

MSc Assignment

3D printing of geopolymers using dredged sediments

The construction industry contributes to about 40% of the global greenhouse gas emissions and about 25% of the building waste. Production of traditional construction materials like cement, concrete, asphalt and bricks have a major share in industrial carbon footprint. Use of dredged sediments as an alternative to contemporary construction materials is gaining momentum through several research works. Dredging in waterways also releases sediments, considered as waste. Dutch companies like Van Oord and NETICS have manufactured CSEB (compressed stabilized earth blocks) from dredged sediments and used them to build walls of channels, reefs in harbors and noise-proof walls along rail lines (Figure c). Furthermore, automating the construction process using 3D printing is crucial to improving its productivity and sustainability. Therefore, the assignment **aims to develop an extrusion-based 3D printing method using geopolymers from dredged sediments as a circular and sustainable construction material to fabricate structural blocks with properties comparable to CSEB.**

Approach

An existing extrusion-based 3D printer in our lab will be adapted to execute the printing of the geopolymer blocks using re-designed mixing, pumping and extrusion systems (Figure a). Controlling the operating and design parameters in 3D printing and curing processes at every step (Figure b) is critical to the (fresh-state and hardened-state) properties of the printed geopolymer. Adhesion between the interfaces and interlayers in the printed specimen will determine its mechanical strength. The main challenge will be developing the printing setup to fabricate construction elements using dredged sediments (from NETICS) with improved or comparable properties to conventional materials like concrete and processes like mold casting and compaction (CSEB).

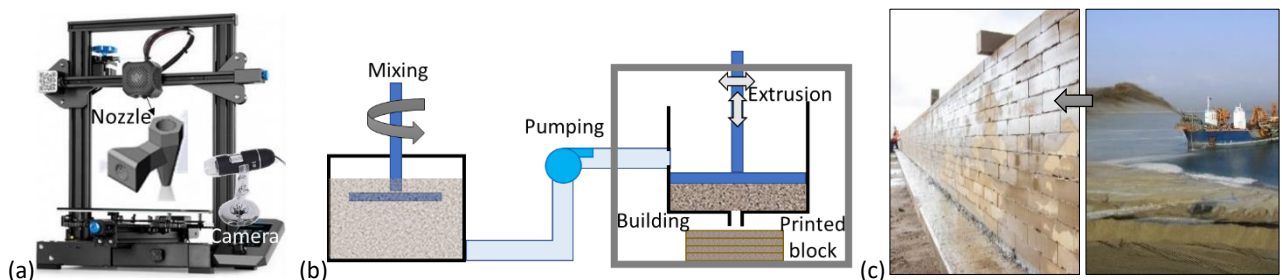


Figure. (a) 3Dprinter at our lab, (b) schematic of extrusion-based 3D printing, (c) CSEB from dredged sediment

Research group and Company

The *Surface Technology and Tribology (STT)* group at University Twente investigates interactions of the surfaces and interfaces. Together with *NETICS B.V.*, a leading international organization on sediment engineering, the printability and mechanical properties of different dredged sediments will be investigated. The assignment will be done under guidance and collaboration with engineers from NETICS (Marc Antoun: marc@netics.nl).

Project tasks:

1. Literature survey on 3D printing techniques and geopolymers.
2. Developing a 3D printing setup for printing geopolymer blocks.
3. Investigate the role of operating parameters on printability of the blocks.
4. Writing a scientific report.

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