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QUALITY ASSESSMENT OF CASTING PRODUCT USING VARIOUS SAND MOULDING PROCESSES

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ABSTRACT

Casting defects can have a negative impact on a foundry's bottom line. At the simple level, they appear as rework costs or casting scrap costs. In many cases, however, casting defects can be found at the machining level, during the assembly stage or during the part use. The resulting value added and maintenance costs may sometimes be passed on to the foundry by the customer. The most common foundry defects in three types of castings are discussed in this section. Number of defective castings and styles of defective castings was observed during the year Sand inclusions and variables that can affect the source of sand inclusions have been given attention. During the wet moulding process the mould was placed in the room temperature and melted aluminum was poured into cavity. The casted product was very rough and having lot of defects due to the gas bubbles caused the cavities in the product surface. That material cannot be analyzed for the surface roughness test due to high defects. Total three readings of both processes were carried out, therefore for specimen of wet moulding (W1) at 10/100 mm depth, have the maximum surface roughness value of 4.88 μm,.For specimen of wet moulding (W2) at 10/100 mm depth, have the maximum surface roughness value of 4.43 μm, It was found that the casting with dry sand moulding have good surface finishing value as compared to the wet sand moulding

Keywords: *aluminum, casting, defects, molding, pattern.*

INTRODUCTION

Quality control is very critical in our local potting workshop, as it is the properties that decide the product's demand. If the quality is poor, the demand will definitely be low and if the quality is good, the demand will undoubtedly be strong [1, 2 3]. The aim of any company is to generate profits. Therefore, if the quality is good, the market will be strong and the income maximized. Like all other items or parts, pots need quality control. Almost all homes need this item (pot) for one reason or another in their daily activities [4].

This strategy has two simple corollars. Second, a better value can only be obtained at a higher cost. Because value represents the quantity of attributes a product contains and the attributes are deemed costly to manufacture, higher quality goods will be more expensive. Second, value is considered an intrinsic feature of bie. The aggregation problem is usually solved by believing that high-quality products are the ones that best meet the needs of the majority of customers. A consensus of opinions is involved, with almost all consumers agreeing on the timeliness of certain product attributes. Sadly, this method lacks the different weights that individuals add.[5].

For the most part, these questions are neglected by theoreticians. For example, economists have commonly defined models in which the market demand curve responds to value changes without explaining how this curve, which represents the sum of individual preferences, was extracted in the first place [6]. This is the complexity of product operations [7-8]. Foundry production process consists of preparation of moulds and molding mixtures, preparation of liquid metal, casting, cleaning of castings, thermal and surface treatment of castings In addition to quality management, each phase has a marked response to environmental issues and health and risk issues [9].

As a result, the three management systems must be adopted, maintained and improved by the foundry plants. Since most foundry plants are small or medium-sized plants, it is necessary for them to build a less expensive system and a pretentious administration: an integrated management system [10]. Production quality, environmental protection, safety and health protection at the workplace are an important part of modern management systems [11]. The integrated management system is the framework that incorporates management systems into an ongoing system to achieve defined goals and mission [12].

Molding defects may have a negative impact on a foundry's bottom line. At the simple level, they turn into repair costs or scrapping costs. But, in many situations, moulding defects can be found during the machining, assembly or use of the part. The resulting costs in terms of value added and warranties can sometimes be shifted from their client to the foundry. Such costs can be far higher than the cost of the molding itself [13-14]. Foundry workers may not have time to conduct a detailed analysis of molding defects, determine root causes, and enforce appropriate corrective actions to prevent the reappearance of these defects. The basic quality management techniques are used to collect operational data related to the production process [15]. Such devices can be said to be methods for monitoring and diagnosing the production process. Its sense comes from the fact that without truthful and complete information about the system, it is difficult to talk about conducting effective management activities. The foundries manufacture molded pieces of ferrous and non-ferrous metals [16].

