



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

D2.10 Pilot 10
implementation report



Work Package	Piloting candidates for BATs
Deliverable number	D2.10
Deliverable title	Pilot 10 implementation report
Due Date	M20
Submission Date	18.01.2023
Deliverable Lead Partners	IITM
Dissemination Level	Public
Document Nature	<input checked="" type="checkbox"/> R-Report <input type="checkbox"/> O-Other
Contributing partners	BGU and IITM
Authors	Prof. Ligy Philip, Prof. Yoram Oren, Prof. Jack Gilron, Prof. Zeev Ronen, Dr. Akshaya Kumar Verma, A Vishnu Vardhan, R Gayatri, and Franco Antony Deepan
Version	V01

Table of Contents

1 Context information and overview of the pilot.....	5
2 Changes of the technology compared to the DOA	5
3 Detailed design and project report (task a)	5
4 Detailed engineering design and construction (task b).....	6
5.Commissioning and start of operation (task c)	7

1 Context information and overview of the pilot

Pilot 10 aims at removing the nitrate from the secondary treated wastewater using Ion Exchange Membrane Bioreactor (IEMB). Two pilot plants each with a capacity of 2 m³/day will be set to achieve this. The pilot plants were fabricated on a mobile unit so that they can be moved easily from one place to another. One pilot plant was installed at the IIT M campus sewage treatment plant (STP) and another was decided to be placed at the municipal STP in Nesepakkam, Chennai.

Pilot plant 1 was commissioned in January 2022 and monitoring was started in Feb. 2022. Since the secondary treated wastewater collected from the IIT M campus STP had lower concentrations of nitrate, it was synthetically spiked with nitrate to a value of around 100 ppm, filtered through 30 kDa ultrafiltration unit (UF feed) and the permeate is fed to the membrane modules through feed inlet. A chloride concentration of 100 mM was synthetically prepared, filtered through another ultrafiltration membrane (UF receiver) and the permeate was fed through receiver inlet. The nitrate present in the feed gets exchanged with the chloride in the receiver through the process of Donnan dialysis. The receiver water with accumulated nitrate was then fed to the fixed bed bioreactor (FBBR) for denitrification after adding glycerol at an optimized C/N ratio of 1.8 – 2. The effluent from the denitrification unit was sent to a polishing unit for lowering the dissolved carbon. The effluent from the polishing unit again passes through the receiver UF unit and completes the loop.

2 Changes of the technology compared to the DOA

The following changes have been made in the initial process diagram,

- Two ultrafiltration (UF) units with a molecular weight cut-off value of 30 kDa to be installed before the membrane module on both feed and receiver lines to avoid fouling the membrane modules.
- Complete flow from the receiver of the module to be taken to the denitrification FBBR units instead of a small portion as designed earlier.
- Denitrification units to be run on single pass mode rather than recirculation mode.
- A complete automation for the entire pilot plant to be set up.

3 Detailed design and project report (task a)

Initial process flow diagram is shown in fig. 1. As mentioned in the previous section, the initial flow diagram was modified, and the final flow diagram is represented in fig. 2.

