

# PREFACE

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Processing and deformation behavior of complex Al-Si alloys (Al-18Si-2.5Cu-0.6Fe, Al-11Si-2.5Cu-0.6Fe, and Al-7.4Si-1.2Cu-0.6Fe) has been demonstrated in the present work. The open and impression dies forging experiments have been performed using solid cylindrical billets of the complex Al-Si alloys under different working temperatures, aspect ratios and interfacial friction between top-bottom dies and test samples. Along this, the converging die forging experiments have also been performed using solid cylindrical billets under different conditions of working temperatures, reduction ratio. Different characterization techniques have been used to study the effect of processing temperature on its microstructural characteristics, mechanical and tribological behaviors of the forged alloys. The present study provides a valuable insight and will be helpful in understanding the metal flow pattern of cylindrical billets during forging and will be useful in developing better quality complex Al-Si alloys product at competitive rates.

**The thesis has been organized in following seven (7) chapters.**

## **Chapter-1: Introduction and Literature Review**

This chapter comprises the brief introduction of the Al-Si alloy, its classification based on silicon contents. Mechanical, physical and tribological properties of Al-Si alloys are also discussed and its important applications. The relevant literature review is based on the processing and characterization of the Al-Si alloys. It contains a concise survey on the different processing techniques, the effect of alloying elements, microstructural modification through different methods, and bulk-forming of the Al-Si alloys. This also includes the effect of processing temperature, different strengthening mechanisms and tribological behavior of Al-Si alloys under different working conditions.

## **Chapter-2: Experimental Work**

This chapter presents the detailed experimental procedure to cast the alloys, to conduct the experiments using different die sets. Deformation behavior of the complex Al-Si alloys was investigated through different bulk processing techniques such as open, impression and converging die forging under various processing conditions. The microstructural features of the as-cast and forged Al-Si alloys were evaluated from optical microscopy and scanning electron microscopy (SEM). The tensile strength and hardness of the as-cast and forged alloys were measured from Instron Machine and Vickers Microhardness tester respectively. A pin-on-disc tribometer was used to evaluate the wear behavior of the as-cast and forged alloys under dry sliding conditions.

### **Chapter-3: Deformation behavior and Tribo-Mechanical Properties of the Complex Hypereutectic Al-18Si-2.5Cu-0.6Fe alloy during Forging**

This chapter presents the deformation behavior of the complex hypereutectic Al-18Si-2.5Cu-0.6Fe and its effect on the tribo-mechanical properties during bulk processing. The complex Al-18Si-2.5Cu-0.6Fe was bulk processed through open, impression and converging dies forging under various processing temperatures, and lubrication. The effect of processing parameters on engineering properties of the material is analyzed through optical and SEM microscopy, tensile, hardness and wear test.

### **Chapter-4: Deformation behavior and Tribo-Mechanical Properties of the Complex Eutectic Al-11Si-2.5Cu-0.6Fe alloy during Forging**

This chapter presents the deformation behavior of the complex hypereutectic Al-11Si-2.5Cu-0.6Fe and its effect on the tribo-mechanical properties during bulk processing. The complex Al-11Si-2.5Cu-0.6Fe was bulk processed through open, impression and converging dies forging under various processing temperatures, and lubrication. The effect of processing parameters on engineering properties of the material is analyzed through optical and SEM microscopy, tensile, hardness and wear test.

## **Chapter-5: Deformation behavior and Tribo-Mechanical Properties of the Complex Hypoeutectic Al-7.4Si-2.5Cu-0.6Fe alloy during Forging**

This chapter presents the deformation behavior of the complex hypereutectic Al-7.4Si-2.5Cu-0.6Fe and its effect on the tribo-mechanical properties during bulk processing. The complex Al-7.4Si-2.5Cu-0.6Fe was bulk processed through open, impression and converging dies forging under various processing temperatures, and lubrication. The effect of processing parameters on engineering properties of the material is analyzed through optical and SEM microscopy, tensile, hardness and wear test.

## **Chapter-6: Comparative Studies of the Bulk Processed Al-Si Alloys**

This chapter shows the comparative study of the forged complex Al-Si alloys based on physical properties, deformation behavior, microstructural features, mechanical properties, and wear characteristics under dry sliding conditions.

## **Chapter-7: Conclusions and Scope for Future Work**

The chapter discusses the important findings of the present research work and future potential is recommended, so to carry out in the further research in this impart area.