PRODUCTION OF SET OF ALUMIUNUM POT

USING SAND CASTING TECHNQUES

BY

NWAOKOLO CHIBUEZE LEO ND/23/MET/FT/0053

MAGAJI FARUQ TEMITOPE ND/23/MET/FT/0062

ABIODUN BISOLA PRECIOUS ND/23/MET/FT/0064

LUKMON QUADRI ND/23/MET/FT/0048

SUBMITTED

TO

DEPERTMEMT OF METALLURGICAL ENGINEERING, INSTITUTION OF TECHNOLOGY, KWARA STATE POLYTECHNIC, ILORIN KWARA STATE.

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CERTIFICATION

This is to certify that this report was compiled by Nwaokolo Chibueze Leo ,Magaji Faruq Temitope , Abiodun Bisola Precious and Lukmon Quadri of the Department of Metallurgical Engineering, Institution of Technology (IOT), Kwara State Polytechnic, Ilorin, for the Award of National Diploma (ND) in Metallurgical Engineering.

DEDICATION

We dedicate this report to God Almighty, the bestowal of breath and knowledge who gave us the privilege to undergo this program successfully to Him we owe praise and thanksgiving all the days of our life, also to every member of our family their love, care, prayer, moral and financial support.

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ABSTRACT

Metallurgy is simply the science of properties of metals, their uses and method of obtaining them.

There are various processes and operation that makes metallurgy such an interesting and an indispensable practice in the economic sector of industrialization.

Casting is one of the processes being carried out in metallurgy. Basically casting is a major operation used in pattern and casting pf the size 40 aluminium of this project.

Metallurgy does not comprise of casting alone, there are some work been done in metallurgy field like forging, rolling welding and extrusion etc.

Mentioned are the advantages and limitations of casting technologies. And appropriate sand mixture is satisfactory discussed.

Furthermore, how one can produce good finished products from hand moulding method of casting is enumerated. Melting range, knockout temperature for different alloys and the excitement and vigours in pattern making are included.

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CHAPTER ONE

1.0 INTRODUCTION

Foundry, as an example of a primary industry capable of supplying both directly, and through other manufacturers the product needed for economic growth has been selected as a topic to investigate alternative method of foundry that could better utilize the economic resources of the country.

Some of the equipment/ articles, which they produce, were spoons, frying pots, and pots of different sizes and shapes.

Foundries supply raw and finished good to manufacturer, agriculture, and the consumer before other domestically based industries can develops,

foundry products must be available.

Today, the production of aluminum has grown widely that the use of aluminum pots is common in our societies especially in occasion where cooking is required.

In addition, efficient production of a small dispersed market, high transport costs and limited equipment support represent typical problems

encountered. Unfortunately, there is little typical about foundries, since then variety of cast produce is so great in our societies, the specific requirements for materials, labour, and foundry equipment vary considerably.

1.1. Scope Of The Project

The project deals with, the use of aluminum scraps for the production making of cooking utensils, and kind of method used for the production which is basically sand casting.

1.2 Limitations Of The Project

1. Smooth surface and dimensional accuracy could be achieved by casting processes except by machining.

2. Processes require a healthy, strong and physically fit laborers for its production.

3. Casting processes is very dangerous to health with smoke and other gases coming out during operation is always emitted.

1.3. Justification For The Project

The project is widely approved by the society because of the widely used of aluminum pots for cooking and for some other purposes.

Casting have some advantage over other methods of producing/making metallic articles/alloys. Some of the importance or advantages are as follows

1. Small initial investment (for sand casting)

2. Intricate shapes can be manufactured and in one process.

3. Shape not possible with fabrication can be manufactured.

4. Metal casting is a process highly adaptable to the requirements of mass production.

5. Casting is economical, because some defects casts are not wasted since they can be melted and be reused over again

CHAPTER TWO

2.0. LITERATURE REVIEW

Foundry could be imagined as a process through which intricate shapes are produced. It is an engineering-manufacturing set-up for the production of intricate shapes which are difficult to machine or fabricated, the size and quantity may be determining factor which justifies the use of foundry as a product process (Campbell, 2003).

In the production of aluminum pot, the pattern which was used was made from aluminium (aluminium pattern). In this process aluminium scraps were heated, to its molten state and was poured into a prepared cavity through which the gating system (runner) and it solidifies. And other operations took

place. Like knocking, cleaning and finishing of the casting, fettling and inspection took place. Followed by, assembling of the pot.

