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Saraswati 2.0

Identifying best available technologies for decentralized wastewater treatment and resource recovery for India

D2.8 Pilot 8 implementation report

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1 Context information and overview of the pilot

In Pilot 8 (Ultrasonic treatment of sludge for sludge disintegration and disinfection) two reactors, 1. Pilot scale sludge treatment system and 2. Bench top ultrasound reactor, has been implemented in IIT Kharagpur campus and the experimentation of ultrasonic sludge treatment is in progress. Provision of ultrasound treatment disintegrates, dewater, and disinfect the sludge simultaneously. Aerobic sludge is being used, disinfected and disintegrated through ultrasonic waves employed by ultrasound. The treated sludge can be used as a soil conditioner and the disinfected supernatant can be use onsite for non-potable uses like flushing, gardening, etc.

a.  b. 

Overview of the implementation area 1.1 – a. Pilot scale sludge treatment system and b. Bench top ultrasound reactor

2 Changes of the technology compared to the DOA

No changes has been made in the technology provided till now.

3 Detailed design and project report (task a)

The detail design should include the following points:

- Description of the technical solution adopted, including flow sheet/diagram, technological basis-including fundamentals, potential of resource/energy recovery, reuse, recycle, technical characteristics of the units, and any other technical information of interest)

3.1 Description of technology adopted:

Sewage sludge disintegration using ultrasound in conjunction with UV disinfection will be studied to enhance the sludge dewaterability, partial disinfection of the supernatant and extend operation lifetime by providing in-situ cleaning of screens will be examined at a pilot scale. Ultrasound is a mechanism in which a pressure wave develops that dissipates a large amount of energy as it travels through a medium where gas and vapour bubbles form, expand, and collide violently at high speeds causing strong turbulent eddies would

start around the collapsing bubbles. The result in high temperatures and pressures inside collapsing bubbles might cause various physicochemical and biological changes such as raise in dewaterability, settleability, increase in available COD and low MPN.

3.2 Potential of resource/energy recovery, reuse, recycle

The potential outcomes of the sludge treatment are by employing treated sludge as a soil conditioner and the supernatant for non-potable interior activities such as bathroom flushing, gardening etc.

3.3 Pilot scale sludge treatment system includes:

a. Sludge processing unit: Rectangular vessel with 8 ultrasonic transducers of 64 Watts each, powered in alternating banks of 4 in staggered formation. The unit is provided with 3 filter slots and removable top cover with viewing window.

b. Ultraviolet Unit: Two UV channels, allowing either parallel or series flow, provided with UV-C lamp of 21 Watts.

c. Electrical control unit: It control total run time, cyclic timer (for staggered alternating operation of ultrasonic transducers) and power to UV lamps.

d. Feed pump unit: Submersible pump with float, the float supports to turn off the pump when it goes below safe level of submergence of feed reservoir.

