International Journal of Current Trends in Engineering & Technology
www.ijctet.org, ISSN: 2395-3152
Volume: 04, Issue: 03 (May- June, 2018)

EXPLORING THE POSSIBILITY OF USING MAGNETIC MOLD IN CASTING

K. BALAJI
Department of Mechanical Engineering
Vemu Institute of Technology
P. Kothakota, India
k.balaji449@gmail.com

YOHANU D.
Department of Mechanical Engineering
Vemu Institute of Technology
P. Kothakota, India
yohanu008@gmail.com

A. GNANA SEKHAR
Department of Mechanical Engineering
Vemu Institute of Technology
P. Kothakota, India
gnanasekhar001@gmail.com

Abstract — Casting is a manufacturing process which is used directly or indirectly in almost every industry. It is a primary manufacturing process and has its effect on the properties of the resultant product. In this a there is a demand to innovate processes, which can reduce lead-time, reduce cost of production without compromising with the quality of the products and reduce it ill effects on environment. Magnetic mould for casting (MMC) is an innovative process having a great potential to replace conventional casting methods due to the process is eco-friendly as it eliminates the use of sand, successfully reduces the overall process time for casting and results in better properties too, The setup of MMC includes winding of copper wire such that it behaves like a solenoid with hollow cavity in which actual casting process is to be carried out. The setup was prepared with copper wire of 19 gauges and winding is done until required magnetic field is created. The prepared setup and trial runs shows that there is a scope of creation of similar setup at large scale so that MMC can be used at industrial levels for reduces the lead time of casting, reduces the cost of casting products and reduces effect on environment and improves properties to the resultant products.

Keyword — Foam pattern, Magnetic mould casting procedure, Sand casting, Steel shots.

I.INTRODUCTION

Casting is a manufacturing process, which is used directly or indirectly in almost every industry it is a primary. process having effect on the properties of resultant product The history of molding and casting traces back to earlier century It has been observed that in first and oldest generation mold was made by means of squeezing/jolting green sand, second generation binders were used in sand molding process i.e., clay or organic resins to enhance the properties. It progressed to the third generation where physical means like gravity, vacuum, lost foam were adopted of the late the magnetic field is being attempted which has observed to stabilize free flowing dry molding materials. This development of unbounded casting process is to improve flexibility and enhances mold ability .the concept of unbounded casting is to change the kind of binder or to avoid substantial binder.

In MMC the magnetic field applied to the mould material i.e., steel shoots by using of the copper wire which will wounded outer of the mould box by giving the power supply to the mould box , the mould box acts as solenoid coil and the steel shots get bounded together by the magnetic field of the mould box. The main purpose of MMC is to reduces the human effect in casting making process by using magnetic field there is no ramming time for the casting and also there is no demolding time for the casting hence it will reduces the direct time of the casting. MMC process employs a one-piece mould and an EPS (expandable polystyrene) pattern, which gives an advantage of cast products being free of defects associated with joint line (Geffroy et. al.). Also the products have better dimensional tolerances than the products obtained from conventional methods. The amount of machining required is less thus reducing the time and cost involved in finishing a product for use. The mechanical properties like tensile strength, impact strength and hardness of the products cast from MMC have higher values as compared to sand casting products .in this project mostly used mould material is steel shots because of it give the quick solidification rate and thermal conductivity is greater than the sand casting. A major concern related to casting is environmental pollution. In casting, foundry waste is released, which is directly related to type of molding technique, type of furnace and type of metal used. In sand casting sand once used gets burnt and is of no use, thus adding up to foundry waste whereas in MMC steel shots can be reused and magnetic field had not any effect on the worker's health. Therefore MMC is an eco friendly process as waste generation is minimum and due to reusability of mould material. This process is still in its research phase.

II. EXPERIMENTAL SETUP

- Mould box dimensions:
- Hallow rectangular box 100×100×120mm is made of the iron material having permeability of 4π × H-
- Copper wire of 19 wire gauge is used to sustain the current for required time period of experiment without damage due to heating
- Power supply- Constant DC power supply is provided with the help of single-phase 0-250V autotransformer and a bridge rectifier of 260V and 6 A rating is used
- The numbers of turns were decided by checking the magnetic field value at different values of turn and winding was stopped when required field value was obtained. In this experiment the magnetic field checked in natural method only.
- The high carbon steel shots having the 3.18mm diameter and permeability of 0.75 H.

