PREFACE

The present work investigates the possible use of fly ash solid-waste for the research of insulation refractory bricks. Fly ash is considered as a powdered material being collected by dust collectors built-in boilers of thermal power plants with the use of coal as a fuel. In India, coal is of poor quality having high ash content around 30–45 wt. %, fly ash created at coal thermal power plants. The development of refractory bricks made of new materials has recently drawn a lot of interest to address sustainability issues. So, in this study, the recycling of lignite fly ash produced by coal-fired thermal power plants has been investigated to make fireclay refractory bricks. The lignite fly ash and ball clay are the primary raw materials characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM), X-ray fluorescence (XRF), and differential thermal analysis (DTA). The chemical, thermal, crystallographic and morphological analysis of fly ash solid-waste has been determined by XRF, DTA-TG, XRD and SEM, respectively. The XRF results show the fly ash solid-waste is alumina and silica-rich. XRD results also reveal that the material is composed of mullite and quartz crystals. SEM investigation exhibits the morphology of fly ash solid-waste is needle-like mullite and fibrous-like quartz type of structure, which supports the XRD results. It can be concluded from the inquiry that fly ash solid-waste is the potential low-cost raw material for insulation refractory bricks.

The samples were prepared using a uniaxial hydraulic press, and firing was done in the range of 1000 to 1200 °C for 2 hours. The fired samples were characterized in terms of chemical composition, mineralogical phase, and microstructural using different characterization tools such as XRF, XRD, and SEM. The physical, mechanical, and thermal properties such as linear firing shrinkage, apparent porosity (AP), bulk density (BD), cold crushing strength (CCS), cold modulus of rupture (CMOR), and thermal conductivity of the fired sample were investigated. The linear firing shrinkage, AP, BD, and CCS values were achieved estimated to be 5.32%,

2.10 gm/cc, 15%, and 52 MPa, respectively. The SEM analysis shows dense, rod-like mullite structure and interlocking microstructure of the fired samples. The results were well matched with ASTM standards and commercially available products. So, this promising result indicates lignite fly ash can be used as a potential raw material to produce fireclay refractory bricks.

Lignite FA from coal-fired thermal power plant NLC India Ltd., Bikaner in northern India, ball clay, and sawdust are the main components of semi-silica insulation refractory bricks. FA and ball clay were blended in various combinations, and sawdust is used as a pore former. The prepared samples were fired in the range of 1000 °C to 1200 °C. The resultant properties of the bricks were characterized in terms of mechanical, thermal, phase analysis, and microstructure. It was found that FA can be used as a suitable candidate in the preparation of semi-silica insulation refractory bricks. The chemical analysis, bulk density (BD), apparent porosity (AP), and thermal conductivity (TC) of insulation refractory bricks with lignite FA were observed to be similar to commercial products. The sample FC30S, which contains 60% lignite FA showed 44.69% AP and 0.38 W/mK thermal conductivity after sintering at 1100 °C for 2 hours. Hence,

A tremendous amount of lignite fly ash (FA) is produced as waste materials in coal-fired thermal power plants. These wastes materials contain toxic elements which are detrimental to the environment. In this study, the lignite FA waste materials are used as the primary raw material for the fabrication of semi-silica insulation refractory bricks to save the environment from these effects. The use of FA is technically feasible, economically beneficial, and can be used as thermal insulation refractory. The study indicates a sustainable technique of using fly ash for the fabrication of eco-friendly semi-silica insulation refractory.

The current thesis deals with the study of lignite fly ash based alumino-silicate refractory materials which may be potentially used for the lining of kiln, furnace, and soak pit etc. In this

work, lignite fly ash, ball clay and sawdust are mixed as per our requirement for the alumino-silicate refractory.

The thesis is divided into six different chapters

Chapter 1 comprises of general introduction about alumino-silicate refractories, brief about finding and literature of other researcher and some properties of like lignite fly ash and alumino-silicate refractories. The brief summary of these materials is discussed along with current problems and objectives.

Chapter 2 the detail of materials used, experimental setup, synthesis method, testing and characterization techniques are discussed which have been employed to perform the works presented in the thesis.

In chapter 3, deals with characterization of lignite fly ash for the utilization in the alumino-silicate refractories.

Chapter 4 describe the effect of fly ash and ball clay on the physical and mechanical properties of the alumino-silicate refractories was investigated.

Chapter 5 reported the attempt to find out the possible application of lignite fly ash in the field of semi-silica insulation refractories a which is alumino-silicate refractories.

Chapter 6 is the concluding chapter in which I have summarized the result obtain to reach on some conclusion and future scope of work.