

A Neighbourhood Treatment System for Fecal Sludge Using Supercritical Water Oxidation

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Our team has designed and built a technical scale prototype supercritical water oxidation (SCWO) system to treat the fecal waste produced by roughly 1000-1200 persons daily. The unit is housed in a standard 20 ft shipping container and has been undergoing testing at Duke since early 2015. The process calls for moderate preheating of the waste slurry which is then mixed with supercritical water (~600 C) and air (which serves as oxidant), which rapidly brings the waste undergoing treatment to supercritical conditions (~400 C, 240 bars). Under these conditions, all organics are rapidly (i.e., few seconds) oxidized to CO₂, with the corresponding heat of combustion released in the reaction medium. In our prototype (see pictures below), the reactor has a 19 mm ID and is 4.2 m long. After the reaction, heat recovery follows in a 39 m long heat exchanger. The system is well instrumented and operation is controlled using a programmable logic controller. Experiments were first conducted with isopropanol (IPA), prior to treating primary and secondary sludge, first as a slurry mixed with IPA as a co-fuel. Detailed system performance including conversion of organics, process kinetics, and energy balances will be presented and discussed at the conference. The project is funded by the Bill & Melinda Gates Foundation.