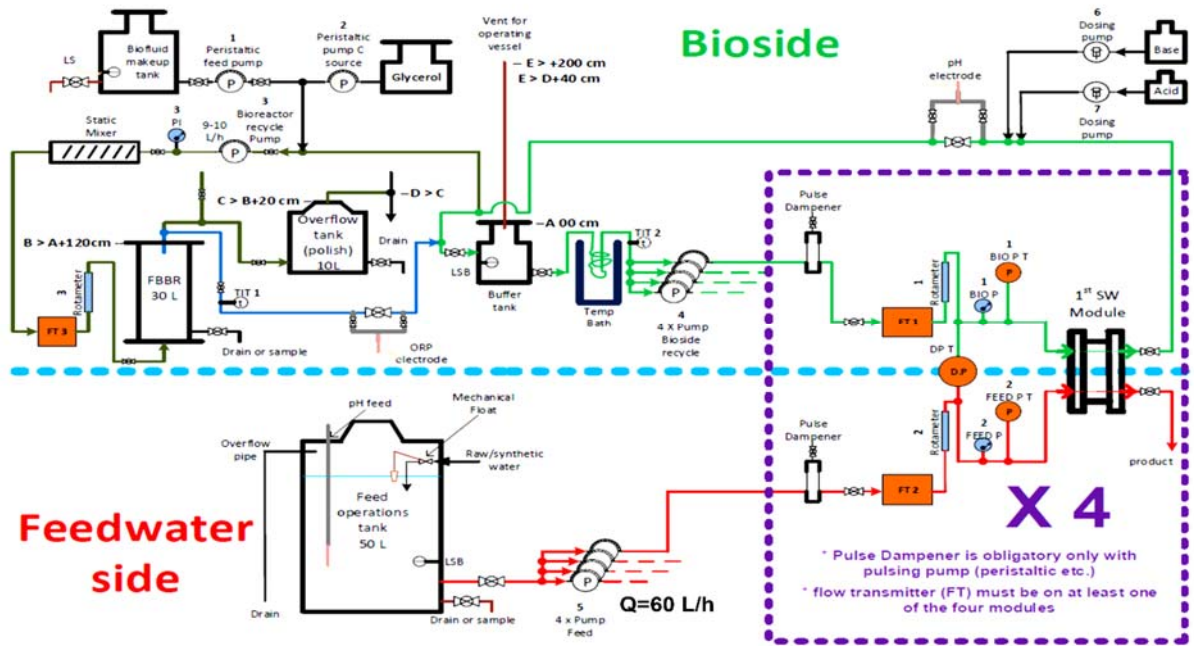


Fig. 1 Initial process flow diagram

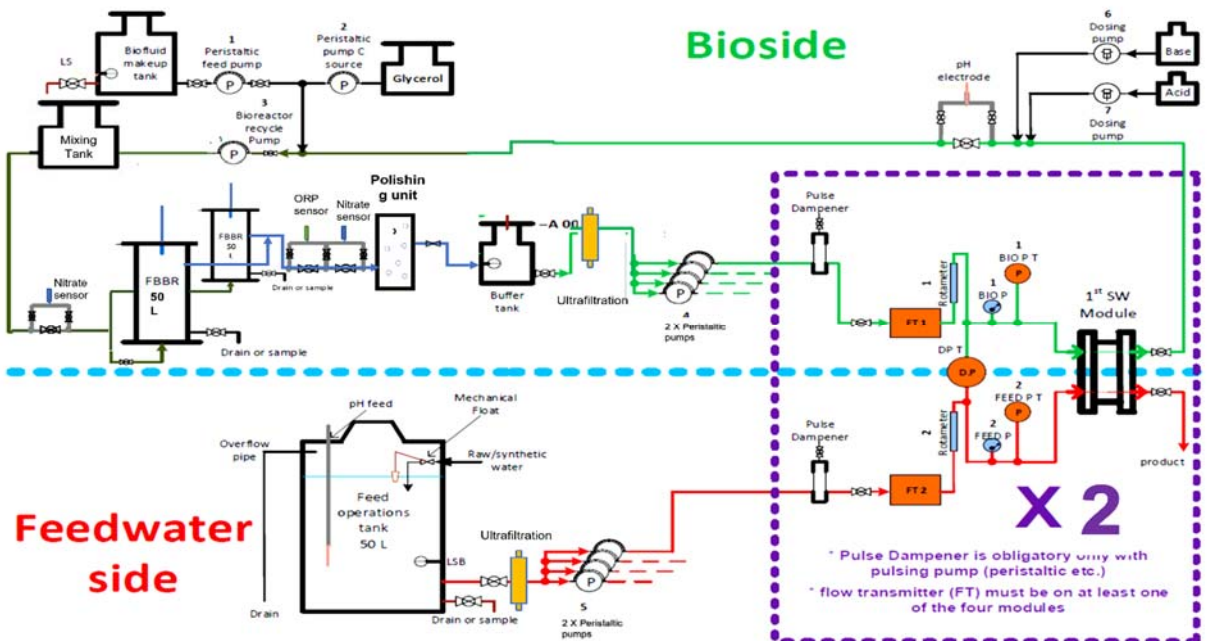


Fig. 2 Modified process flow diagram

4 Detailed engineering design and construction (task b)

Pilot plant-1 was fabricated (by Naveen constructions pvt. Ltd. Chennai) and installed at campus STP of IIT Madras (a detailed process flow diagram is attached separately). The pilot plant consists of two trolleys, trolley 1 houses two membrane modules (procured from Spiraltech, Germany), peristaltic pumps for feed and receiver, pressure transmitters, differential pressure transmitters, flow transmitters, UF modules and its complete piping. Whereas trolley 2 comprises of various tanks such as mixing tank,

FBBR denitrification units of capacity 50 L, polishing unit, buffer tank and nitrate, pH and ORP sensors.

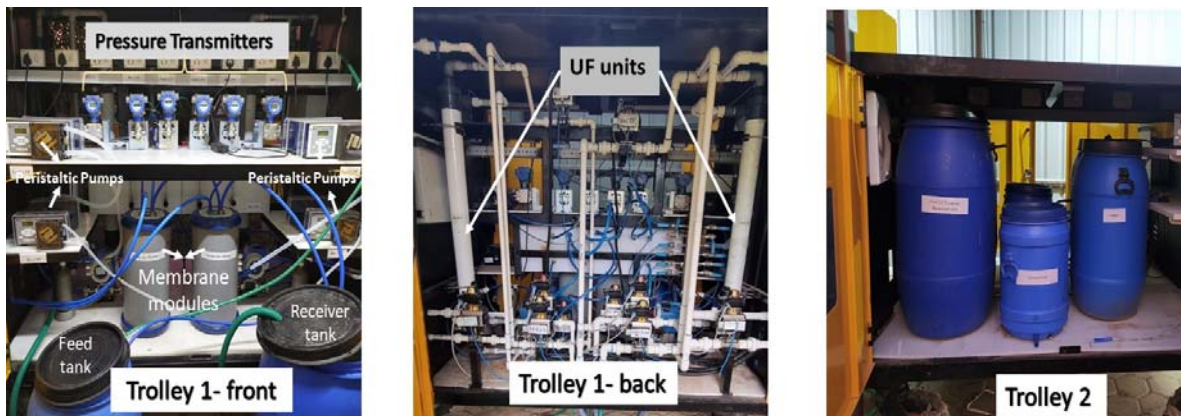


Fig. 3 Pilot plant 1, installed at IIT Madras campus STP

The secondary treated wastewater which was spiked with nitrate and filtered through UF membrane was fed to the membrane module at the rate of 60 L/hr. The receiver with 100 mM NaCl was recirculated through the membrane modules at a flow rate of 60 L/h. The receiver with accumulated nitrate was sent to a mixing tank where glycerol is added. The nitrate sensor in the receiver tank gives the concentration based on which the amount of glycerol was calculated and added. After addition of glycerol, it was fed to two FBBR denitrification reactors at flow rate of each 25 L/hr. After denitrification, the effluent was analyzed for nitrate, COD, ORP and pH and sent to a polishing unit for more COD removal in order to prevent any kind of fouling inside the membrane modules.

5. Commissioning and start of operation (task c)

- The pilot plant -1 was commissioned on 10-Jan-2022 and operation started on 23-Feb-2022.
- Installation of sensors and complete automation for the first pilot module was completed by 10th of July 2022.
- Automation of the second set of the pilot will be completed by 20th July. Shifting and commissioning at municipal STP in Nesapakkam, Chennai will be finished by the end of July 2022.
- Monitoring of both pilot modules will be carried out thereafter.