Iron molded parts include iron and steel, while non-ferrous molded parts consist primarily of silver, copper, zinc, lead, tin, nickel, magnesium and titanium. Molded parts are obtained by boiling, casting and shaping of ferrous and non-ferrous metals. The two substances are coming from many foundries [17]. Two subgroups of basic casting processes are based on the casting of compatible and non-compatible molds. A standard smelting process includes. the following main activities: melting and processing of metals in the melting workshop; preparing of molds and nuclei in the molding workshop; flowing of the molten. Metal into the mold, cooling to solidify it and removing. the casting. from the mold. in the casting workshop; and finishing of the raw parts in the finishing workshop [18].

Various types of fusion furnaces and metal treatments are used to manufacture ferrous or non-ferrous materials depending on the type of metal involved. The fountain is usually found in cubicles, induction furnaces, electric arc furnaces and rotary furnaces. Molded steel is usually melted in electric arc furnaces or kernel-free induction furnaces. Molded steel metal processing consists of grinding (e.g. removal of carbon, silicon, sulfur and/or phosphorus) and deoxidation [19].

Today, it is almost impossible to conceive of anything that does not require a casting process. Nonetheless, one of the problems associated with the casting process is a casting defect that may arise from process parameters. The aluminum alloy molded parts were first manufactured using processes already used for other materials, as described above. The relatively attractive engineering properties of low-fusion aluminum and casting capability quickly led to the adoption of existing casting processes and innovations extending the means of producing artificial forms from fused metal [18].

2.1 RESEARCH METHODOLOGY

To achieve the objectives of this study, the step-by-step research methodology was designed as shown in Figure 1.

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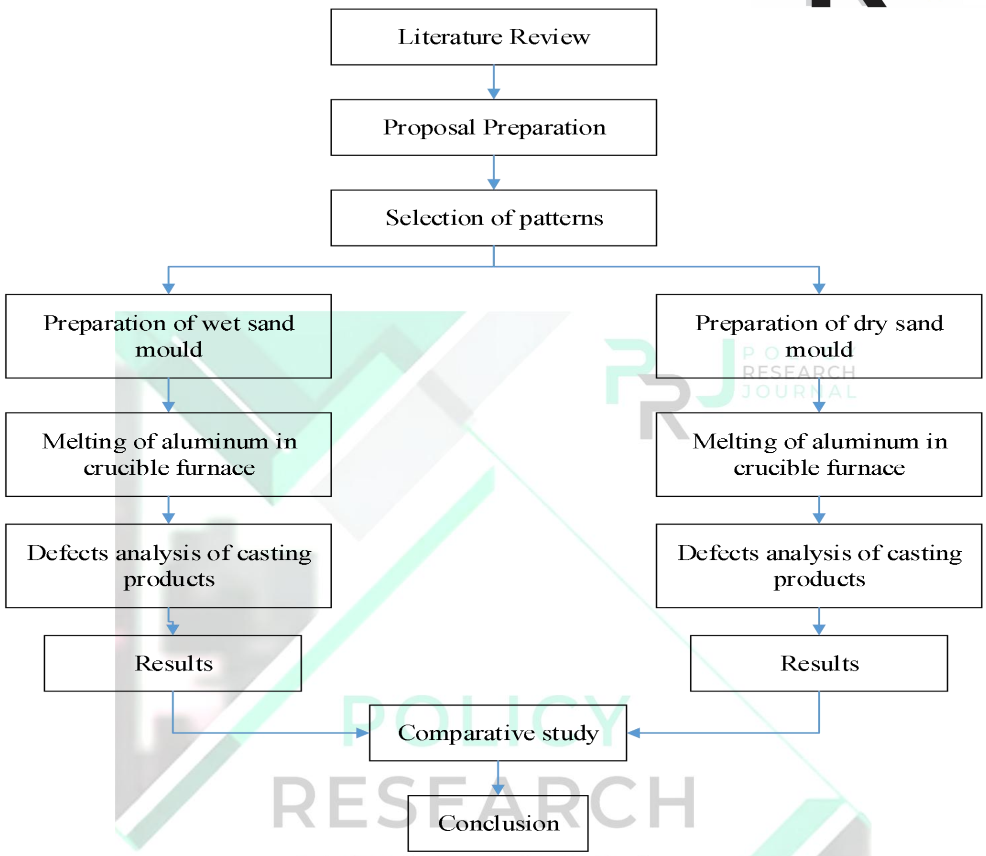

