Anaerobic Hybrid Reactor integrating a Real-time Monitoring and Control System

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Summary

- Introduction
- Anaerobic Hybrid reactor characteristics and structure
- Online real-time monitoring & control unit
- Conclusions

Anaerobic digestion – def.

process of multifunctional features

that holds the ability to contribute to its own sustainability

by providing

- energy production and organic effluents stabilization;
- capability to concentrate the substrate nutrients, providing a digested stream for agricultural application;
- converting the organic matter into compounds of commercial interest, as the bioactive compounds

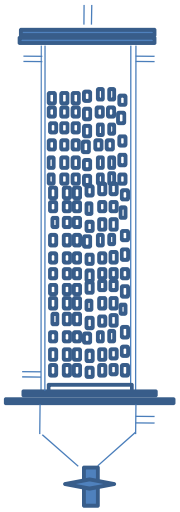
Anaerobic Hybrid Reactor integrating a Real-time Monitoring and Control System

• Anaerobic Hybrid reactor

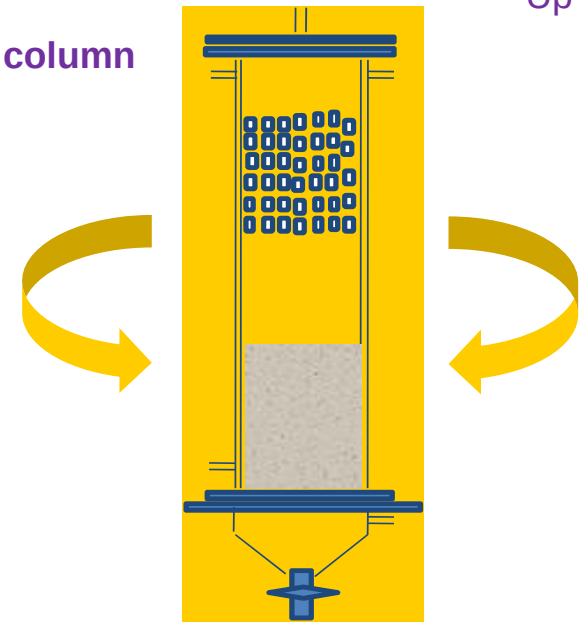
AF

Anaerobic filter

packed bed . filling . entire column



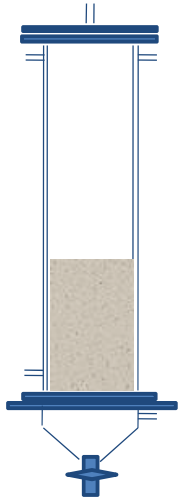
AH



UASB

Up flow anaerobic sludge blanket

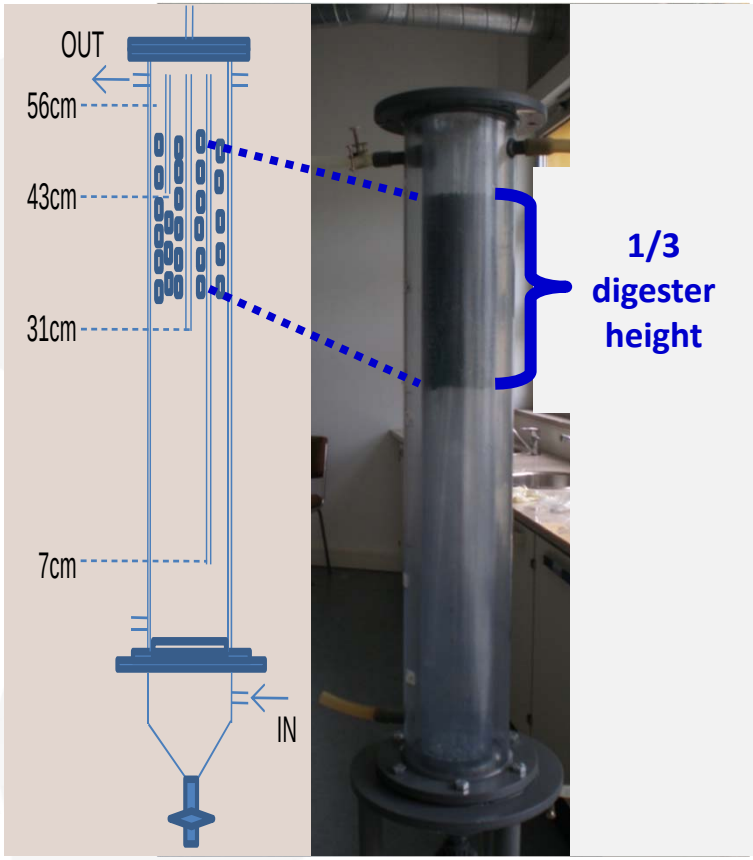
without packed bed



combines

suspended biomass principle of UASB, in the bottom part & fixed bed of AF in the upper section

