TECHNIUM

Romanian Journal of Applied Sciences and Technology

ISSN: 2668-778X

IJCST

vol. 17 / 2023

The 7th International Conference on Science Technology

organized by
Faculty of Social Science and
Law Universitas Negeri Manado and
Consortium of International Conference
on Science and Technology

The Innovation Breakthrough in Digital and Disruptive Era

PLUS COMMUNICATION

International Communication & PR

TECHNIUM

Technium: Romanian Journal of Applied Sciences and Technology
Vol. 17, 163-167, November, 2023
ISSN: 2668-778X
www.techniumscience.com

Investigating the Effect of Pouring Temperature Variations on Casting Defects of Making Camshaft Covers for Yamaha Jupiter Motorcycles Using Sand Casting Method

Asril l. Fabanyo[1], *Ivan Junaidy* A. Karim[2], *Bambang* Tjiroso[3*]

[1,2,3] Mechanical Engineering Department, Faculty of Engineering, Universitas Khairun, Ternate, Indonesia

Abstract. Casting using the sand-casting method is one of several methods in the metal casting process. The pouring temperature in the casting process is critical because it affects the casting results. This study aims to determine the effect of variations in pouring temperature on porosity defects in used aluminum metal castings and the impact of variations in pouring temperature on casting defects. The aluminum is melted and poured into the molds used are clay molds; In general, the mold is divided into two parts, namely the top (cup) and the bottom (drag), so that after the mold is finished, the melted aluminum is poured into the mold with variations in pouring temperature of 660˚C, 690C, and 720˚C. The method used is the observation method which is done by direct observation of the object of research. From the analysis of porosity defects data, the higher the casting temperature, the lower the porosity defects; a temperature of 660 C with a percentage value of 36.8%, a temperature of 690 C with a percentage value of 34.8%, and a temperature of 720˚C with a percentage value of 34.5%. This shows that casting temperature affects casting defects and porosity.

Keywords: Sand casting, casting temperature variation, casting defects and porosity, used cans

* Corresponding author: bambangtjiroso@unkhair.ac.id

Technium: Romanian Journal of Applied Sciences and Technology
Vol. 17, 163-167, November, 2023
ISSN: 2668-778X
www.techniumscience.com

1 Introduction

The need for aluminium metal today is increasing, especially in the engine component industry, such as engine blocks, cylinders, pistons, etc. Aluminium has several advantages over other metals; aluminium is lighter than steel, copper, or brass. Aluminium also has a low melting point, making it easier to fabricate. The strength of pure aluminium is not as good as other metals, but this can be overcome by combining aluminium with other metals such as copper, magnesium, silicon, manganese, and zinc.[1]

Aluminium is a light metal with good corrosion resistance, electrical conductivity, and other properties. Generally, aluminium is mixed with other metals to form aluminium alloys. This material is used not only for household appliances but also for industrial, construction, etc. [2]

Spare parts or spare parts are components of a machine that are reserved for the repair or replacement of damaged vehicle parts. Spare parts are an essential part of logistics management and supply chain management.

A study about casting defects and Sand Casting Method was done, among others, (Ivan Junaidy Abdul Karim, 2010). investigated the effect of polystyrene foam density on the flowability and casting quality of aluminum alloy 356.1, which was released by the evaporative method. The results showed that increasing the density of polystyrene foam molding patterns provided a longer freezing time to form an elliptical or nearly spherical Al-dendrite microstructure and a short and thin eutectic silicon structure between the dendrites. The hardness value of castings reached 60.8VHN at the density of the printed polystyrene foam pattern of 0.007 g/cm3, decreased by 5.3% with an increase of the printed polystyrene foam pattern of 0.020 g/cm3. Tensile strength was 147.7 MPa, for castings with foam molded design.

According to (Ipung narwanto dkk., 2020). hat mold variations affect porosity defects so that they affect density; the more significant the porosity value, the fewer porosity defects. The size of the inlet also affects the density. In the cast product results, the higher the density value, the higher the specimen density. The content of Si has the function of increasing hardness and accelerating corrosion. The hardness value depends on the grain shape of the microstructure. The metal casting method has an even and homogeneous grain shape compared to sand casting.

