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The Application of Expanded Polystyrene (EPS) Foam as Pattern Material in Sand Casting of a Logo

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Abstract

Expanded polystyrene (Eps) foam was used as pattern material in sand casting of the University of Agriculture, Makurdi logo The Eps foam and the traditional wood were designed and shaped to give the University logo and both used as pattern in sand casting. The University logo was produced as cast with the wooden and Eps pattern. Visual examination and gauge dimensional comparism for accuracy/ precision were investigated. The Eps foam produced a more accurate and precise dimensional cast compared to the wood, thereby placing the Eps too as a pattern material in casting. This is an aspect of waste management involving the transformation of waste to useful materials. It could impact on the commitment of the current Nigerian Government's fight against unemployment while increasing the options available for the local foundry industry.

Keywords: Expanded polystyrene, Foam, Sand, Casting, Moulding, Foundry, Aluminum alloy.

1. INTRODUCTION

Man has always sought for improved ways of making and doing things. It is in this light that technological advancement has improved materials and techniques for making products needed by industries and the society. Modern materials in Engineering have shown that plastics can be used in a variety of ways to replace a wide range of traditional materials. Expanded polystyrene (Eps) is one of these plastics used to substitute the traditional wooden and metallic pattern in Foundry and Metal casting (Brough, 1993).

Technological innovation and skills accumulated need to be disseminated if the nation is to achieve technological progress and maintain improved productivity. The University system is one of the principal vehicles for spreading technological knowledge. Expanded polystyrene (Eps) can be used as pattern mould material for casting aluminum products (Lindberg, 1977). Although literatures demonstrate convincingly that Eps can be used as pattern material, this unique technique does not appear to have been tried in our local industries. This research uses Eps foam made from Ethylene and Benzene as pattern material to cast the University of Agriculture, Makurdi logo as a proto-type compared to the one obtained using wooden pattern with regards to suitability in sand casting.

Aluminum has become tonnage metal, second only to steel as a major factor in the metal industry. This growth is based on characteristics such as high strength- weight ratio; good corrosion resistance, reasonable thermal and electrical conductivity, and ease of fabrication, modern metallurgical control of structure and properties are favorable economics. The attractiveness and utility of Aluminum alloy

is attributed to its properties of lightweight, high strength at elevated temperature, moderate corrosion resistance and ease of machining (Lindberg, 1977). It is obvious that the main limitations of Aluminum are its low melting point (660 ^{0}C) and its inability to be used at temperature above 300 ^{0}C (because of creep) in spite of its superior oxidation resistance. Special alloys with high temperature have been employed. Most important alloying elements are often added to Aluminum to produce stronger materials and improve casting properties such as: Copper, Magnesium, Manganese, Zinc, Silicon, and Nickel and in some cases small amount of Lead and Tin. Aluminum is characterized with lightness, electrical conductivity, mechanical properties, high thermal conductivity, and resistance to corrosion and affinity to Oxygen enabling it to be used as a de-oxidizer in steels (Altenpohl, 1993).

Plastics form another group of engineering material which is widely used in industry and homes with less cost. Man made (synthetic) organic material which are solid in finished form but during production/manipulation are soft (liquid) enough to be formed into various shapes are produced from basic materials such as gas, petroleum oil, coal etc (Jamiu et.al, 2012).

A pattern is the first step in producing a cast in sand; it is a prepared "model" used to form a cast of desired shape in sand (Agboola et.al, 2010).

2. MATERIALS AND METHODS

2.1 Materials

The aluminum alloy scrap was obtained from a metal scrap market in Makurdi, Benue State, Nigeria. The Expanded polystyrene foam was obtained from plastic scrap (waste) market also in Makurdi, Benue State, Nigeria. The foundry/molding sand was collected from River Benue in Makurdi- Benue State. The wood was obtained from the timber shed also in Makurdi, Benue State.

2.2 Methods

The wooden pattern "University of Agriculture, Makurdi" logo was designed and shaped out, by cutting and smoothening using sand paper. The same pattern was cut out from Expanded Polystyrene foam as pattern also.

The moulds were produced using standard procedure (Fayomi et.al, 2011). Bearing in mind that the wooden pattern would be **withdrawn** and the Eps **left in the mould**. The withdrawal necessitates the creation of cavity (shape) in the mould while, the left in mould evaporates through the vents on pouring the hot (melted) aluminum. The aluminum scrap was melted in the furnace (controlled environment) to the melting temperature of 760 ^{0}C. The melt was gradually poured in to the wooden and Eps moulds and allowed to solidify. The casts were then removed and comparative examination undertaken in the form of visual examination and dimensional/geometrical gauge conformity.

3. DISCUSSION AND RESULTS

Two techniques were used to obtain the "University of Agriculture Makurdi" logo as cast. **Pattern withdrawal technique** was used for the wooden pattern, while the **disposable pattern technique** was used for the Eps. Both patterns produced sound casts, but for dimensional accuracy /specifications the Eps pattern produced more accurate sizes and shapes as indicated by Harper, (1981). The cast from the wooden pattern required further machining, filing and grinding to obtain the final shape and dimensions/size, while the Eps pattern process produces exact shapes and dimensions/sizes requiring no further machining

operations as indicated by Lindberg, (1977). This is so for Eps because the pattern needs no withdrawal as it melts from solid to steam through the vents in the mould and hence the cavity created remain exact, on like the wooden pattern which required that the cavity be made larger (for allowance and ease of removal) for further machining of the cast to size and shape.

The Eps pattern can be made in a relatively short time, also cores and parting lines are eliminated because of the direct evaporation of the foam from the mould through the vents, and backup sand is often directly reusable.

4. CONCLUSION

It may be concluded from the foregoing that:

i. The process can be used for casting of any size in both ferrous and non-ferrous metal.
ii. It is quite economical especially where very small quantity of casting is required. This is because expensive re-usable patterns need not be made.
iii. Very accurate castings are produced that often reduces or eliminates machining and finishing operations and the surface finish is quite good.
iv. This study support the claim that Expanded Eps foam can be used as pattern material for the casting of metal products using the "lost-pattern casting" method, the technology appear to be simple and does not require sophisticated tools and skills.

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