Figure 1. Methodology flowchart

1.2 SELECTION OF PATTERN

Pattern, come in many materials including wood, metal, plastics and wax. The material pattern is choosing based on the casting volume and process used. For the experiments it chose the wood material for making pattern. In this research we made the pattern in three different shapes.

2.3 Wet Sand Mold:

For wet sand mold green sand was used as moulding sand. The weight about 6kg of sand with help of shovel and cleaned by riddle equipment to remove their impurities from sand. Then took water first about 3 litres mixed with pure sand and meshed it clearly. The meshed was still dry, then added 2 liters more water and clearly meshed it again. A homogeneous mixture was being prepared. The pattern is the ideal casting template. Often the separating sand is dusted over the pattern to help remove the pattern is coated with a few inches of sand. Then more sand is poured into the drag and rammed with a wooden coil Using a log, the water is then struck level with the cope's bottom. On top of the drag, a board is put and the drag I d flipped over. Then cope is placed on the drag and to make holes for the sprue and one or more risers, dowels are mounted in the sand.The template is taken out of the air, leaving a molding cavity. The passageway for the metal to join the mold called the "port" is then cut from the sprue hole to the void left by the pattern. And the runner is cut out of the sand to allow the metal to flow into the risers.

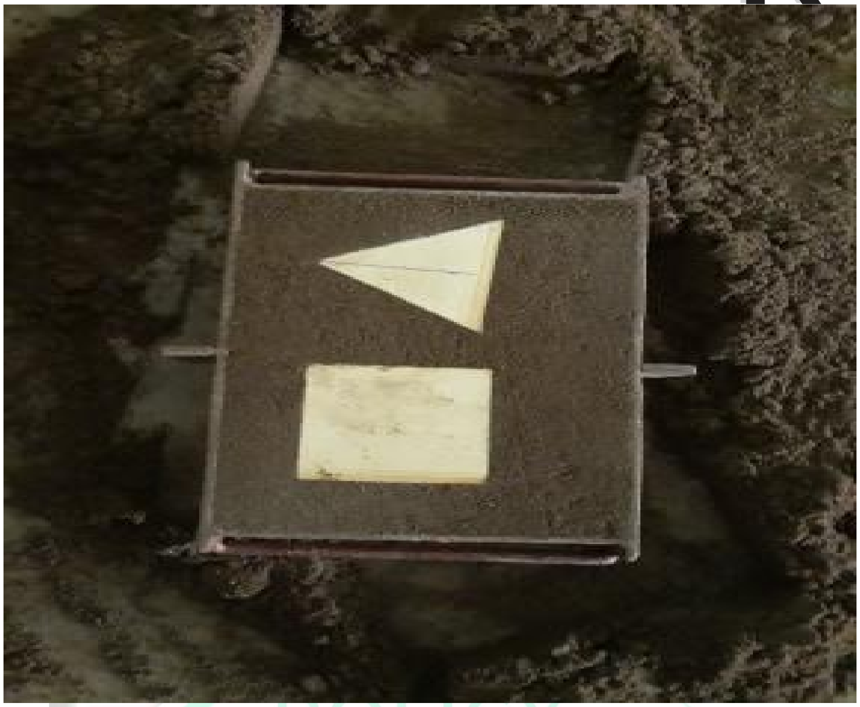

Figure 2 Developed the Mold for Casting

2.4 Dry Sand Mold

For Dry sand mold it was taken green sand. Take about 6kg sand with help of shovel and clean by riddle equipment to remove their impurities from sand. Then took water first about 3 liters mixed with pure sand and meshed it clearly. It was seen the meshed had still dry then added 2 liters water more and meshed again it clearly. A homogeneous mixture is prepared. The Design is the template of the desired casting. The parting sand is often dusted over the design to aid the removal of the pattern is covered by a few inches of sand. More sand is then dumped into the drag and rammed with a wooden wedge. The sand is then raised at the bottom of the crust using a wooden sheet. On top of the drag, a board is put and the drag I d flipped over. Then cope is placed on the drag and to make holes for the sprue and one or more risers, dowels are put in the water. We used Electric Furnace to allow molds to dry. Continuously dried the mould for 3 hours around 190^0C.