(Praba Apriliyanto, 2014). Stated that the best alloy composition was the alloy composition (25% used piston + 75% aluminum remelting) because it produced the lowest surface roughness (10.85 μm) and the highest level of hardness (22.73 Kg/mm2), while the alloy composition (75% used piston + 25% aluminum remelting and 50% used piston + 50% aluminum remelting) produced a higher level of roughness (11.25 μm and 11.11 μm) and lower levels of hardness (21.60 Kg/mm2 and 22.30 Kg/mm2).

(Ivan Junaidy Abdul Karim,dkk, 2020), state that the higher the pouring temperature, the greater the air cavity defects. Differences in temperature variations cause differences in freezing rates; freezing rates affect the defects of air voids (blow holes). The higher the pouring temperature, the percentage of porosity decreases; this is because the gas trapped in the liquid does not have time to escape due to the high freezing speed at low pouring temperatures, while at high pouring temperatures, the freezing speed is slow so that the trapped gas can escape more. They make propellers by casting with used aluminum alloy and using volcanic ash sand molds with pouring temperature variations of 660 ºC, 700 ºC, and 740 ºC.

(Teguh Satrya Witaryanto,dkk., 2017). Researching the innovation of making alum from used cans. Based on the results of making this Potassium Aluminum Sulfate. Tawas's most optimum percent yield analysis result is the concentration ratio of 3M KOH to 6 M H2SO4, which is 11.2%. The results of physical analysis, PH, and turbidity of Potassium Aluminum Sulfate for all variables are under MSDS 42326-5000, where the crystal color is white and odorless, the minimum limit is PH 3, and the melting point is 920C. The analysis results of % Al2O3 from Potassium Aluminum Sulfate are not under SNI 06-0032-2004, which states that the minimum content for Dialuminium Trioxide in solid aluminum sulfate is 17%. The BEP obtained was Rp. 52,396,038.5 on a sales volumes of 9,648 units in Kg.

According to (Mulyanto, 2018) rom the Vickers test results, the hardness of cast aluminum products was found in the red sand mold variation reaching 91.78 VHN, and the hardness price using the ladu sand mold variation was 78.29 VHN, while the cast product using mixed sand molds obtained hardness of 85.35 VHN. Judging from the microstructure of the cast product, the most dominant elements are Al and Si, which can be seen in the red sand mold, which has smaller grain diameters and is denser, so the hardness is higher than the ladu and mixed sand molds which have larger grains so the hardness is low.

(Erlangga Aji Dinata ,2018). nvestigated the effect of variations in smelting temperature in casting aluminum metal waste on the hardness of aluminum casting results. In this study, the temperature variations at the time of melting were 660 ºC, 680 ºC, 700 ºC, 720 ºC, and 740 ºC. After varying the smelting temperature in the casting of aluminum waste, the specimen results were subjected to the Rockwell hardness test to determine the hardness value of the aluminum casting from the smelting temperature variation. The research data shows that the smelting temperature from 660°C to 740°C affects the decreasing hardness value of aluminum. At a melting temperature of 660°C, aluminum has the highest hardness value reaching 112.9 HRB, while the lowest hardness value is 98.9 HRB with a melting temperature of 740°C.

This study aimed to determine the effect of variations in casting temperature on porosity defects in used aluminium metal castings and to assess the impact of variations in casting temperature on casting defects.

2 Material and Method

Technium: Romanian Journal of
Applied Sciences and Technology
Vol. 17, 163-167, November, 2023
ISSN: 2668-778X
www.techniumscience.com

The material used in this research is aluminum cans that have been pressed to make it more accessible during smelting. Some of the casting equipment used includes coup and drag molds, patterns made of wood, smelting chambers, gloves, blowers, thermocouples, clamping pliers, ladles, clay molds, and malls that have been created. The Camshaft is used as a tool where two tests will be carried out, including testing for casting defects and porosity on the specimens.
This research activity began with several stages: mold making, smelting, casting, casting defect testing, and analysis of the test results. The aluminum smelting process is carried out at temperatures of 660 °C, 690 °C, and 720 °C.

