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Analize Die Casting process and Structure of HDF 12 Material for Lower Arm

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Abstract. *Steel is part of raw material for manufacturing process making a product. Ferro Casting Ductile is part of manufacturing process from iron ore to be metal part using casting process. Die casting is a part of manufacturing process especially in automotive industries for engine of vehicle production process. this research will be focus on casting process, Ferro Casting Ductile (FCD). In this research using material steel HDF 12 Material, in this process production Magnesium, Pig Iron, Scrap, Silicon, Carburizer, Inoculant and Slagtol. Manufacturing process is melting process of all raw material using temperature (melting point) at 1100 - 1400 ºC. When Specimen finish to process production will be analyze using spicrometer and SM machine for check of characteristic material and structure for crack issue. The result show that after casting process, the HDF12 have composition rate iron (Fe) content, namely 93.37% and also carbon (C) 3.82% and silicon (Si) 2.31% after check using. As visual check after die casting, lower arm is there no any crack, flash, flow mark finding by visual check inspection result. SEM Measurement check result until 300µm the result show that no any finding crack issue and result of Tensile strength of material Lower Arm upper limit is 433Kgf/cm2 and lower limit is 420 Kgf/cm and Elongation is 32%.*

Keywords: *Die Casting, Hot Dip Ferro, Metal*

INTRODUCTION

Die casting is a part of manufacturing process especially in automotive industries for engine of vehicle production process. this research will be focus on casting process, Ferro Casting Ductile (FCD). [1]. Die Casting Die Design and Process Optimization of Aluminum Alloy Gearbox Shell, the result show that Aiming at the leakage problem of the gearbox shell in the bench and road test after assembly, the cause was found through numerical simulation and industrial CT analysis, and the problem was solved by adding high-pressure point cooling at the corresponding position of the leakage, and the correctness of the optimization was verified [2]. Design and Analysis of Pressure Die Casting Die for Automobile Component, the result show that the reduced all machining and can make the process the optimum choice for small volume production as well [3]. Effect of refractory aggregate shape on the porosity of A356 alloy castings in lost foam casting, the result show that Defects at specific locations of the castings were analyzed and statistically counted through optical microscopy. In conclusion, the combination of expanded graphite and bauxite clinker yields the best quality castings in A356 LFC. [4]. The Application of the Direct Water-Cooling Process on the Lost-Foam Casting Technique to Improve Microstructural and Mechanical Properties of A356 Alloy, the result show that the highest obtained mechanical values were found around to be approximately

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195 ± 3.5 MPa ultimate tensile strength, 4.45 ± 0.78% elongation, and 84 ± 1.77 HB in hardness.

STUDY OF LITERATURE

Iron is a lustrous and ductile it has a chrome-colored appearance that reflects a significant amount of light. Iron is also a ferromagnetic metal, meaning it's magnetic and attracts other ferromagnetic metals. Steel, on the other hand, is a ferrous alloy consisting primarily of iron and carbon. Many people assume that steel is a metal, but this isn't necessarily true. While it exhibits similar properties as metals, it's technically classified as an alloy. Steel is part of raw material for manufacturing process making a product. Ferro Casting Ductile is part of manufacturing process from iron ore to be metal part using casting process. Die casting is a part of manufacturing process especially in automotive industries for engine of vehicle production process. this research will be focus on casting process, Ferro Casting Ductile (FCD). In this research using material steel HDF 12 Material, in this process production Magnesium, Pig Iron, Scrap, Silicon, Carburizer, Inoculant and Slagtol. Manufacturing process is melting process of all raw material using temperature (melting point) at 1100 - 1400 ºC.

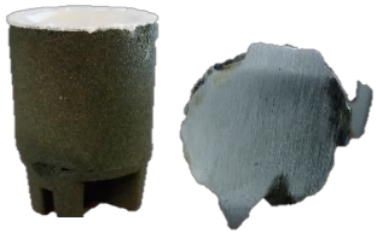

Figure 1. Cup CE meter and specimen

Die Casting Part, Spectrometer and SEM Test

Below figure is final part for material HDF 12 is lower arm, this material will be assembly for sub part automotive. In process production this part using Magnesium, Pig Iron, Scrap, Silicon, Carburizer, Inoculant and Slagtol. Working temperature for processing to molding is 1100 - 1400 ºC. Molding of part using 2 cavities for production process, after completed visual check will be continue to analyze by spectrum meter Cup CE and SEM for analyze of structure of final product.

