The 2018 World Congress on
Advances in Civil, Environmental, & Materials Research (ACEM18)
Songdo Convensia, Incheon, Korea, August 27 - 31, 2018

Thermal conductivity of controlled low strength material (CLSM) under various degrees of saturation

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ABSTRACT

This study focuses on an experimental determination of thermal conductivity of CLSM, made entirely from by-products (e.g., coal ash, gypsum, red mud), under various degrees of saturation. In the experimental program, pond ash is used as a full replacement of natural sand whereas fly ash activated by a little lime, red mud, and gypsum is the main binder in the production of CLSM. In order to do this, various laboratory tests including flowability, bleeding, initial setting time, and unconfined compressive strength are performed on the prepared CLSM mixture to determine its general characteristics. Thermal conductivity is then measured subjected to various degrees of saturation (i.e., 0%, 20%, 40%, 60%, 80%, and 100%). As a result, the general engineering properties of CLSM satisfy the specifications of ACI 229R by controlling the mixture proportions. In addition, the thermal conductivity of CLSM is significantly affected by the degree of saturation (i.e., the higher the thermal conductivity, the higher the degree of saturation). Eventually, a predictive model for thermal conductivity estimation of CLSM is proposed in this study.

1. INTRODUCTION

The American Concrete Institute (ACI) defines CLSM as a self-leveling, self-compacting, and cementitious material primarily used to replace conventional backfill soil and structural fillings that result in unconfined compressive strengths of 8.3 MPa or less (ACI 229R 1999). CLSM is not considered as a type of low-strength concrete, but rather as a structural backfill. CLSM is known by many different names such as flowable fill, controlled-density fill, unshrinkable fill, flowable mortar, soil–cement slurry, and plastic soil–cement. There are various inherent advantages of using CLSM instead of compacted fill in the applications mentioned. These benefits include reduced labor and equipment costs (owing to self-leveling properties and no need for compaction),

*Note: Paper to be submitted to "Geomechanics and Engineering, An International Journal" for the purpose of Special Issue.