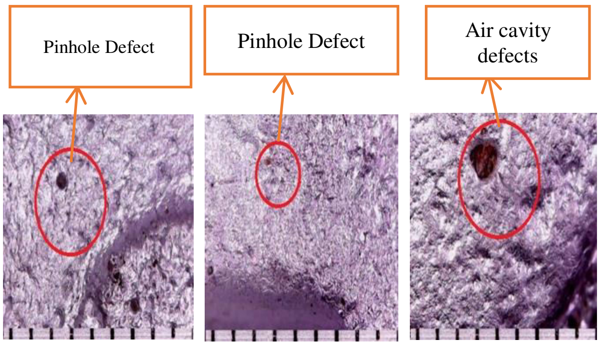
3 Results and Discussions

3.1 Observation of Casting Products

The casting results with 720ºC, 690ºC, and 660ºC indicate defects in the casting products. And the highest porosity occurs at a pouring temperature of 660ºC compared to temperatures of 720ºC and 690ºC which have low porosity defects. This observation was carried out by visually observing the castings' results to find defects in the casting products. After observing, the results obtained are as follows:

3.1.1 Pouring at Temperature 720ºC

The temperature is 720ºC, indicating the occurrence of pinhole defects on the surface of the casting product. Porosity defects occur because when the molten metal is poured, the gas that collects in the mold cavity falls, resulting in air cavity defects. The evaporation cycle was stopped before sunset at 5pm and restarts at 7am.



(a) (b) (c)

Fig. 1 Pouring at temperature 720ºC (a) pinhole defect (b) pinhole defect (c) air cavity defect.

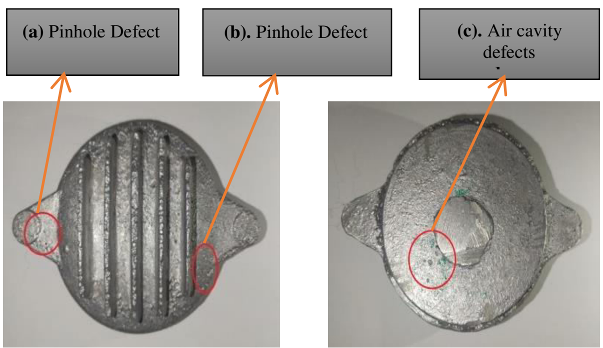
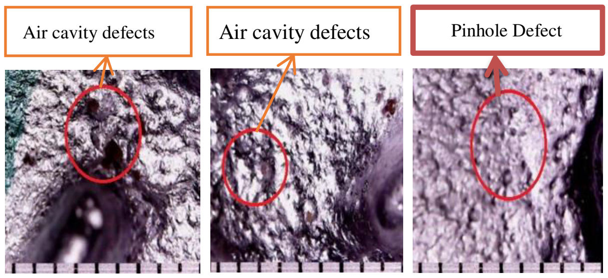


Fig. 2 Castings results at temperature of 720ºC

The figure shows that the upper surface has a pinhole defect while the lower surface has an air cavity defect.

3.1.2 Pouring at Temperature 690ºC

The casting product with a temperature of 690ºC shows the occurrence of pinhole defects on the surface of the casting product. Porosity defects occur because the mold has an air cavity during the casting.



(a) (b) (c)

Fig. 3 Pouring at temperature 690ºC (a) air cavity defects (b) air cavity defects. (c) pinhole defects

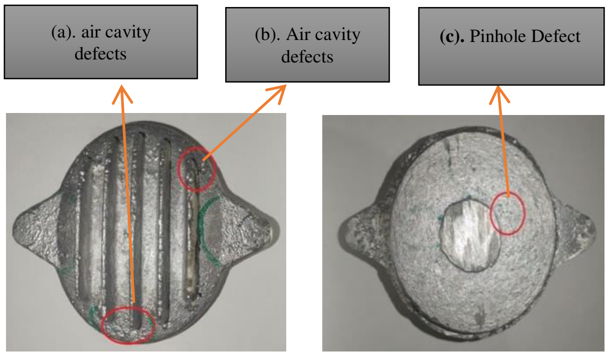
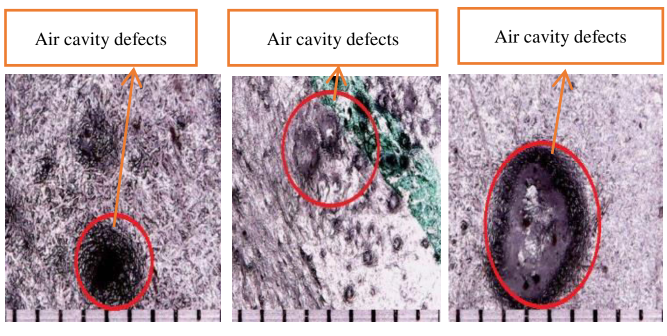


Fig. 4 Castings results at temperature of 690ºC

3.1.3 Pouring at Temperature 660ºC

The casting process at 660ºC has defects in the product caused by slow pouring where the pouring channels are too narrow, and the molten metal is not filled in the mold cavity. The freezing process of molten metal also takes place slowly and causes gas to form in the mold cavity with air cavity defects.