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Figure 3 Electric furnace used for Dry sand molding

Parting sand sifted again over the pattern and then slowly and carefully pulled out of the sand. The template is removed from the sand, leaving a molding cavity. A metal passageway into the mold called "path" is then cut from the sprue hole to the void left by the designs, and a runner is cut from the san

2.5 METAL MELTING, POURING AND CASTINGS REMOVAL

Approximate amount of aluminum (Piston of tractor) was calculated. The capacity of the crucible which has been selected for melting the aluminum is 10 kg. Since the main part of the P.V.V. is weighing 1. 25kg, six sand moulds (3 based are wet Sand and 3 based are Dry sand) were prepared for each melt. The furnace selected for the melting aluminum is a crucible Furnace. Aluminum material was collected from scrap areas, mainly represents old households and defective car, defective tractor parts. The furnace crucible was charged with scrap metal. The furnace was fired to heat the charge. The heating process took 45 minutes to raise the temperature of metal to 640ºC at which all the aluminum metal was converted into molten metal.

Figure 4 Melting Aluminum in Crucible Furnace

2.6 SAMPLES OF WET SAND MOLDING

It was found unwanted irregularities that appear in the casting during metal casting process. There were various defects appeared after casted specimen such as pin holes, blow holes, shrinkage cavity and pouring metal defects during wet sand casting. The greater defects appeared in wet sand casting than Dry sand casting.

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Figure 4 (a) Figure 4 (b)

Figure 4 (c)

Figure 4 Samples of Wet Sand Casting

2.7 SURFACE FINISHING

Surface finishing processes are based primarily on the concepts of either removing (or reshaping) the work piece surface or inserting and modifying the surface using external agents. The casted alloy pieces are machined dimension change and surface finishing done with the help of lathe machine to make the specimen for testing surface roughness test. Cut every specimen 2mm.

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Figure 6(a) figure 6(b)

Figure 6 Surface finishing in Lathe Machine

3 RESULTS AND DISCUSSION

3.1 SURFTEST MACHINE

The machine used to measure the surface roughness of casted specimen is Surf test SJ-410. It is used to measure the maximum values of defective materials and check the quality of any casted products.

3.2 Roughness Test Specimen Sample W1

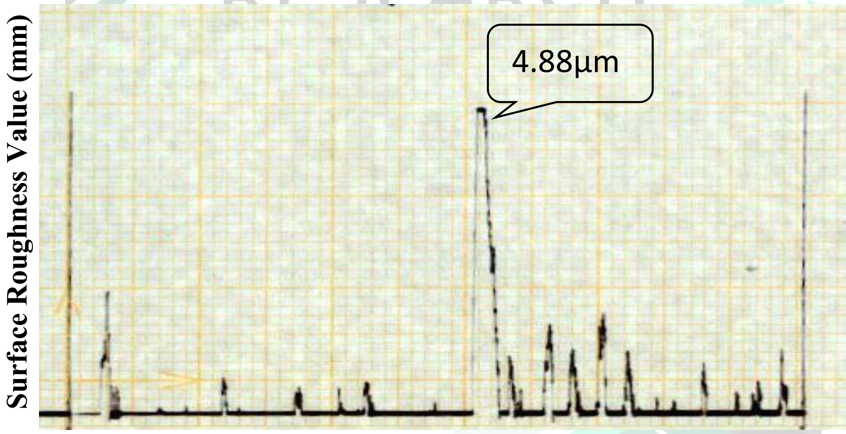

Figure 7 Surface roughness 1R figure of specimen W1

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3.3 Surface Roughness Value of D1

