Saraswati 2.0

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

D2.11 Pilot 1 Implementation report final version

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1. Context information and overview of the pilot plant

In the frame of the Saraswati 2.0 project, a pilot plant is installed at the Indian Institute of Technology Bhubaneswar (IITBBS). The task of the pilot plant is to demonstrate the domestic wastewater treatment through the integration of anaerobic treatment and deammonification. The pilot technologies at IITBBS demonstrate enhanced removal of organic pollution (BOD, TSS), nutrients (particularly Nitrogen). In addition, suitable automation and control strategies will be tested.

The technology is comprised of a two-stage system. In Stage-I, organic compounds will be converted to biogas (process I) in a UASB reactor, and the residual nutrient removal will be performed in the Stage-II through two steps, namely, partial nitrification and anaerobic ammonium oxidation (ANAMMOX) (process II). At the stage II, a two-step system of a) aerobic treatment for residual COD and partial nitritation of UASB treated wastewater and b) ANAMMOX reactor for nutrient removal are established. Methane removal technology (process III) will be applied as the intermediate stage between process I and II. The process III applies a physical principle of dissolved methane removal technology and will be tested on the effluent of UASB pilot. The removal of methane from the UASB effluent contributes to the environmental sustainability of the WWTP process by decreasing the amount of released greenhouse gases and enables wider applicability of the UASB technology. The biogas consisting of methane from the UASB pilot will be stored and utilised for generating heat energy. The effluent from the ANAMMOX will be subjected to a storage pond for adding sufficient DO and thus imparting freshness to the water. The water from this pond will be utilized for several non-potable applications such as horticulture, toilet flushing and street washing, etc.

The pilot plant consists three major units:

- UASB reactor with flow equalisation and influent pumping station;
- Demethanisation of UASB effluent and energy recovery;
- Deammonification pilot for simultaneous carbon and nitrogen removal;

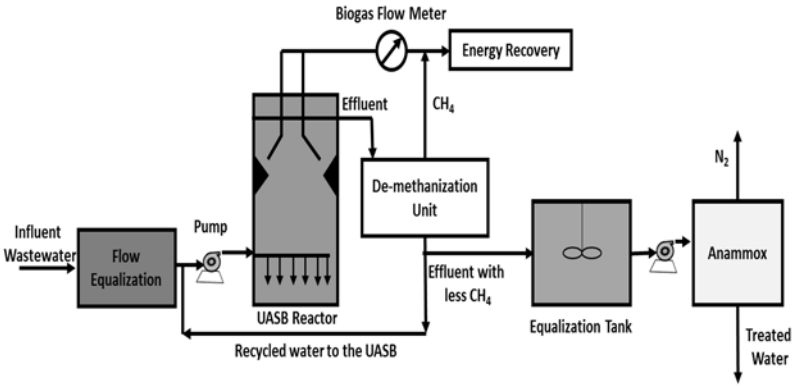


Figure 1: Overview and operation units of Pilot-1.

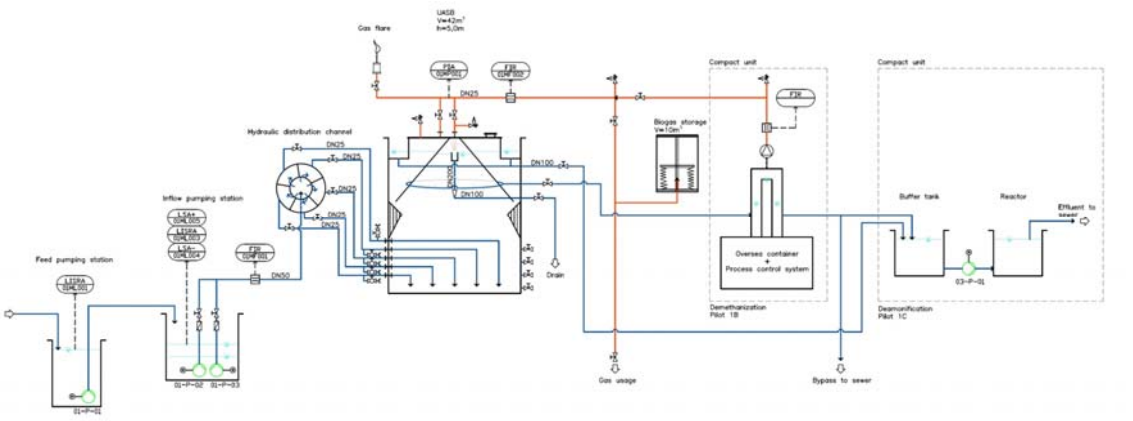
2. Changes in the technology compared to the DOA

The scope/design has not changed.