(a) (b) (c)

Fig. 5 Pouring at 660ºC has (a) air void defects (b) air void defects (c) air void defects

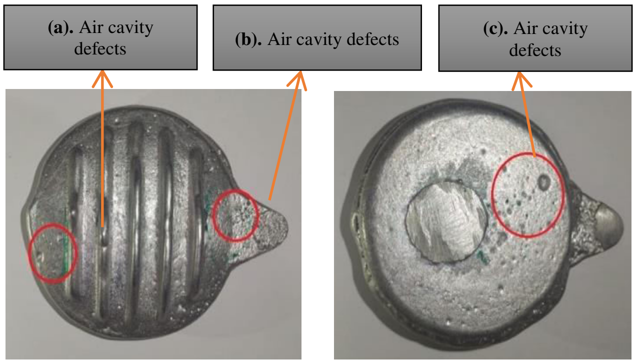


Fig. 6 Castings results at temperature of 660ºC

At a temperature of 660ºC, the casting results are imperfect, where the upper surface appears to have air cavity defects. At the same time, the lower surface also has air cavity defects.

Casting defects are damage or errors that occur in the casting, which causes the casting to be rejected by the consumer (reject). The casting process is carried out in several stages, from mold making, smelting, pouring, and disassembling. A good casting must be planned and done as well as possible. However, casting results often occur imperfections or defects.

Based on observations of macro defects in the form of air voids that occur the most usually appear as holes on the surface or inside the casting. Air voids can arise in low pouring temperatures and too long pouring times. If the pouring time is too long, much air will enter the mold cavity.

The macro defects that often occur in Al-Si castings due to holding time with temperature variations of 660ºC, 690ºC, and 720ºC are pinholes. Pinhole defects are found on the casting surface identical to small balls with a smooth surface, pinhole defects such as needle puncture marks. The size is under 1 to 2 mm, which is very small.

3.2 Effect of Pouring Temperature on Porosity Defects

A porosity defect is a cavity contained in the casting. Porosity occurs due to gas trapped in molten metal or shrinkage during solidification. The low pouring temperature suppresses the formation of porosity. (Harmanto, 2016). Based on the results of the porosity test are shown ion Figure 7:

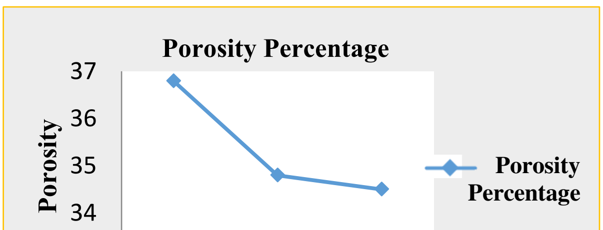


Fig. 7 Porosity Test Results

Figure 7 shows the graph of porosity percentage by showing the results of the porosity test with the lowest rate occurring at a temperature of 720ºC with a value of 34.5%. In contrast, at a pouring temperature of 690ºC, the porosity that occurs is 34.8%, and the highest porosity is found at a pouring temperature of 660ºC with a porosity percentage of 36.8 %.

Low pouring temperatures can cause high porosity defects due to the freezing time in castings that is too short so that the gas contained in the molten metal does not have time to come out of the cast metal. In contrast, high pouring temperatures can cause low porosity defects because they can provide a long freezing distance so that the gas contained in the casting has time to come out of the metal in the casting.. (Ivan Junaidy Abdul Karim,dkk, 2020).

4 Conclusion

Based on the results, it can be concluded that the higher the pouring temperature, the lower the porosity defects of the surface of the castings, the temperature of 660ºC with a yield value of 36.8% porosity, a temperature of 690ºC with a yield value of 34.8% porosity, and a temperature of 720ºC with a yield value of 34.5% this results that porosity casting temperature affects the porosity defects. Visually, there are several defects in the casting results, namely, the occurrence of pinhole defects and air cavity defects.

References

[1]. Dahlan, M. (2014). Jurusan Teknik Mesin Fakultas Teknik Universitas Mataram. *Jurnal Energi Dan Manufaktur*, ***6***(1).

