

**DESIGN AND CONSTRUCTION OF A VACUUM CASTING  
EQUIPMENT FOR ALUMINIUM ALLOYS**

**BY**

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## ABSTRACT

This work reports the design and construction of an apparatus for the vacuum casting of aluminium alloys, production of cast components using the apparatus and evaluation and comparison of the quality of cast components produced by vacuum casting. This is with a view to alleviating the problems of poor castability and produce inclusions-free castings.

Melting and vacuum requirements of the equipment were determined based on a furnace capacity of 15 kg of aluminium. The heating power requirement was calculated for this mass while refractory requirements necessary for a 15 kg mass and non-slagging application was determined. Low-cost clay-based refractory and insulating bricks were specifically developed from locally-available raw materials and novel production routes were used for their production. The vacuum system was made from locally available materials designed for optimal efficiency required for vacuum casting. Computer Aided Design software was integrated into both sheet metal forming and refractory mould design. The equipment was used to melt and cast small-sized specimens using the lost-wax technique and compared with green sand and ceramic mould cast specimens. Tensile and shrinkage tests and microstructural examination were carried out on all specimens.

The results of the tensile strength of the vacuum cast, green sand cast and ceramic mould cast specimens of the aluminium alloy were 123.23, 98.83 and 113.56 MPa respectively. Furthermore, shrinkage defect which was common to both green sand and ceramic mould casting was eliminated in vacuum casting. The continual replenishment of the mould cavity by molten metal from the furnace effectively eliminates shrinkage in the cast component during vacuum casting.

In conclusion, the aluminium alloys cast from the designed and constructed vacuum casting apparatus showed improved properties when compared with those from the traditional green sand and ceramic mould.