Anaerobic Hybrid Reactor for liquid organic effluents: INETI/LNEG



- tubular shape
- worked in up-flow mode, 37 ± 1ºC

- packing material was designed in INETI/LNEG

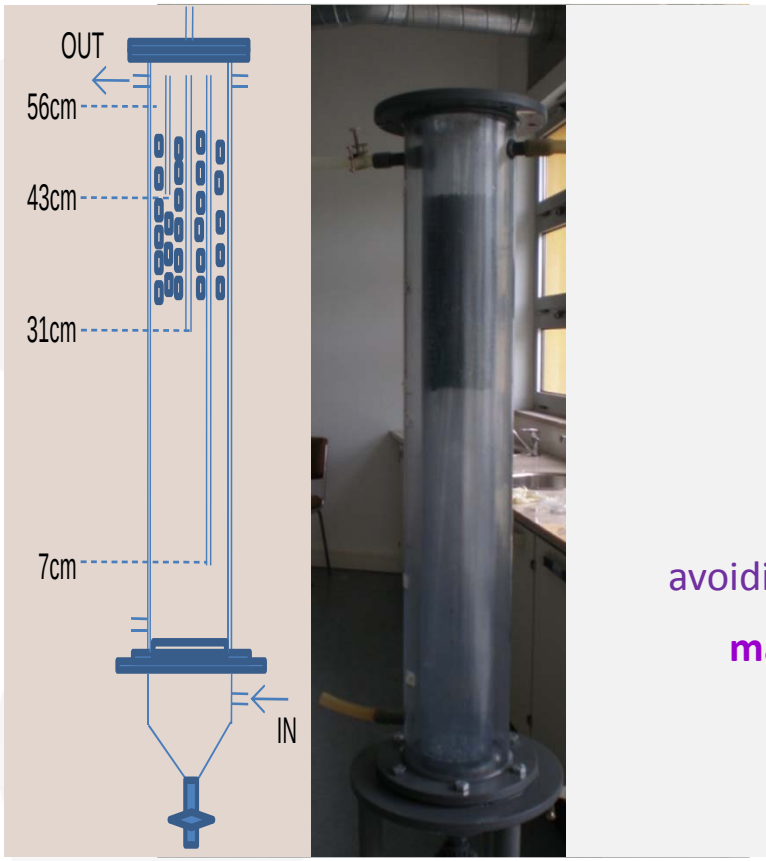
- *decrease plant cost:* packed bed was successfully reduced

- *important feature:* does not require a gas-liquid/solid separator inside the reactor

allowing

more flexible and cheaper

Anaerobic Hybrid Reactor for liquid organic effluents: INETI/LNEG



tested successfully at LNEG facilities

digesting recalcitrant and inhibitor/toxic substrates characterized by an

unbalanced/unfavorable composition

e.g. effluents from olive mills industry = OMW

AH characteristics + feeding approach strategy

avoiding effluents pretreatments = corrections/detoxification

maximize : organic matter conversion & energy recovery

obtain a low-cost treatment solution

Anaerobic digestion

complex combination of biochemical and physical/chemical dynamic process, involving clusters of microorganisms