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Figure 2. Lower Arm

Below figure is spectrometer and SEM machine. In this step analyze of raw material and final product is there any issue crack or not. Specimen will check using 3 formula composition and will be check Fe ≤90.50 will be disposal. And after finish will be continue for process die casting and then check by SM machine for analyze structure of part.

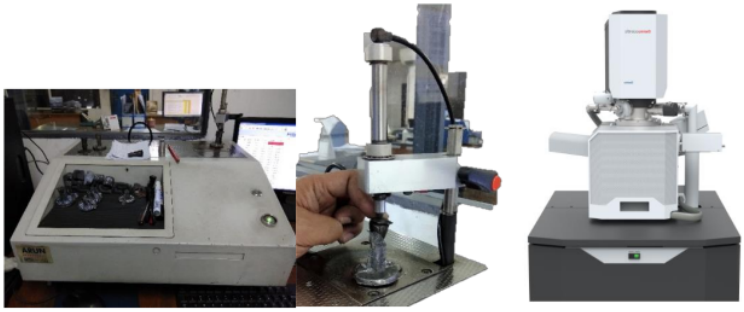

Figure 3. Spectrometer and SEM Machine Test

RESEARCH METHODOLOGY

The research method is using material HDF 12, base composition material is Magnesium, Pig Iron, Scrap, Silicon, Carburizer, Inoculant and Slagtol. Mixing material will process with mixer machine with 3 specimen or composition material as standard. After mixing process will continue to CE Casting for make specimen of steel material and analysis using spectrometer inspection. Spectrometer inspection result will take for reference casting process material for continue to process finish good product analyze using SEM.

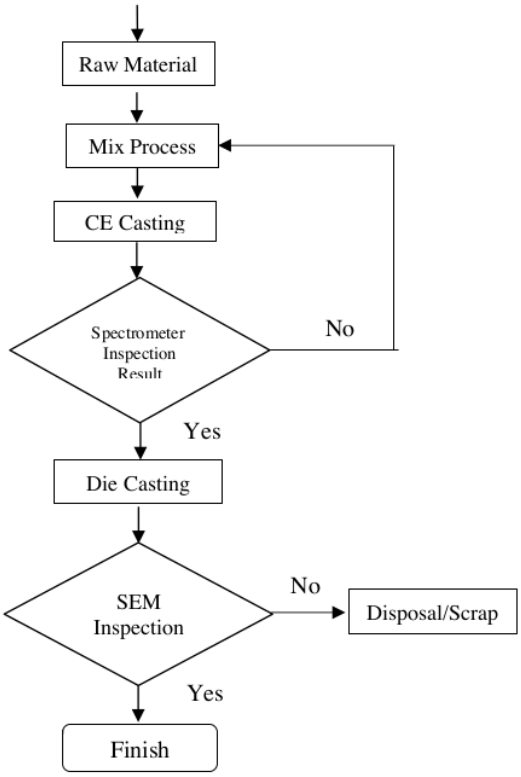

Figure 4. Research Methods

CE Casting

When CE Casting for raw material HDF 12 using temperature 1100 – 1400◦C for sampling analysis of Spectrometer Inspection. The temperature of the liquid metal is still held at this temperature until the chemical composition of the liquid metal is produced which is displayed on the CE Meter display. At this stage we can mix the metal mixture to comply with the predetermined standards, while the temperature display is "TL˚C" (Liquid Temp) and "TE˚C" (Eutectic Temp) which is shown automatically on the CE meter display is the temperature when measuring the % CE composition. If the desired composition has been achieved, the temperature of the liquid metal is checked as in Figure 7 in preparation for tapping. However, if the desired composition has not been achieved, then the elements that have not been achieved are added.