Production of Aluminium Pot by Casting

Casting generally means the pouring of molten metal (superheated) into a refractory mold (sand or metal) with a cavity of the shape to be made and

allowing it to solidify in the mold. When solidified, the desired metal object is taken out of the mold either by breaking the disposable sand or taking the mold apart when a reusable metal mold is used. The solidified object is called CASTING.

2.1 Properties of Moulding Sand

Refractoriness Permeability Green strength Dry strength Collapsibility

2.2. The Selection of Moulding Sand Depends on the Following The alloy to be cast The size of the casting The type of the cast

The surface finish pacified for the casting

The method used and equipment available for the preparation of the sand mixture

2.3 Method Through Which Casting Can Be Achieved

Sand casting

Lost-foam casting

Die casting

Centrifugal casting

Shell casting

2.4. Sand Casting

Sand casting is the most common technique used for the production of aluminium pots as it is around the world. It is also preferred for making large castings because, the limits on maximum size and maximum section thickness is higher. Sand casting is usually selected for the production of small quantities of castings of almost any size because of the relatively tooling costs.

Not only does this method allow manufacturers to create products at a low cost, but there are other benefits to sand casting such as very small-size

operations. Sand molding systems use sand as a refractory material and a binder that maintains the shape of the mold during pouring. A wide range of

sand/ binders systems are used. Green (wet) sand systems, the most common sand system, use bentonite clay as the binder which typically makes up between 4% and 10% of the sand mixture. Water, which makes up to around 2% - 4% of the sand mixture, activates the binder (Campbell, 2003).

Carbonaceous material such as charcoal (2% - 10% of total volume) is also added to the mixture to provide a reducing environment. This stops the molten metal from oxidizing during the pouring process. Sand typically comprises the remaining 85% - 95% of the total mixture (Avner, 2006). Other sand molding processes utilize a range of chemical binders. Oil binders are combinations of vegetable or animal oils and petrochemicals. Typical synthetic resin binders include phenolic, phenol formaldehyde, urea formaldehyde, urea formaldehyde/furfuryl alcohol, phenolic isocyanate and alkyl isocyanate. Chemical resin binders are frequently used for foundry cores

and less extensively for foundry moulds.

2.4.1 Pattern Making

Pattern making is the first stage for developing a new casting. The pattern, or replica of the finished piece is typically constructed from wood but may also be made of metal, plastic, plaster or other suitable materials. These patterns are permanent so can be used to form a number of molds. Pattern making is a highly skilled and precise process that is critical to the quality of the final product. Many modern pattern shops make use of computer-aided design (CAD) to design patterns. These systems can also be integrated with automated cutting tools that are controlled with computer-aided manufacturing (CAM) tools. Cores are produced in conjunction with the pattern to form the interior surfaces of the casting. These are produced in a core box, which is essentially a permanent mold that is developed.

2.4.2 Mould Making

The mold is formed in a mold box (flask) which is typically constructed in two halves to assist in removing the pattern. Sand molds are temporary so

a new mold must be formed for each individual casting. The bottom half of the mold (the drag) is formed on a molding board. Cores require greater strength to hold their form during pouring. Dimensional precision also needs to be greater because interior surfaces are more difficult to machine, making errors costly to fix. Cores are formed using one of the chemical binding systems. Once the core is inserted, the top half of the mold (the cope) is placed on top. The interface between the two mold halves is called a PARTING LINE. Weights may be placed on the cope to help secure the two halves

together, particularly for metals that expand during cooling.

2.4.3 Melting and Pouring

Many foundries, particularly ferrous foundries, use a high proportion of scrap metal to make up a change. As such, foundries play an important role in the metal recycling industry. Internally generated scrap from runners and risers, as well as reject product, is also recycled. The charge is weighed and introduced to the furnace. Alloys and other materials are added to the charge to produce the desire melt. In some operations the charge may be preheated often using waste heat. The furnaces commonly used in the process metal is superheated in the furnace. Molten metal is transferred from the furnace to a ladle and held until it reaches the desired pouring temperature. The molten metal is poured into the mold and allowed to solidify.