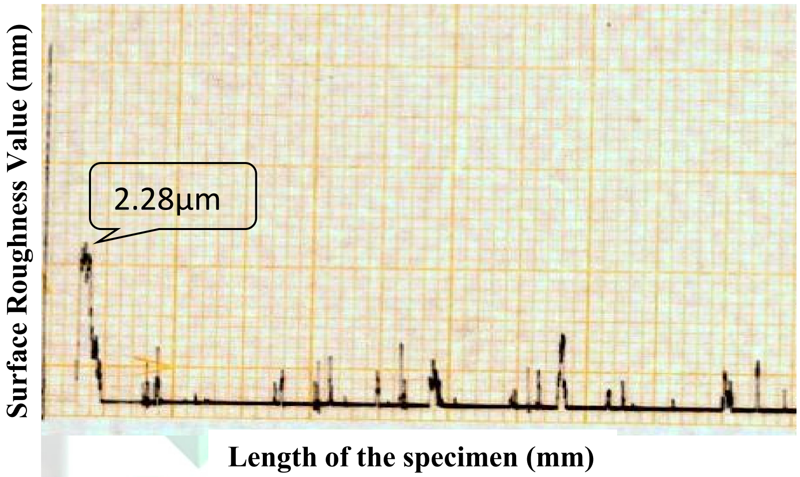

Figure 8 Surface roughness 1R figure of specimen D1

The surface roughness of Specimen (D1) and Specimen (W2) was measured using the Surf Test SJ-410 machine. For Specimen (D1), the maximum roughness value recorded was 2.28 µm. Figure 7 illustrates this higher roughness value, which indicates the presence of significant defects such as large cavities, pinholes, blowholes, and other imperfections in the casted piece.

For Specimen (W2), the maximum roughness value recorded was 4.88µm µm. Figure 8 highlights this higher roughness value, similarly showing the existence of large cavities, pinholes, blowholes, and other casting defects.

3.4 SURFACE ROUGHNESS VALUES OF SPECIMEN W2

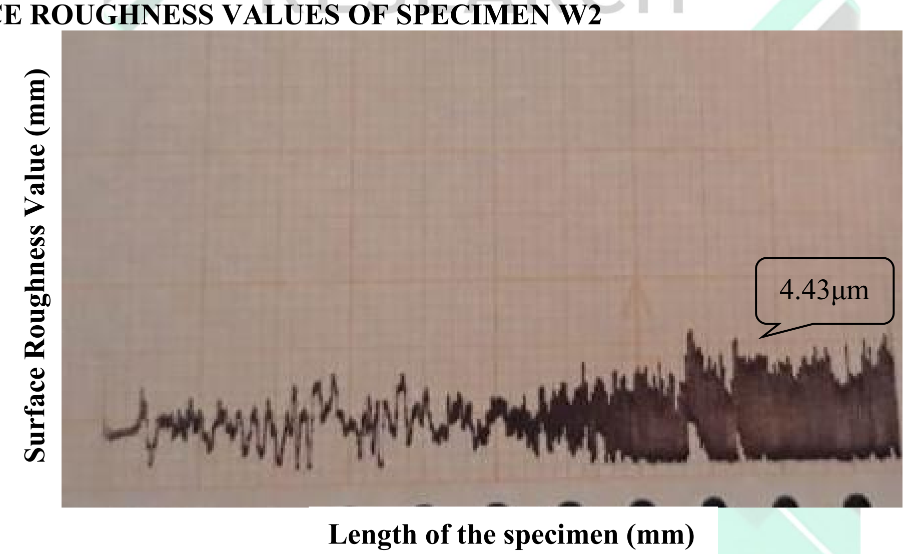

Figure 9 Surface roughness 1R figure of specimen W2

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3.5 SURFACE ROUGHNESS TEST FIGURE OF D2.

