

**INVESTIGATION OF THE SUITABILITY OF
SINTERED FLY ASH AND RESERVOIR
SEDIMENT MATERIALS AS A FINE
AGGREGATE REPLACEMENT MATERIAL**

T. Tharshigan

198059J

Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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T. Tharshigan
198059J

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
in Civil Engineering

Department of Civil Engineering
University of Moratuwa
Sri Lanka
September 2021

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Date: September 2021

Prof. W.K. Mampearachchi.

ABSTRACT

Fly ash is produced as a byproduct from Lakvijaya coal power plant, Sri Lanka. The daily production of fly ash at Lakvijaya power plant is 950 – 1000 tons. Around 40% of fly ash is consumed by cement manufacturers, balance of fly ash is stored without any means of disposal inside the plant. This research study discusses about development of fine aggregate replacement material using sintered coal fly ash with internal curing characteristics. A series of samples were prepared with various composition of fly ash and reservoir sediment material and sintered from 800⁰C to 1300⁰C temperatures in the interval of 100⁰C for 30 minutes of sintering time the sintered fly ash was crushed to prepare fine aggregates. Reservoir sediment material was used as a binder material and it improved green strength of solidified fly ash. TGA – DSC and XRF analysis were used to investigate the thermal and chemical properties of raw materials, respectively. Microstructure of produced fly ash aggregate was observed using SEM photographs. Water absorption, water desorption and relative density of fine aggregate were measured. Water absorption and relative density of aggregates were in the range of 21 – 40%, 1.2 – 1.55, respectively. The aggregate with 80% of fly ash and 20% of reservoir sediment material which was heated at 1100⁰C had 21.4% water absorption and 74.12% water desorption was selected as suitable replacement material instead of natural river sand. Relative density of selected fly ash aggregate was recorded as 1.46. Concrete was prepared using wetted fly ash aggregate by replacing 17.7% of natural river sand and the concrete was not subjected to external curing. Concrete with wetted fly ash aggregate gained lower strength at early stage then it gained more strength at 28 day than that of conventional concrete. Fly ash aggregate supplied internally stored water for hydration reaction of cement after finishing the free water presence inside the concrete and gave internal curing behavior to the concrete, therefore concrete with fly ash aggregate gained more strength than conventional concrete without external curing.

Keywords - coal fly ash, reservoir sediment material, sintering, fine aggregate, water desorption, internal curing concrete.

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LIST OF ABBREVIATION

XRF – X - ray fluorescence

CFA – Coal fly ash

FAFA – Fly ash fine aggregate

RSM – Reservoir sediment material

ICC – Internal curing concrete

ECC – External curing concrete

NCC- No curing concrete

SSD – Saturated surface dry

SEM- Scanning electron microscope

TGA -Thermo gravimetric analysis

DSC- Differential Scanning Calorimeter

IRH- Internal Relative Humidity