less dust. [5]

3. METHODOLOGY

The SG cast iron we used was a standard experiment specimen with chemical properties as follows: -

1. Carbon content – 3.30% to 3.80%

2. Silicon content – 2.40% to 2.60%

3. Manganese content – 0.2% to 0.5%

4. Phosphorous content – 0.03% to 0.06%

5. Sulfur content – 0.025% to 0.040%

6. Magnesium content – 0.020% to 0.050%

The specimen was melted in an open air furnace at a temperature of 1100 c for half hour (until it was completely molten to be exact). The molten metal was poured in the mold which was made using low pressure freezing technique with contents including silica sand and water(as a binding agent). The metal was poured in the mold in 20 sec slowly letting it settle down in the pours perfectly to get the minimum error for our experimental specimen.

The casted specimen was taken out after it solidified and the extra portion (riser leftover) was removed using grinder to keep the specimen from any damage. The casted specimen is now used in different experimental setups to get the mechanical properties i.e. hardness, tensile strength and various other properties.[6]

Mold making process

The mold making process was quite simple all we used was fine grained silica sand and water for mold and liquid nitrogen was used to freeze the mold to provide it the strength to withstand the metal pouring process. [7]

Liquid nitrogen was used as a replacement to the low pressure aspirator or a freezing room for the mold. The mold was taken down up to a temp -23'C (which was the lowest we could manage). The mold is made inside wooden frames (half for cope and half for drag) after the mold is completely ready the metal was poured in carefully. The molding process after the freezing of the mold was same as our regular casting process. The mold was collapsed after the casted metal piece was taken out. As the binding agent was frozen water the mold losses its strength and becomes comparatively softer as the hot metal is poured down on it. [8] All the specimens were of standard size as defined by (ASTM)

Mechanical properties tests performed

Tensile tests: - Tensile test was done on a UTM i.e. a Universal Testing Machine. Tensile test is the mechanical/material science test of a material under which a tension is applies on the material until fracture. This test gives us various working aspects of the material being tested like %elongation ultimate tensile strength, breaking strength and properties like poisions ratio and young's modulus can also be found using tensile test. [9]

Indentation hardness test: - This test determines the hardness of the material that is being deformed in the machine/experiment. The material being examined is indented various times at different position to get a mean value for better accuracy/ to get close result to true value. This test can be performed in both microscopic and macroscopic level.

Fatigue test: - It is a mechanical property test of the material which determines the number of cyclic load the material could handle before breaking down. [10]

4. RESULTS AND CONCLUSIONS

The properties of the materials we tested had following readings

Brinell hardness: - 163

Rockwell hardness: - 87.3

Charpy impact value: - 89.8 (Kj/m^2)

Elongation: - 9.3% (aprox) i.e. 2.79cm

Tensile test: - 546MPa

Conclusion:

It was observed during this experiment that the specimen which were made using freeze molding technique were very similar in every way to our conventional molding technique products. The benefit here was the new molding technique is much more eco friendly than our regular technique and we also established the properties of the Spheroidal graphite cast iron using various tests (material testing).

REFERENCES

[1] Willman industries inc booklet

[2] Smith & Hashemi 2006, p. 432.

[3] Modern casting inc.in

[4] Kazumichi Shimizu1, Yaer Xinba1, Masahito Tanaka2 and Hideki Shudai3

[5] H. Shudai and N. Tokunaga: Refrigeration 80 (2005)

[6] K. Kobayashi: JACT NEWS, No. 262 (1978)

[7] K. Kobayashi: JACT NEWS, No. 262 (1978)

[8] V.B. Bhatt theory of refrigeration 3012 (1999 edition)

[9] K. Kobayashi: JACT NEWS, No. 253 (1978)

[10] Japan engineering foundry comities introductory manual.