

## **Preface**

The fact cannot be denied that rapid urbanisation brought on by industrialisation resulted in a generation of enormous quantities of waste and its utilisation is the need of the hour. Wastes in different forms (liquid, solid & gaseous) affect the environment badly due to improper disposal of wastes. To resolve issues related to waste generation and to minimise the impact of global warming due to the release of carbon dioxide with the use of conventional construction materials the phenomenon of geopolymerization using waste by-products will be an alternative approach to minimise the impacts due to improper disposal of wastes. Geopolymer is a technology which utilises waste at a great level. Geopolymer is a mechanism in which reactions take place between alumina-silica-rich waste and alkaline solution. Intending to address the issue of waste generation using the geopolymerization technique, an attempt has been made to study the synthesis of geopolymers using industrial wastes and evaluation of their engineering properties. With this study, the type of geopolymer can be identified for certain infrastructural applications leading to sustainable development.

In the present study, the waste materials opted from industries that are pond ash, red mud and urban-based waste i.e., municipal solid waste reject. A binder material Ground granulated blast furnace slag (GGBFS) is an industrial waste by-product is considered for the synthesis of geopolymer along with an alkali activator i.e. sodium hydroxide (NaOH). Over all the thesis work is discussed in eight different chapters.

Chapter 1 introduction discusses the generation of waste, problems that occur with waste and remedies for waste generation problems, the method for reduction of the waste, and the introduction of the phenomenon of geopolymer and the mechanism of the geopolymer etc. has been discussed.

Further, this thesis discusses the literature review in Chapter 2 which summarises the past studies related to the geopolymer mechanism, studies on the alkaline activator, mechanical properties of geopolymers, and microstructural studies on geopolymers. After the literature review, the detailed planning of the experimental programme and methodology for developing the geopolymer was discussed. This chapter also discusses the materials opted for geopolymer synthesis in the current research programme and their geotechnical and microstructural properties were discussed. The fourth chapter mentioned a description of the development of Pond ash-GGBFS geopolymer, geotechnical characterisation of the geopolymers of designed mixes, their UCS analysis at different curing periods and their microstructural analysis (XRD, FTIR & SEM). The rock triaxial tests, ultrasonic pulse wave velocity tests, and leachate analysis on Pond ash-GGBFS geopolymers have also been discussed. Chapter five discusses the development of MSW Reject-GGBFS geopolymer, and their geotechnical characterisation such as specific gravity analysis, grain size distribution analysis, compaction characteristics and permeability analysis of each designed mix, UCS analysis at different curing periods (7, 28 and 56 days) with polyethene curing, UCS analysis on the geopolymer samples cured in water and acidic environment, microstructural analysis. The test results related to rock triaxial, and ultra-sonic pulse wave were also briefed in this chapter. Chapter six discusses the synthesis of Red mud-GGBFS geopolymer, and their geotechnical properties of each designed mix, UCS analysis at different curing periods (7, 28 and 56 days), UCS analysis in polyethene, water and in an acidic environment, and microstructural analysis. In Chapter Seven discusses the research work focused on the development of Pond ash-Red mud geopolymer, their geotechnical characterisation (compaction characteristics of each designed mix), UCS analysis at different curing periods (7, 28 and 56 days), shear parameters using triaxial tests, microstructural analysis (XRD,

FTIR). Finally, the thesis ends with chapter eight summarises the conclusion, field applications, and future scope of the study.