PREFACE

Utilizing industrial solid waste is well known to reduce the need for energy, natural resources, environmental harm, and other costs. Industrialization, which is the answer to national development, has a direct relationship to waste. As the country develops, a massive amount of waste is created, leading to environmental issues with disposal, health concerns, and pollution. Recent decades have focused on recycling garbage and using waste as a value-added product in several businesses. The resulting waste has been dumped in landfills and piled on the ground, causing environmental problems and land deterioration. The use of industrial waste is restricted to some businesses, such as cement production and road building, which do not balance out the production of industrial waste. Consuming industrial waste is still a major concern today. The foundry industry is one of those sectors where sand demand rises globally on a daily basis, making it a good candidate for testing the viability of using industrial waste materials like red mud, ferrochrome slag, and blast furnace slag.

The present work has been divided into six chapters**.**

Chapter 1 presents a brief introduction to solid waste generation, various industrial solid waste, a statement of problem related to the handling and disposal of this waste, and beneficial of the utilization of solid waste. The sand consumption globally in the sand-casting process. The Al-Si phase diagram elaborates the phase present in the A319 alloy such as α- Al, eutectic Al-Si, and primary silicon whereas the presence of Cu contributes to the formation Al_2Cu.

Chapter 2 critical literature review on the extraction process of industrial solid waste such as blast furnace slag, ferrochrome slag, and red mud and various utilization sector of these wastes are discussed with variations in the content of solid waste in parent substrate. The utilization of sand in the foundry practice with the different aspects of binder, moisture, and additives. As well as with alternative sand to replace sand in foundry practice such as ant hill power, groundnut shell ash, and fly ash.   The effect of various ingredients of the foundry on the microstructure and the mechanical properties of cast alloy.

The mold material is one of the important aspects of the foundry industry. The properties of cast alloy also depend upon the mold material used. The quality of the mold depends on the appropriate composition of molding materials and the molding process. The molding materials include such as foundry sand, binder, additives, etc. In the casting of ferrous and non-ferrous, the mold must have high strength, low friability, high permeability, and low thermal expansion.

Chapter 3 deals with the materials used for the present investigation and the experimental procedure for the physical, chemical, and flowability behaviour was discussed with the comparison of conventional sand used in foundry industries. The experimental details and selected parameters based on various standards as well as literature were also included. Different characterization techniques such as EPMA, XRD, TGA, and SEM for the present study of chemical composition, phase analysis and also clay content, thermal analysis, sieve analysis, and flowability behaviours have been discussed in detail.

Chapter 4 presents a detailed discussion of the CO_2 molding process, Slag-sand mold preparation, and mold properties such as compressive strength, shear strength, permeability, compactness, and hardness of the fabricated slag-sand mold and compared with the conventional mold properties. Casting A319 alloy in different molds and estimating the solidification rate of alloy cast in different molds with the help of a cooling curve.

Partially replacement of sand in the mold practice with blast furnace slag (30%-70%), ferrochrome slag (30%-70%), red mud (30%-70%), and olivine sand (30%-70%) using a CO_2 molding process enhanced the mold properties such as compressive strength of mold increased to 6% -15% with the addition of solid waste in a sand mold.

Chapter 5 presents a detailed discussion of, microstructural evaluation, secondary dendritic arm spacing (SDAS), porosity and density, microhardness, tensile strength, fracture morphology, wear rate, and worn surface morphology of A319 alloy cast in slag-sand and compared with conventional mold. Different characterization techniques such as optical microscopy, density measurement, Vickers hardness, tensile test, and reciprocating wear have been discussed in detail.

The micrograph was obtained by optical induced dendritic structure along with primary α-aluminum dendritic arms with secondary dendritic arm spacing. The size of SDAS measured with the Image software and the content of slag in the mold reflect on the size SDAS leading to an increase in the mechanical and tribological behaviour of a cast alloy. An in-depth understanding of the wear mechanisms, such as adhesion, abrasion, delamination, and oxidative wear, was obtained by using a scanning electron microscope to examine the worn surface. An alloy's wear resistance is reduced by the porosity in the cast.