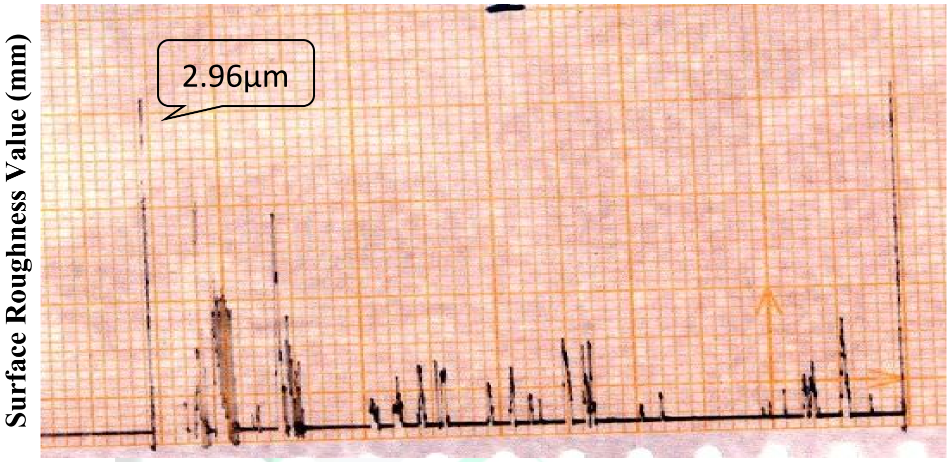

Figure 10 Surface roughness 1R figure of specimen D2

The surface roughness of Specimen (D2) and Specimen (W2) was measured using the Surf Test SJ-410 machine. For Specimen (D2), the maximum roughness value recorded was 2.96µm. Figure 9 illustrates this higher roughness value, which indicates the presence of significant defects such as large cavities, pinholes, blowholes, and other imperfections in the casted piece.

For Specimen (W2), the maximum roughness value recorded was 4.43 µm. Figure 10 highlights this higher roughness value, similarly showing the existence of large cavities, pinholes, blowholes, and other casting defects.

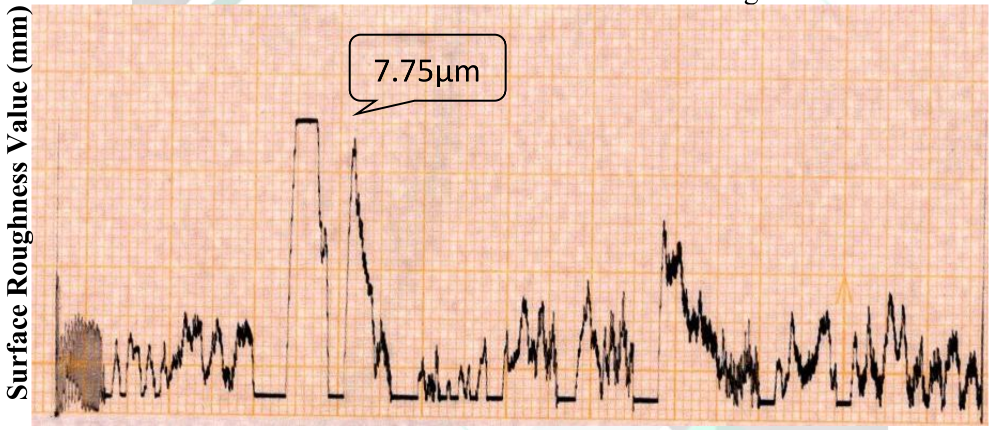

Figure 11 Surface roughness 1R figure of specimen W3

The surface roughness of Specimen (W3) was obtained in Surf test SJ-410 machine. The maximum roughness value was recorded 7.75µm. The above figure 11 is shown higher roughness value which shows there are a large cavity, pin holes, blow holes and others defects in casted piece.

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3.6 SURFACE ROUGHNESS TEST OF SAMPLE D3.