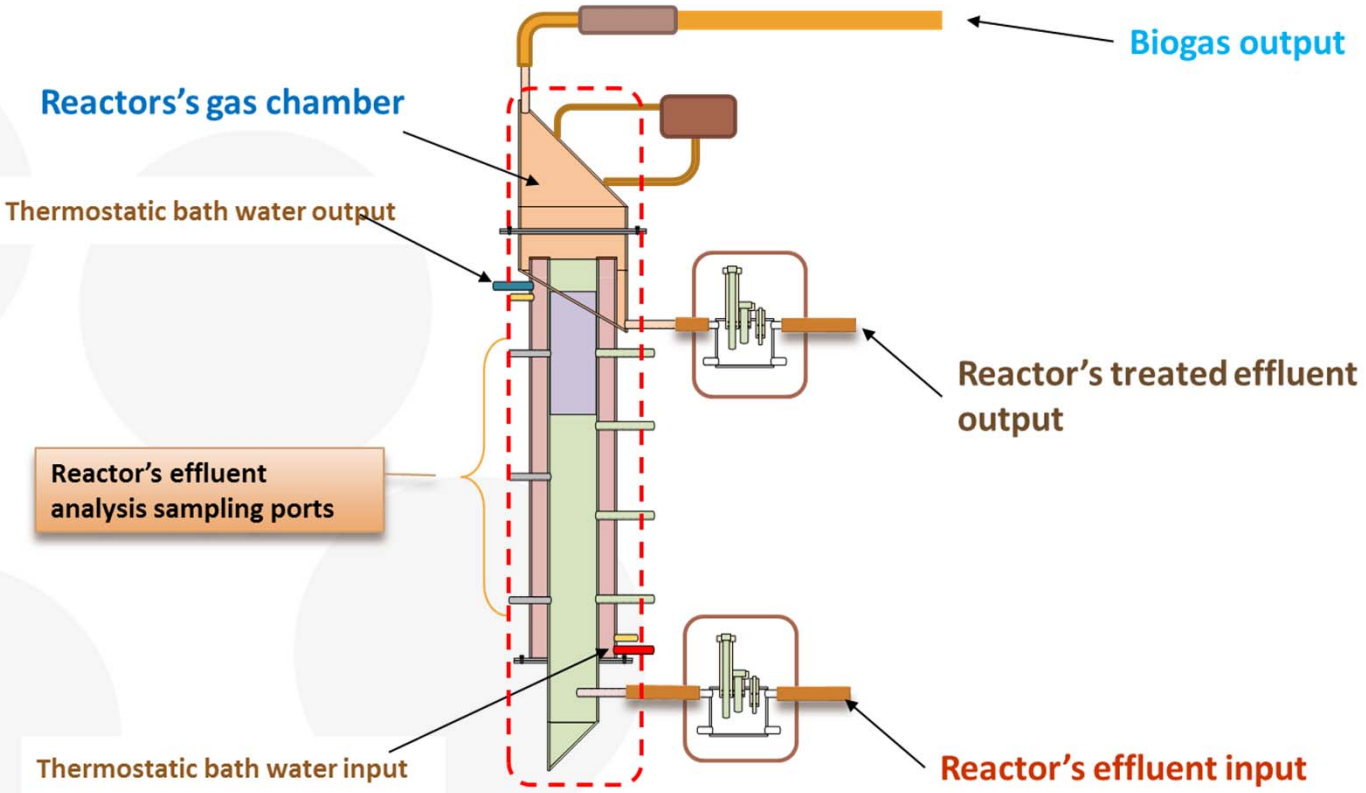
monitor the process
in order to streamline

A new lab-scale hybrid anaerobic reactor

is currently under development and test,
integrating an electronic custom modular monitoring system

- monitor and control the key process variables
- optimize the conversion process
- maximize the reactor throughput