3. Detailed design and project report (Task A)

There are three major processes in this pilot: UASB, demethanization and deammonification. The design details for UASB and deamonification (ANAMMOX) unit were done by the Univesity of Tartu, which was further checked and modified as per the Indian context by IIT Bhubaneswar. Further, the initial design of the demethanisation unit was done by IIT Bhubaneswar in discussion with University of Tartu (UT). The tender documents for pilot 1 was prepared by IIT Bhubaneswar looking at the adaptability of technology in the Indian context and ready-to-construct drawings were prepared for the construction of the pilot.The detailed design of these components (Figure 2) are as follows:

- UASB and deammonification reactors are designed for the organic carbon strength of COD concentration of 300 mg/L to 600 mg/L.
- The pilot plant is designed for a partial flow of the IIT Bhubaneswar campus of capacity100 m3/d (each individual unit has a capacity of handling 100 m3/day of sewage)
- The designed volume of UASB reactor is 42 m^3 having 3.6 m diameter, 5.5m height and 8.4 m^2 base area.
- Deammonification Pilot consist of an equalisation tank with partial aeration (25 m^3) facility and deammonification tanks which is an MBBR based Anammox system (50 m^3).
- Max N loading rate at for deammonification is1 g N/(m^2*d).
- BOD loading rate: 4 g BOD/(m^2*d).
- Chosen biofilm carrier volume at 500 m^2/m^3: 16 m^3.
- Filling density of biofilm carriers: 30 %



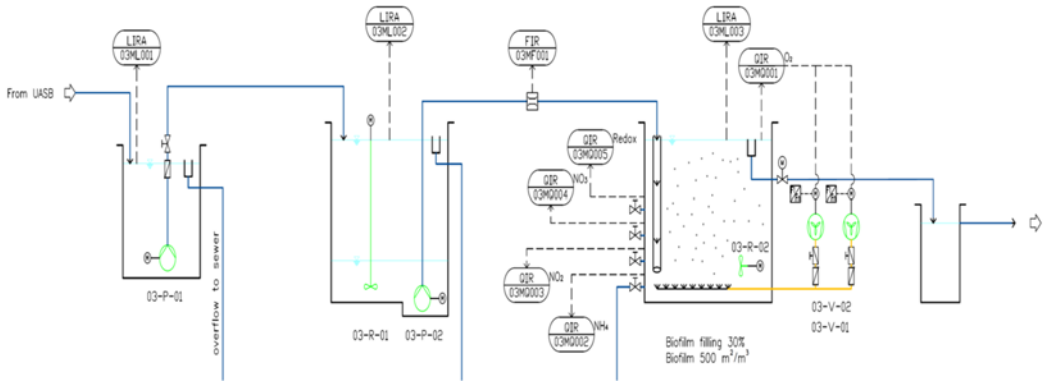


Figure 2: Line Diagram of Pilot

4. Detailed engineering design and construction (Task B)

The detailed engineering design and construction have been conducted by the contractor winning the tender procedure. Figure 2 shows pictures of the pilot plant construction stage.

Figure 3: Construction and installation of pilot plant

5. Commissioning and start of operation (Task C)

- In accordance with the input received from UT, to examine the growth characteristics and pattern of the anammox culture in Indian conditions, a culture system for anammox bacteria has been developed in Environmental Engineering Laboratory IIT Bhubaneswar.
- Experiments on UASB treating domestic wastewater were conducted at the Environmental Engineering Laboratory IIT Bhubaneswar. Pre-treatment prior to the nitritation-anammox stage has been done to remove COD, BOD, TSS. More than 70 % of COD removal was achieved in the UASB. Methane gas production analysis and methane removal technology from the effluent of UASB are under process.
- Anammox-MBBR is being studied on a lab scale to observe the nitrogen removal. The kaldnes k5 bio-carrier was used which enhances the process, which proliferates the anammox bacteria quickly. Nitrogen removal of more than 80 % was observed over 60 days of operation.
- Installation of all units (Equalisation cum screening Tank prior to UASB reactor, Demethanization Unit, Equalisation Tank with partial aeration before deammonification unit and MBBR based Anammox unit) have been constructed/fabricated and installed on the site inside IIT Bhubaneswar Campus. The construction of the pilot and its surrounding area development is completed and the newly laid sewerage system is connected to pilot for feeding wastewater.