2.4.4. Cooling and Shakeout

Once the metal has been poured, the mold is transported to a cooling area. The casting needs to cool, often overnight for ambient cooling, before it

can be removed from the mold. Castings may be removed manually or using vibratory tables that shake the refractory material away from the casting.

Quenching baths are also used in some foundries to achieve rapid cooling of castings. This speeds up the process and also helps achieve certain metallurgical properties. The quench bath may contain chemical additives to prevent oxidation.

2.4.5 Sand Reclamation

Most sand foundries recover a significant proportion of the waste sand for interval reuse. This significantly reduces the quantity of sand that must be

purchased and disposed off. In Queensland, most sand is reclaimed mechanically, cores and large metal lumps are removed by vibrating screens and the binders are removed by attrition (i.e. by the sand particles rubbing together). Fine sand and binders are removed by extraction and collected in a baghouse. In some systems metals are removed using magnets or other

separation techniques. For operations using mechanical reclamation, the recycle rate is often limited to around 70%. This is due to the need to maintain a minimum sand quality. For large iron foundries, where sand quality requirements are less stringent, over 90% reclamation can be achieved by mechanical means. (ASM, 1997). For many processes, mechanically reclaimed sand is not of sufficiently high quality to be used for core production. This process heats the sand to the point where organic materials,

including the binders, are driven off. This process can return the sand to an "as new" state, allowing it to be used for core making. Thermal reclamation is more expensive than mechanical systems. Sand can also be reclaimed using wet washing and scrubbing techniques. This method produce sand of a high quality but are not commonly used because they generated a significant liquid waste stream and require additional energy input for sand drying. The amount

of internal reuse depends on the type of technology used and the quality requirements of the casting process. Reclamation processes, particularly mechanical ones, breakdown the sand particles and this can affect the quality of some metals. Also, for mechanical reclamation techniques, impurities may

build up in the sand over time, requiring a proportion of the material to be wasted. Large iron foundries do not require high sand quality so typically achieve the highest rate of reuse in the industry. Often sand cycles through the operation until it is ground down to a fine dust and removed by baghouse.

2.4.6 Fettling, Cleaning and Finishing

After the casting has cooled, the gating system is removed, often using band saws abrasive cut-off wheels or electrical cut-off devices.

A parting line flash is typically formed on the casting and must be removed by grinding or with chipping hammers. Castings may also need to

be repaired by welding brazing or soldering to eliminate defects. Shot blasting — propelling abrasive material at high variety onto the casting surface — is

often used to remove any remaining metal flask, refractory material or oxides.

Depending on the type and strength of the metal cast, the grade of shot may vary from steel ball bearings to a fine grit. The casting may undergo additional

grinding and polishing to achieve the desired surface quality. The casting may then be coated using either a paint or a metal finishing operation such as galvanizing, powder coating or electroplating.

2.5. Lost- Foam Casting

Lost-foam casting is a type of evaporative pattern casting process that is similar to investment casting except foam is used for the pattern instead of

wax. This process takes advantage of the low boiling point of foam to simplify

the investment casting process by removing the need 2.5

Lost- Foam Casting

Lost-foam casting is a type of evaporative pattern casting process that is similar to investment casting except foam is used for the pattern instead of wax. This process takes advantage of the low boiling point of foam to simplify the investment casting process by removing the need to melt the wax out of the mold. The lost foam or expendable pattern-casting process is a relatively new process in chemical terms, but is gaining increased attention due to the to melt the wax out of

the mold. The lost foam or expendable pattern-casting process is a relatively new process in chemical terms, but is gaining increased attention due to the environmental and technical benefits that are achievable for some types of casts. In this process, an expendable pattern is formed out of polystyrene foam. Patterns can be made manually, using automated systems or by molding them using a permanent die. Manual pattern making typically involves carving blocks and gluing sections together to build up the desired shape. The finished pattern is a single piece (i.e. no cores) incorporating all necessary gating systems. This carving process can be automated using Computer-Aided Manufacturing (CAM) system sand can incorporate rapid prototyping techniques. For repetitive castings, patterns can be molded using a permanent aluminum die. Polystyrene beads are pre-expanded using a vacuum, steam or hot air processes. This helps to minimised the density of the foam as much as possible, to minimize the amount of vapor that is produced during the pouring process. The expanded material is then blown into the aluminum mold. Steam is used to cause the material to expand further, bond together and filled the mold cavity. The mold and pattern are allowed to cool and the pattern ejected.