Figure 7. CE Casting Process

RESULTS AND DISCUSSION

The result show that HDF 12 has a high average iron (Fe) content, namely 93.37% and carbon (C) 3.82% and silicon (Si) 2.31%. If compared with the standard composition of the FCD 450 material in table 3.1, the data obtained does not enter the standards that have been set, therefore the specimens made will be included in the rejected items and will be reprocessed according to the procedures that have been set or if the liquid is still in the refining process. then you can add materials so that the carbon and silicon levels can meet the established standards.

Figure 8. CE Test Before and After

Table 2. Spectrometer Test Result

Composition	Fe	C	Si	Mn	P	S	Cr	Mo
1	93.39	3.84	2.27	0.229	0.035	0.023	0.039	<0.005
2	93.33	3.83	2.33	0.233	0.031	0.022	0.039	<0.005
3	93.39	3.79	2.32	0.236	0.033	0.022	0.040	<0.005
Avg	93.37	3.82	2.31	0.233	0.033	0.022	0.039	<0.005
Composition	Ni	Al	B	Co	Cu	Ti	V	Mg
1	<0.005	<0.003	0.0038	<0.002	0.016	0.020	<0.003	0.031
2	<0.005	<0.003	0.0030	<0.002	0.017	0.019	<0.003	0.040
3	<0.005	0.005	0.0037	<0.002	0.017	0.019	<0.003	0.032
Avg	<0.005	0.003	0.0035	<0.002	0.017	0.020	<0.003	0.034
Composition	Zn	Pb	Sn					
1	<0.003	<0.005	<0.005					
2	<0.003	<0.005	<0.005					
3	<0.003	<0.005	<0.005					
Avg	<0.003	<0.005	<0.005					

Figure 9. Show that process and final product of lower arm. In this process final product, no any defect of crack, flash, flow mark finding by visual check inspection result. After completed visual inspection, will be continue to analyze by SEM machine for final quality inspection result. Structure of engine will be check by measurement test and will be check by random as lot of production of Lower arm.

Figure 9. Lower Arm

Figure 10 show that SEM machine that structure of lower arm no any crack finding, specimen of lower arm check using three composition of material and zoom of material until 300µm. Structure of material after die casting can be check is there melting as well. This condition can be used for standard of saferty material for mass production, Crack issue will be impacting long term for durability of Lower Arm. After SEM process will be check tensile strength and elongation of material.

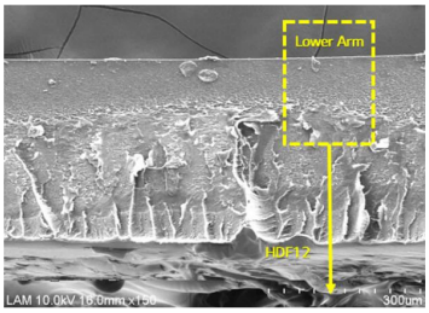

Figure 10. SEM Measurement of Lower Arm

Figure 11 show that result of Tensile strength of material Lower Arm upper limit is 433Kgf/cm2 and lower limit is 420 Kgf/cm2. The test method is 2 times specimen and check limit of material lower arm, and Elongation is 32%. The result mention is material can be used as well for lower arm, as performance and durability check that material not issue for crack issue finding.

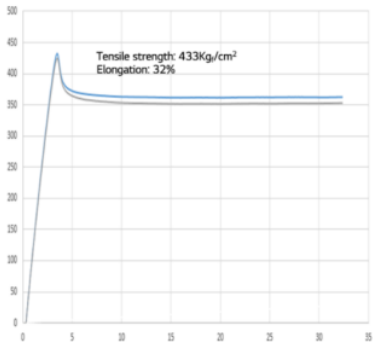

Figure 11. Tensile Strength Test Result

CONCLUSIONS

The result show that Die casting process need to detail check raw material and result after process production. In this anlize of material HDF 12 have result that CE test show that average iron (Fe) content, namely 93.37% and also carbon (C) 3.82% and silicon (Si) 2.31% after check using. As visual check after die casting, lower arm is there no any crack, flash, flow mark finding by visual check inspection result. SEM Measurement check result until 300µm the result show that no any finding crack issue and result of Tensile strength of material Lower Arm upper limit is 433Kgf/cm2 and lower limit is 420 Kgf/cm and Elongation is 32%.

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