liquid effluents: LNEG



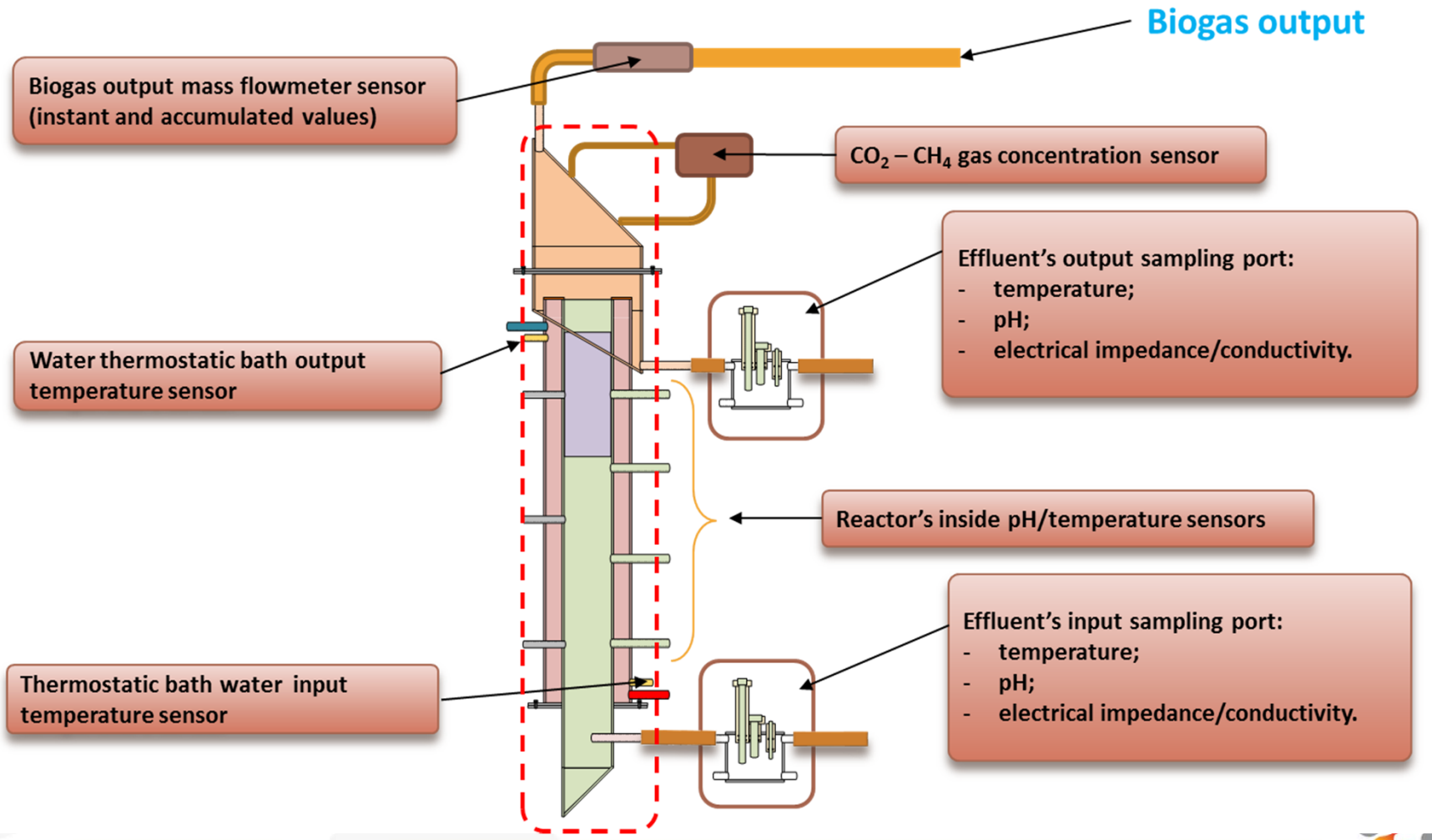
Monitoring of reactor digesting parameters

is of key importance to ensure the reactors successful operation

- **detects process imbalances in very early stages**
  - ✓ *taking adequate actions and alarms to prevent digester failures*
- **allows local automatic control of reactor process:** custom algorithms
  - ✓ *optimizes digestion performance and biogas output*

Online real-time monitoring
Anaerobic Hybrid reactor

process variables



Online real-time monitoring
Anaerobic Hybrid reactor

monitoring and control system

- **continuously acquires and processes data in real-time**

[characterizing the processes being held inside the reactor]

- **configurable, modular and expandable**

[allowing the integration of new electronic modules with different specifications/functionalities]

- **programmable and up-scalable**

[to be used with other similar reactor digesters of greater dimensions]

Anaerobic Hybrid Reactor integrating a Real-time Monitoring and Control System

Online real-time monitoring
Anaerobic Hybrid reactor

monitoring and control system

- **real-time data acquisition and logging**
  - ✓ *local* - using an USB direct connection with computer
  - ✓ *remote data monitoring and acquisition* - using Web based cloud storage services

- **information will be presented to the user by a graphical interface**
  - ✓ *allows a graphical display of the process status and evolution*
  - ✓ *easy management of anaerobic digester*

Anaerobic Hybrid Reactor integrating a Real-time Monitoring and Control System

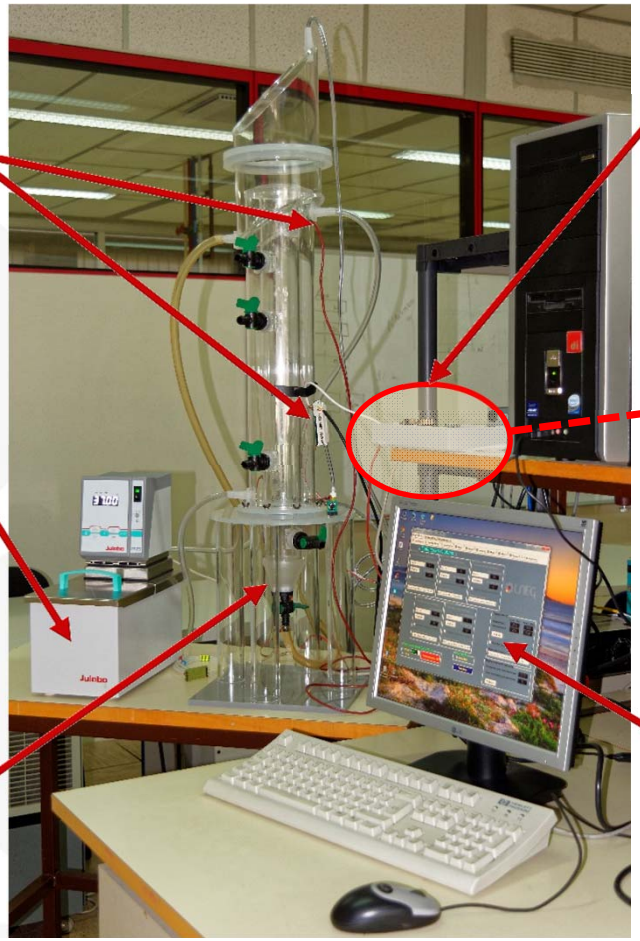
Online real-time monitoring
Anaerobic Hybrid reactor