As for investment casting, when the castings is small multiple castings can be joined, often to a central tree, to increase pouring efficiency. The patter is coated with a specially formulated gas permeable refractory slurry.

When the refractory slurry has hardened, the assembly is positioned in a flask, and unbonded sand is poured around the mold and compacted into any internal cavities. The refractory coating must be sufficiently strong to prevent the loose sand from collapsing into the cavity as the pattern vaporizes, but also permeable to allow styrene vapor to escape from the mold cavity. A vacuum system can also be used to increase sand compaction. Molten metal is then pour into the polystyrene pattern, which vaporizes and is replaced by the metal. This is different from the lost wax process in which the wax is removed before the pouring stage. Vents in the side of the flask allow vapor to escape.

If vapor is produce more rapidly than it can be vented, the casting may become deformed. When the metal has solidified, the flask is empty onto a steel grate for shakeout. The loose sand falls through the grate and can be reused without treatment. The refractory material is broken away from the casting in the usual manner

2.6. Die Casting

The die casting process forces molten metal under high pressure into mould cavities (which are machined into dies). Most die castings are made from non-ferrous metals, specifically zinc, copper and aluminium-based alloys 1, but ferrous metal die castings are possible. The die casting method is specially suited for applications where many small to medium-sized parts are needed with good detail a fine surface quality and dimensional consistency.

Tooling costs and other capital costs are high due to the cost of designing dies.

Operational costs, however, are relatively low due to the high level of automation and the small number of production steps (i.e. direct pouring into a permanent mould rather than preparing destroyable patterns and/or moulds). The process, therefore is best suited to mass production.

Die casting is most suitable for non-ferrous metals with relatively low melting points (i.e. about 870°C) such as lead, zinc, aluminium, magnesium and some copper alloys.

Casting metals with high melting points, including iron, steel and other ferrous metals 1, reduces die life. Die are usually made from two blocks of steel, each containing part of cavity I, within are locked together while the casting is being made. Retractable and removable cores are used to form internal surfaces. Molten metal is injected into the die and held

under pressure until it cools and soldifies. The die halves are then opened and the casting is removed, usually by means of an automatic ejection system. The die is cleaned between each casting cycle, preheated and lubricated to reduce wear on the die, to improve surface quality and to aid ejection. Mould coating

material can also be used to protect the molten metal from the mould. Cooling systems are often used to maintain the desired operating temperature.

2.7. Shell Casting

Shell moulding, also known as shell-mould casting, is an expendable mold casting process that uses a resin covered sand to form the mould. As compared to sand casting, this process has better dimensional accuracy, a higher productivity rate, and lower labor requirements. It is used for small to medium parts that require high precision (Degarmo, 2003). Shell mold casting is a metal casting process similar to sand casting, in that molten metal is poured into an expendable mould. However, in shell mould casting, the mold is a thin-walled shell created from applying a sand-resin mixture around a pattern. The pattern, a metal piece in the shape of the desired part, is reused to form multiple shell moulds. A reusable pattern allows for higher production rates, while the disposable moulds enable complex geometries to be cast. Shell mold casting requires the use of a metal pattern, oven, sand-resin mixture, dump box, and molten metal. The dump box is rotated through 360° so that the sand contacts the heated surface. An organic thermosetting resin such as phenol formaldehyde or furnace is typically used (2.5-4.5% of sand volume) in conjunction with a catalyst (11-14% of resin volume) (Recheroetal, 2006). Catalyst include weak aqueous acid of such as ammonium chloride or hexamine, a white powder.

Shell mould casting allows the use of both ferrous and non-ferrous metals, most commonly using cast iron, carbon steel, alloy steel, stainless steel, aluminum alloys, and copper alloys. Typical parts are small-to-medium in size and require high accuracy, such as gear housings, cylinder heads, connecting rods, and lever arms.

The shell mold casting process consists of the following steps:

Pattern Creation - A two-piece metal pattern is created in the shape of the desired part, typically from iron or steel. Other materials are sometimes used,

such as aluminum for low volume production or graphite for casting reactive

materials.

Mould Creation - First, each pattern half is heated to 175-370 °C (350-700 °F) and coated with a lubricant to facilitate removal. Next, the heated pattern is clamped to a dump box, which contains a mixture of sand and a resin binder.