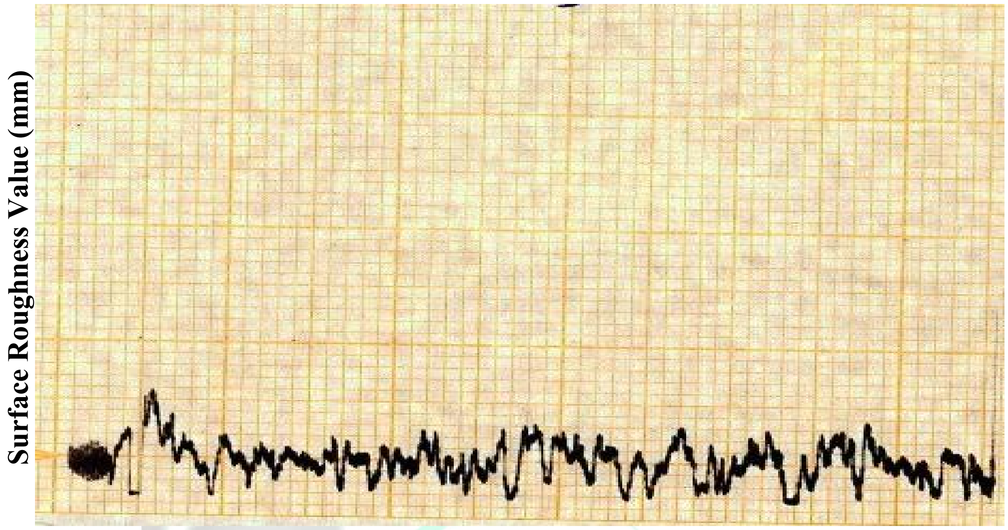

Figure 12 Surface roughness 1R figure of specimen D3

The surface roughness of Specimen (D3) was obtained in Surf test SJ-410 machine. The maximum roughness value was recorded 5.46µm. The above figure 12 is shown higher roughness value which shows there are a large cavity, pin holes, blow holes and others defects in casted piece

3.7 COMPARISON THE ROUGHNESS VALUE OF WET SAND AND DRY SAND CASTING.

The following table shows the roughness value

Samples	Surface Roughness Value at 10/100m
W1	4.88µm
D1	2.28µm
W2	4.43µm
D2	2.96µm
W3	7.66µm
D3	5.46µm

CONCLUSION AND FUTURE RECOMMENDATIONS

4.1 CONCLUSION

The main aim of this study was to investigate the quality of casted product using various moulding processes such as, dry and wet moulding.

The casted products had lot of defects during to manufacturing process. The results of this study concluded that;

- During the wet moulding process the mould was placed in the room temperature and melted aluminum was poured into cavity. The casted product was very rough and having lot of defects due to the gas bubbles caused the cavities in the product surface. That material cannot be analyzed for the surface roughness test due to high defects.
- Total three readings of both processes were carried out, therefore for specimen of wet moulding (W1) at 10/100 mm depth have the maximum surface roughness value of 4.88 µm.
- For specimen of wet moulding (W2) at 10/100 mm depth, have the maximum surface roughness value of 4.43µm,

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- The specimen of wet moulding (W3) at 10/100 mm depth, have the maximum surface roughness value of 5.46 µm,
- Similarly, for specimen produced in drymoulding (D1) at 10/100 mm depth, have the maximum surface roughness value of 2.63µm,
- Moreover, for specimen produced in dry moulding (D2) at 10/100 mm depth, have the maximum surface roughness value of 2.96µm,
- Finally, for specimen produced in dry moulding (D3) at 10/100 mm depth, have the maximum surface roughness value of 7.66µm.
- It was found that the casting with dry sand moulding have good surface finishing value as compared to the wet sand moulding.

4.2 FUTURE RECOMMENDATIONS

Following are the recommendations for future work

- This experimental work can also be carried out at different proportion of water adding in sand for wet moulding.
- In this research the mould was placed at electric oven for heating at temperature of 2100C, which can be enhanced to get drier mould for avoiding the gas vaporization.

If the different type foundry sand can be used that will change the casted product quality

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