development & test

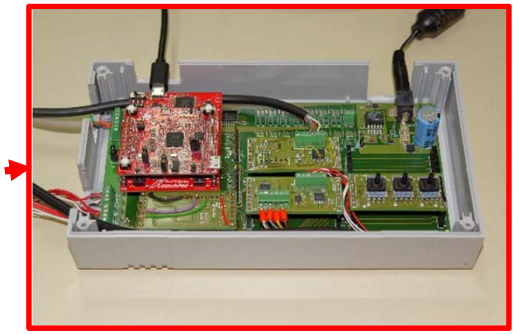
Anaerobic process data acquisition sensors

Thermostatic bath controller

Hybrid anaerobic reactor unit



Real-time monitoring and control unit



User Interface for system setting and data gathering

software, hardware and firmware
are being integrated and tested together

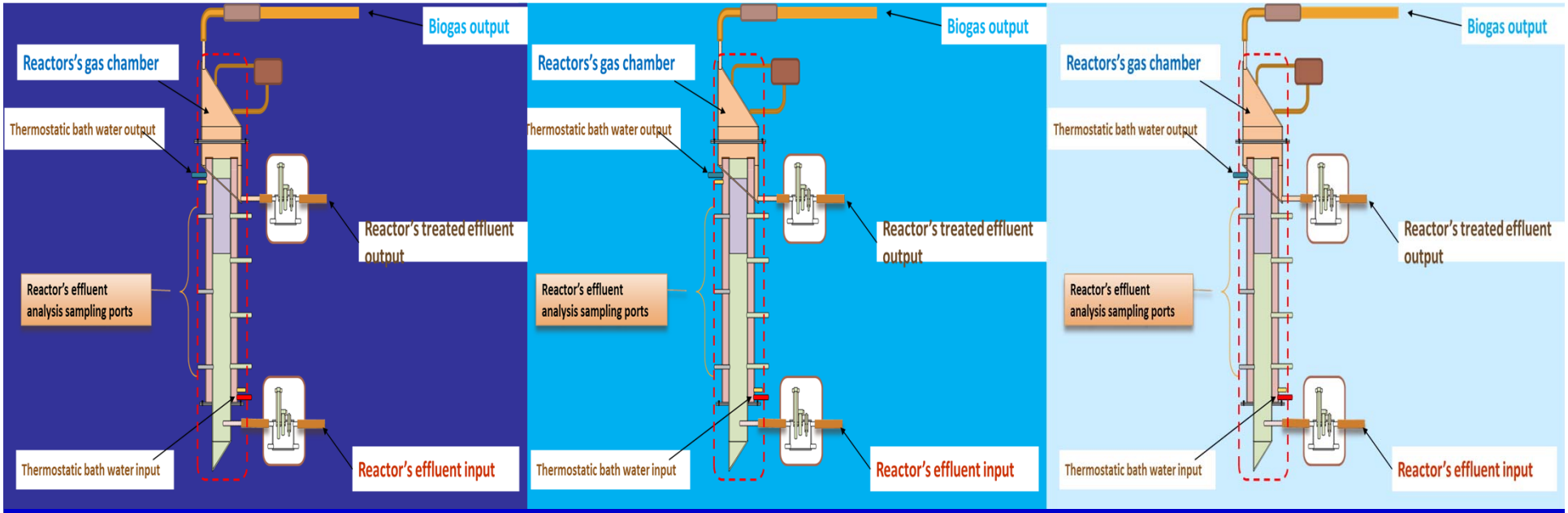
• Conclusions

✓ A lab-scale anaerobic hybrid fixed bed reactor for liquid effluents with an electronic custom online monitoring system

is being developed and assembled

✓ The inclusion of a real-time online monitoring and control unit allows the reactor to be easily managed, with remote monitoring of instant changes in some of the key process parameters

Anaerobic Hybrid Reactor integrating a Real-time Monitoring and Control System



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Thank you!

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