The dump box is inverted, allowing this sand-resin mixture to coat the patten.

The heated pattern partially cures the mixture, which now forms a shell around the pattern. Each pattern half and surrounding shell is cured to completion in an oven and then the shell is ejected from the pattern.

Mold Assembly - The two shell halves are joined together and securely clamped to form the complete shell mould. If any cores are required, they are

inserted prior to closing the mold. The shell mould is then placed into a flask and supported by a backing material.

Pouring - The mould is securely clamped together while the molten metal is

poured from a ladle into the gating system and fills the mould cavity.

Cooling - After the mould has been filled, the molten metal is allowed to cool and solidify into the shape of the final casting.

Casting removal - After the molten metal has cooled, the mould can be broken and the casting removed. Trimming and cleaning processes are required to remove any excess metal from the feed system and any sand from the mould.

Examples of shell moulded items include gear housings, cylinder heads and connecting rods. It is also used to make high-precision molding cores.

2.8. Centrifugal Casting

Centrifugal casting or rotocasting is a casting technique that is typically used to cast thin-walled cylinders. It is typically used to cast materials such as

metals, glass, and concrete. A high quality is attainable by control of metallurgy and crystal structure. Unlike most other casting techniques, centrifugal casting is chiefly used to manufacture rotationally symmetric stock materials in standard sizes for further machining, rather than shaped parts tailored to a particular end-use.

Centrifugal casting is both gravity and pressure independent since it create its own force feed using a temporary sand mould held in a spinning chamber at up to 900N (Jain, 2014). Lead time varies with the application.

Typical materials that can be cast are iron, steel, stainless steels, glass, and alloys of aluminum, copper and nickel. Two materials can be combined by

introducing a second material during the process.

Features of Centrifugal Casting

Castings can be made in almost any length, thickness and diameter.

Different wall thicknesses can be produced from the same mold.

Eliminates the need for cores.

Good mechanical properties due to the grain structure formed by centrifugal action.

Typically cylindrical shapes are produced:

- In sizes of up to 6 m (20 ft.) diameter and 15 m (49 ft.) length.
- With a wall thickness range from 2.5 to 125 mm (0.098 to 4.921 in).
- In tolerance limits of the outer diameter of 2.5 mm (0.098 in) and die inner diameter of 3.8 mm (0.15 in).
- In a surface finish from 2.5 to 12.5 mm (0.098 to 0.492 in) rms.

Cylinders and shapes with rotational symmetry are most commonly cast by this technique. Long castings are often produced with the long axis parallel to the ground rather than standing up in order to distribute the effect of gravity evenly.

Thin-walled cylinders are difficult to cast by other means. Centrifugal casting is particularly suited as they behave in the manner of shallow flat castings relative to the direction of the centrifugal force.

Centrifugal casting is also used to manufacture disk and cylinder shaped objects such as railway carriage wheels or machine fittings where grain, flow, and balance are important to the durability and utility of the finished product.

Noncircular shapes may also be cast providing the shape is relatively constant in radius.

In centrifugal casting, a permanent mold is rotated continuously at high speeds (300 to 3000 rpm) as the molten metal is poured. The molten metal spreads along the inside mold wall, where it solidifies after cooling. The casting is usually a fine-grained casting with an especially fine-grained outer diameter, due to the rapid cooling at the surface of the mold. Lighter

impurities and inclusions move towards the inside diameter and can be machined away following the casting.

2.9 Defects in Casting

Casting defects may be defined as those characteristics that creates deficiency or imperfection contrary to the quality or imperfection contrary to

the quality specification imposed by design quality and service requirements. The quality of casts may be affected by adversely by series of imperfection that may lead to additional worries on foundry or metallurgical products, the following problems are the common defects in casting.

Swell: a swell is an enlargement of the mould cavity by metal pressure, resulting in localized or overall insufficient ramming of the sand. If the molten metal is poured too rapidly, a swell may occur, and also insufficient weight of the mould during pouring may cause the cope to lift, thereby creating swell

Shrinkage Cavity: shrinkage Cavity is a depression in the casting caused mainly by uncontrolled and haphazard solidification of the metal. It may be due to wrong location or an improperly sized gating system, inadequate riser or poor design of casting involving sudden changes of sectional thickness.