III. EXPERIMENTAL PROCEDURE

In this experiment the magnetic field checked in natural method because of we didn't have availability of sensor which will measure of magnetic field , initially we calibrated the all equipment's which will we need to do the experiment i.e. , muffle furnaces , Rockwell machine, impact test equipment and microscopes.

Fig-1 flux checking

In 1st stage we do the trails with the muffle furnaces with different crucibles like graphite, stainless steel material crucibles, we identify that graphite crucible is suitable for our experiment.

in 2nd stage we do the trails with mould box for the magnetic field, we are used rectangular hallow box to this experiment the dimensions of mould box already given in above, the copper wire of 19 gauge used in this experiment with different quantities, we wounded the copper wire to the mould box and give the power supply to the mould box we used trial and error methods to find require magnetic field. we did different trails with different changes like number of turns, different power supply's , final we found that we had the sufficient magnetic field at 667turns , and flux density is 0.25 tesla.

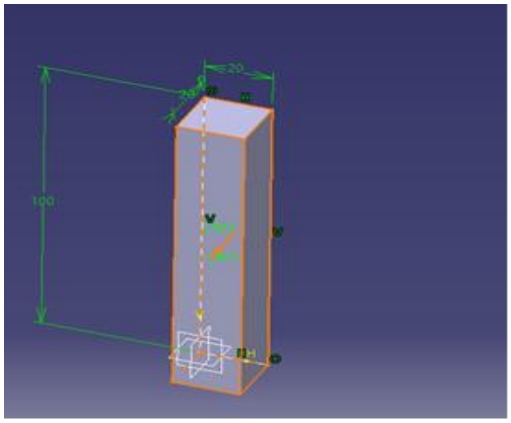

fig-2 .*Catia modeal of foam pattern*

3rd stage we are decide to the shape of the pattern and dimensional tolerances of the pattern, in this experiment we didn't do the any chemical coating to the pattern , we taken the foam material to make the pattern.

4th stage magnetic mould casting preparation, We place the foam pattern in the mould box and we filled the mould box with the steel shots and we gave the power supply to the mould box, we gave the 260v and 6 amps to our mould box and we pored the molten aluminum metal which was already melted on graphite crucible in muffle furnace. when the molten metal was poured in to mould box on the foam pattern the foam was get vaporized and it allowed to fill the metal in the shape of foam , after filling the pattern completely we were solidified the metal with time span of 5min at room temperature.

Fig-3. Metal pouring to mould

Fig-4. MMC componet

IV.TESTING AND RESULTS

As per the experiment we are expecting the good strength and better hardness than sand casting specimen. To prove our object we are done the below test for both magnetic mould casting specimen and sand casting specimen.

Fig -5. Microstructure of MMC specimen

Testing need to done
1. Micro structure
2. Charpy test
3. Hardness test

1. MICROSTRUCTURE
In magnetic mould specimen had the fine grain structure without flakes, but in sand casting specimen had the flakes in microstructure.

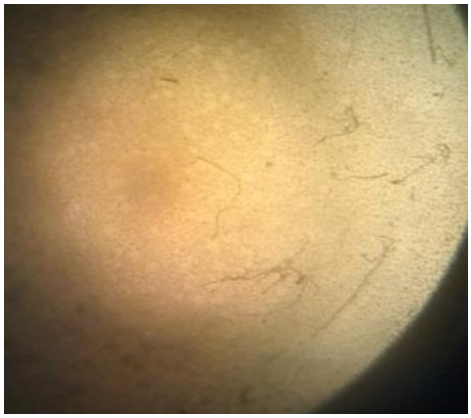
Fig -6. Microstructure of sand casting specimen