[2]. Erlangga Aji Dinata ,(2018). pengaruh variasi temperatur peleburan pada pengecoran limbah logam aluminium terhadap kekerasan. Fakultas Teknik – Prodi Teknik Mesin UNIVERSITAS NUSANTARA PGRI KEDIRI

[3]. Firdaus, (2002), "Analisa Parameter Proses Pengecoran Squeeze terhadap Cacat Porositas Produk Flens Motor Sungai", Jurnal Teknik Mesin No. 1 : 6 -12, Fakultas Teknik Mesin Universitas Kristen Petra.

[4]. Harmanto, S. (2016). Pengaruh Temperatur Penuangan Terhadap Porositas Pada Cetakan Logam Dengan Bahan Aluminium Bekas.

Jurnal Rekayasa Mesin, ***11***(5), 81–86.

[5]. Isranuri, Ikhwansyah, dkk, (2011). "Pengaruh Putaran Terhadap laju Keausan Al-Si Alloy Menggunakan Metode Pin On Disk Test". Departemen Teknik Mesin, Fakultas Teknik Universitas Sumatera Utara.

[6]. Junaidy. I. (2010). Pengaruh Kerapatan Polystyrene Foam Terhadap Mampu Alir Dan Kualitas Coran Paduan Aluminium 356.1 Yang Dicor Dengan Metode Evaporative. *Mekanika*, ***9***(1), 243–246.

[7]. Junaidy, I., Karim, A., Umar, K., & Asri, S. (2020). *Metode Sand Casting*. *5*(April), 2–6.

[8]. Khalid1), A. (2019). Cetakan Permanen Dari Tanah Liat Untuk Pembuatan Wajan Dari Bahan Alumunium. *Molecules*, ***07***(2), 13–22.http://jurnal.globalhealthsciencegroup.

[9]. Kalpakjian, S.(1985). Recent progress in metal forming tribology. *CIRP annals*, *34*(2), 585-592.

[10]. Narwanto, I., Studi, P., Mesin, T., Teknik, F., & Surakarta, U. M. (2020). *STUDI PENGAMATAN DENSITY DAN STRUKTUR MIKRO Scanned By Camscanner*.

[11]. Nukman, Mataram, A., & Yani, I. (2015). Peleburan Skrap Aluminium pada Tungku Krusibel berbahan Bakar Batubara Hasil Proses Aglomerasi Air-Minyak Sawit. *Mechanical*, ***6***, 6–14. https://doi.org/10.23960/mech.v6.i1.201502Sakti, P. A. dan A. M. (2014). Analisis variabel proses produk pengecoran logam menggunakan cetakan sand casting. *Jurnal Teknik Mesin*, *02*(02), 70–78.

[12]. Surdia, T., & Chijiwa, K. (1991). Teknik Pengecoran Logam, PT. *Pradnya Paramitha, Jakarta*.

[13]. Surdia, T. dan Chijiwa, K.(2000).Teknik pengecoran logam, PT. Pradnya Paramita, Jakarta,

[14]. Syahbuddin, Bambang Pamungkas, (2020) Pengecoran Block Mesin Rc Car Nitro Engine 27 Cc Metode Investmen Casting. Dinamika : Jurnal Ilmiah Teknik Mesin, 2502-3373 12 1 26 34 http://ojs.uho.ac.id/index.php/dinamika/article/view /12895

[15]. Sand, mulyanto (2018) P. variasi cetakan terhadap produk pengecoran aluminium (daur ulang) menggunakan. (2018). *Studi, Program Mesin, Teknik Teknik, Fakultas Surakarta, Universitas Muhammadiyah*.

[16]. Unggul, H. M., Ardhyananta, H., & Wibisono, A. T. (2019). Analisis Pengaruh Komposisi Aluminium (Al) Terhadap Struktur Mikro, Kekerasan dan Laju Korosi Anoda Tumbal Berbasis Seng (Zn) untuk Kapal dengan Metode Pengecoran. *Jurnal Teknik ITS*, *7*(2). https://doi.org/10.12962/j23373539.v7i2.31835

[17]. Witaryanto, Satrya, T., & Idzati. (2017). *Inovasi Pembuatan Tawas dari Limbah Kaleng Bekas*. 102. http://repository.its.ac.id/46866/

[18]. Yani, M., & Fachri, M. (2021). *Membandingkan Pengikat Cetakan Pasir Bentonit Dan Air Kaca Terhadap Hasil Coran Logam Berbahan Limbah Kaleng Aluminium*. 631–640.