Shrinkage may also be eliminated by applying the principles of directional solidification in mould design.

Drops: when the upper surface of the mould cracks and pieces of sand fall into the molten metal. "Drop" occurs when sand having too much green strength, soft ramming or sufficient reinforcement of the mould may cause this defect.

Dirt: dirt generally appears in form of foreign particles and sand embedded on the surface of the casting. The causes for this defect may be crushing of the mould due to mishandling, sand wash when the metal is poured because of the low strength and soft ramming, insufficient of molten metal, and presence of slag in the mould due to its incomplete separation from molten metal.

Sand Inclusion: this is also called sand holes and is the common defect for sand casting. It looks like small or middle hole with a sand grain in the internal or on the surface of the casting. It is mostly caused by sand drop, over baking, and sand cut.

2.10 The Following Precautions and Factors That Can Reduce the Chance of Defects on Casting

- Pattern should be gently detached from casting.
- Proper ramming should be done.

- Enough quantity of water should be added.
- The sand must be sieved very well to avoid lump sand.
- The parting sand must be sprinkled on the surface.

CHAPTER THREE

3.0. Production Method

3.1 Sand Moulding Preparation

The green sand was made by adding bentonite and charcoal which water was later added to it and was mixed with shovel; it was observed that the sand had properties of binding and then sieving tool place so that the sand will be sweet able for moulding.

Furthermore, at this stage floor moulding and cope was used. The cope will be on top of the floor mould, while the cope is placed correctly on the

floor mould.

A space was created for the pattern on the floor mould and gave it a soft ramming. Button was located on the floor mould for alignment of the cope and the floor mould; bellow was used to blow the sand particles away from the surface of the mould, then Coal dust and parting sand was sprinkled on the mould. The cope was then created on the top of the floor mould and the gating system (runner and riser) was located at the edge of the pattern with the aid of the sprue. After all, the cope was filled with sand.

Nevertheless, after filling the cope with sand, we made sure the mould was properly rammed and the sprue was carefully removed from the mould, the passage created by the channel is to allow molten metal to flow through the pattern layout. The edge of the runner and the riser was widened so that the molten metal would be easy to pour inside the mould, and proper venting took place immediately with the aid of vent pin, this was done so that there will be escape of gas during solidification.

Furthermore, the sand particles were blown away with the use of bellow and marked the side of the cope and the floor mould with wet sand and pin. The cope was removed from the floor moulding and sprinkled water at the edge of the pattern for easy remover. Two screw drivers were used gently to remove the pattern; this was done in other to avoid distortion of the shape

formed by the pattern. After all this, we covered the floor mould with the cope and the mould now was ready to receive the molten metal from the furnace.

Later on, the pit furnace was now used to cast aluminium, (the melting point of aluminium is 660°C).

3.2. Pattern Making

In casting, a pattern is a replica of the object to be cast, used to prepare the cavity into which molten material will be poured during the casting process.

Patterns used in sand casting may be made of wood, metal, plastics or other materials. Patterns are made to exacting standards of construction, so that they can last for a reasonable length of time, according to the quality grade of the pattern being built, and so that they will repeatedly provide a dimensionally acceptable casting.

The making of patterns, called pattern-making (sometimes styled pattern-making or pattern making), is a skilled trade that is related to the trades of tool and die making and mould making, but also often incorporates elements of fine woodworking . Patternmakers (sometimes styled pattern-

makers or pattern makers) learn their skills through apprenticeships and trade schools over many years of experience. Although an engineer may help to design the pattern, it is usually a patternmaker who executes the design.

Materials used

Typically, materials used for pattern making are wood, metal or plastics. Wax and Plaster of Paris are also used, but only for specialized applications. Sugar pine is the most commonly used material for patterns, primarily because it is soft, light, and easy to work. Honduras Mahogany was used for more production parts because it is harder and would last longer than

pine. Once properly cured it is about as stable as any wood available, not subject to warping or curling. Once the pattern is built the foundry does not want it changing shape. True Honduras Mahogany is harder to find now because of the decimation of the rain forests, so now there are a variety of woods marketed as Mahogany. Fiberglass and plastic patterns have gained popularity in recent years because they are water proof and very durable. Metal patterns are long lasting and do not succumb to moisture, but they are

heavier, more expensive and difficult to repair once damaged.