2. IMPACT TEST:
MAGNETIC MOULD CASTING:
Breath of specimen: 10 mm
Thickness of specimen: 10 mm
Length of the specimen: 55 mm
Energy absorbed without specimen E1:300 J
Energy absorbed for breaking the specimen E2:10 J
Total energy K=E1-E2
=300-10
=290 J * (1 joule=0.10197kg F/M)
K=2900kgf/cm
Impact strength of specimen I=K/A
I= (2900*10)/100
I=290 kg/mm

SAND CASTING:
Breath of specimen: 11 mm
Thickness of specimen: 12 mm
Length of the specimen: 55 mm
Energy absorbed without specimen E1:300 J
Energy absorbed for breaking the specimen E2:5 J
Total energy K=E1-E2
=300-5
=295 J * (1 joule=0.10197kg F/M)
K=2950kgf/cm
Impact strength of specimen I=K/A
I= (2950*10)/132
I=223.48 kg/mm

Impact strength of the magnetic mould casting specimen is 290 kg/mm, but sand casting specimen had 223.48 kg/mm

3. HARDNESS TEST:
Hardness of the magnetic mould casting is 83.7HRB, but sand casting specimen had 53.7 HRB.5.2.

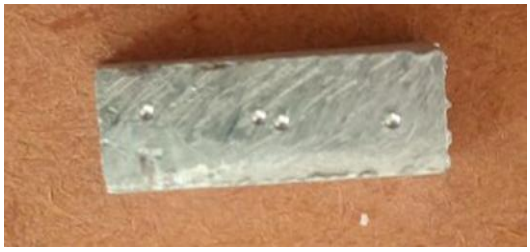
Fig-7 Sand casting specimen after Hardness test.


Fig-8 MMC specimen after Hardness test

V.CONCLUSION
A magnetic mould casting successfully prepared .it was observed that MMC specimen had the good hardness and fine grain structure over the sand casting specimen, by using of MMC method we reduces the time and cost in casting manufacture process. The complex shape can easily produce and we can eliminate the chemical usage in mold making process. MMC would be eco friendly process as compared to sand casting. If we increased the intensity of magnetic flux we can produced the inculcate tools easily with less cost

VI. ACKNOWLEDGEMENT
G. Suresh, M. Tech, Associate prof, (HOD of Mechanical Engineering in Vemu Institute of Technology).
V. Ramesh, M. Tech, Associate prof., (Department of Electrical Engineering in Vemu Institute Of Technology) for their consistent and valuable guidance throughout the project.

VII. REFERENCES
[1]. Susumu Takamori, Yoshiaki Osawa, Takashi Kimura, Xinbao Liu and Toshiji Mukai "Casting Surface of AZ91 Alloy and Its Reaction with Sand Mold", Materials Transactions, Vol. 49, No. 5 (2008) pp. 1089 to1092
[2]. Pierre-Marie Geffroy, Merouane Lakehala, Javier Goñia, Eric Beaugnonb, Jean-Francois Silvain,
[3]. "Thermal and mechanical behavior of grey cast iron and ductile iron castings using magnetic molding and lost foam processes", Journal of Materials Processing Technology, Volume 209, Issue 8, 21 April 2009,
[4]. Dr.Eman J. Abed, Lecturer, Dept. of materials engineering, University of Kufa, Najaf-Iraq. "The influence of different casting method on

solidification time and mechanical properties of AL- Sn castings'', International Journal of Engineering & Technology IJET-IJENS Vol: 11 No: 06 (2011) pp. 34-44.

[5]. J. Szajnar, "Casting structure change caused by magnetic.

[6]. Gnanavel, P. (2013). Innovative Design on Fabrication of energy conservation in non-ferrous casting manufacturing process. Indian foundry journal, 59(12), 32-35.

Author's Profile

(1) K.BALAJI – is currently Assist. Prof, Department of Mechanical Engineering in Vemu Institute Of Technology. His main interest in Design and optimization, k.balaji449@gmail.com

(2) Yohanu Dandugula is currently a student of Vemu Institute Of Technology. His main interest in research includes In Design of mould, magnetic flux and study of properties between MMC and sand casting. yohanu008@gmail.com

(3) A.Gnana Sekhar is currently a student of Vemu Institute Of technology. His main interest in research includes in study of properties between MMC and sand casting. gnanasekhar001@gmail.com