3.4 Bench top ultrasound reactor includes:

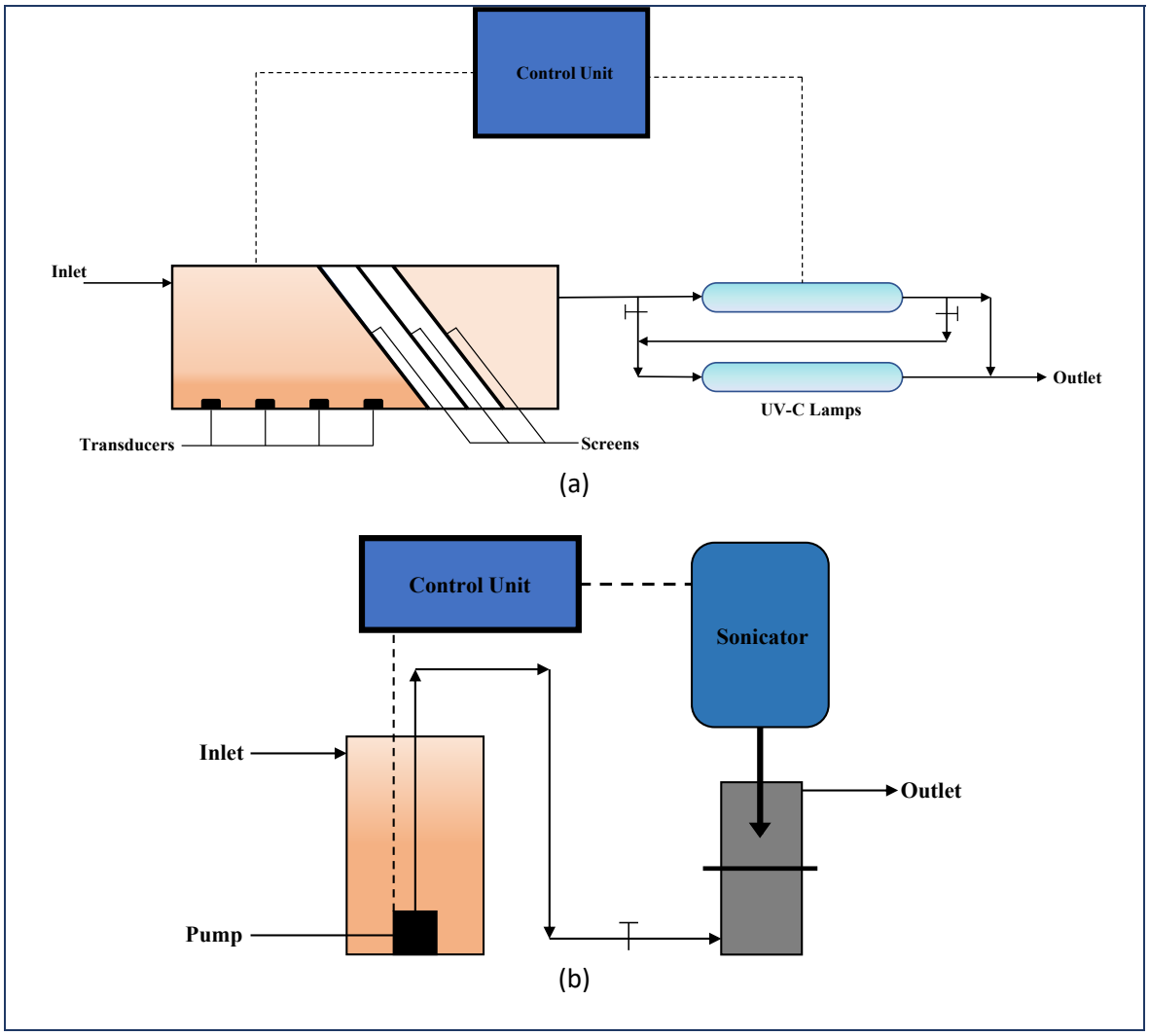
a. Two-stage reactor vessel: Lower stage with two inlets for liquid entrance and upper stage with a removal PTFE spool-like insert, with a circular constriction in the middle, to constrain fluid into proximity with the ultrasonic probe tip.

b. Ultrasonic generator and controller: It is mounted on a vertical steel post, contains piezoelectric transducer (25±3 kHz) of 250 Watts, energized via a cyclic timer.

c. Main power converter: It contains power conversion electronics and a run-time timer.

d. Submersible pump with recycling flow control: A two-valve arrangement to control desired flow rate

e. Replaceable ultrasonic tips: Two probe tips with sizes 15 mm and 5 mm made of titanium (Ti).



Flow diagram, Figure 1.2 – a. Pilot scale sludge treatment system and b. Bench top ultrasound reactor.

4 Detailed engineering design and construction (task b)

The pilot was supplied pre-fabricated by Managing Innovation and installed in IIT KGP campus.

5 Commissioning and start of operation (task c)

The pilot was commissioned on 03-Nov-2021 and operation started on 15-Dec-2021.

The bench-top ultrasound reactor and ultrasound sludge treatment unit were demonstrated using the sample of both water and wastewater sludge at the operation site. A preliminary batch investigation was carried out on a bench-top ultrasonic reactor with a sludge concentration of 5 g/L as the proposed range of 5-30 g/L.