Wax patterns are used in a casting process called investment casting. A combination of paraffin wax, bees wax and carnauba wax is used for this

purpose. Plaster of Paris is usually used in making master dies and molds, as it gains hardness quickly, with a lot of flexibility when in the setting stage.

3.3 Tools and Materials Used During Casting and Their Uses

- Rammer: it is a piece of equipment used in foundry to compact bulk sand in a moulding box
- Sprue Cutter: this is a tool used to cut tapered openings in moulding sand used for pouring in molten metal. It is also used to cut the runner and risers.
- Trowel: it is a hand tool used for smoothing a mould. It is essentially used for mould dressing.
- Sieve/Riddle: riddle (sieve) is a mesh used for sieving and spreading the parting sand on the pattern in the drag, the process is known as riddling. The purpose is to remove debris from the sand.
- Strike-Off Bar: the Strike-Off bar is a rectangular wooden strip used to level the sand packed in the flask.
- Vent Pin: it is a mild steel wire used for making vents in the mould to allow gases to escape.

- " Rapping Bar: the rapping bar is a wooden bar, square in cross-section and used for tapping the draw screw to lose the pattern in the mould, so that it is easier to remove.

- Pit Furnace: this is a machine used for heating and melting metals during castings.

- Crucible Pot: the metals to be melt are charge into the crucible lot and put into the furnace for melting.

- Tong: they are generally used for gripping and lifting of crucible pots from the furnace after melting.

- Skimmer: this is used to remove the slag that float on top of the molten metal in a crucible lot after melting.

- Sponge: the sponge is a soft fiber used for wetting around the pattern to prevent the sand from breaking up when the pattern is being removed from the mould.

- Water Can: the water can is used for fetching water and sprinkling on the sand to dampen it.

- Draw Screw: the draw screw or gimlet is a kind of screw used for drawing the pattern out of the mould after ramming.

3.4. Melting Processes of Aluminum and Pouring

Aluminum was charged inside the metal crucible pot and place in the pit furnace with fire wood added to the side of the metal crucible pot inside the furnace. The tank was connected to the burner channeling black oil to the furnace and burner which enhance combustion. The furnace was lighted and blower was switched on for a while to enhance combustion and later switched off, the burner was also open so that block oil will enter the furnace so that the fire will be burn and later locked. After all this, fire start to burn in the furnace and the metal began to melt. The gas cylinder was opened for the metal crucible pot to start burning. After burning for about 30 minutes, the aluminum is not normally superheated because it does not solidify quickly like cast iron and also so that's the slag will not get to the melting point and melt with the metal. After melting, the tong was used to carry the metal crucible pot out of the furnace into the carrier and then tapered to where the mould is for pouring. Through a tiny space produced by the riser, the molten metal (aluminum) was poured carefully into the hole. The cope was separated from the floor mould after some minutes.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 Assessment of the Cast Product

4.1.1 Cleaning of the Casting.

After the casting is ejected from the mould, it is no longer fit for use as such as it has sprue, riser attached to it. Besides, it is not completely free of sand particles. This operation of cutting off the unwanted, parts, cleaning and operation may be divided into different stages.

1. Knockout of dry sand cores, using iron barn.

2. Removal of Gates and risers using hammer, saw flame or abrasive cut off machine.

3. Cleaning and smoothing the surface using tumbling barrel, sand blasting.

4. Repair casting to fill up blow holes, straightening the warped for deformed casting.

4.1.2 Performance and Durability of Aluminium Pot

Aluminum pots have excellent thermal conductivity, which is one of the major factor that made aluminium pots good for cooking. It can be used for more than 10hours without any problem and the pot can be used for ten years or more without developing any fault.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The use of aluminium alloy for casting cooking utensils like cooking pots, aluminium tea spoons and aluminium cups etc. have brought development to the country and it also improves the technological

advancement of the country.

This type of production helps in contributing towards the government a bender and provide job opportunity for an individual.

After doing some little work in this project application of different Materials which is being used for casting operations is well known.

5.2. Recommendations

The project also afforded the opportunity of putting into practice the things learnt theoretically in the class.

It is right step by those who introduced practical project to all engineering students 1, metallurgical engineering in particular who is about graduating National Diploma (ND) as well as going for individual

attachment so that they can meet up with the challenges at their various places of work in future

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