BIOGRAPHICAL SKETCH

Abdul Salam Mohammad was born in Aurangabad (MS), India, on October 30, 1990. He entered Dr. Babasaheb Ambedkar Marathwada University in Aurangabad (MS), India on June 2008 and in June 2012 received the degree of Bachelor of Science in Biotechnology Engineering with distinction. During his undergraduate studies, he successfully completed an in-plant training in upstream and downstream process of Active Pharmaceutical Ingredients (API) at Wockhardt Ltd. He entered Tennessee Technological University in January 2014 and received a Master of Science Degree in Chemical Engineering in August 2016. In January 2018, he entered Tennessee Technological University to complete Doctor of Philosophy in Engineering and expected to graduate on August 2022. He is currently working as a Research Scientist in James Hardie Research USA, Inc.

EDUCATION

Ph.D. Engineering
Tennessee Technological University, 2018-2022 (expected)

M.S. in Chemical Engineering
Tennessee Technological University, 2014-2016

B.S. in Biotechnology Engineering
Dr. Babasaheb Ambedkar Marathwada University, 2008-2012

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College of Engineering

TENNESSEE TECH

The Department of

Chemical Engineering

Announces the Dissertation Defense of

Abdul Salam Mohammad

In Partial

Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

August 17, 2022

9:00 AM

Held in

Zoom

Tennessee Tech University

Zoom Link:

https://tntech.zoom.us/j/82754034765?pwd=QkY3ZTB4QWFXQlVkcUMxWFdDbkZCdz09

FIELD OF STUDY

Chemical Engineering

DISSERTATION TOPIC

Rheology and Computational Printing of Cement-Based Materials

EXAMINING COMMITTEE

Dr. Joseph J. Biernacki (Chairperson)

Dr. Pedro Arce

Dr. Bahman Ghorashi

Dr. Ismail Fidan

Dr. Jie Cui

ABSTRACT

Additive manufacturing or 3D printing of cement-based materials is the future of the construction industry and has evolved rapidly in recent years. Although demonstrations and showcases of 3-D printed cement-based structures are available, there are numerous challenges at the technical level including the engineering (formulating) of cement-based materials for 3-D printing applications. Designing cement-based printing pastes with good extrudability and buildability is related to the rheological (flow) characteristics of the material e.g., yield stress, viscosity, and time-dependent effects (physical and chemical, i.e. particulate and hydration-related structuration). Undesirable manifestations of poor rheology are significant factors presently limiting the widespread application of 3D printing of cement-based materials. Understanding and correlating rheological properties to printability for down-stream paste design and scaling strategies are among the existing research gaps. This dissertation focuses on model-based paste design and estimation of model parameters for the simulation of cement rheology and the computational printing of cement paste in two-dimensions using Computational Fluid Dynamics (CFD). The dissertation is sub-divided into three parts.

Part 1 – Develop an efficient 2D continuum-based strategy for computational printing. The purpose of this work is to correlate rheological properties to printability and provide a domain of printability based on the rheological properties to improve the design of fresh cement paste for 3D printing.

Part 2 – Explain the relationship between print scale and printing paste rheology. The purpose of this work is to develop dimensionless two-phase Newtonian-non-Newtonian fluid flow equations and apply them to the problem of scaling the additive manufacturing of cement-based materials.

Part 3 – To extend the 2D computational strategy with time-dependent properties. The purpose of this work is to correlate time-dependent rheological properties to printability and to provide a domain of printability based on the time-dependent rheological properties to improve the design of fresh cement paste for 3D printing.