

Pilot plant used for scale up experiments of wastewater treatment into value added products

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Abstract

This plant is designed to meet the challenges of process development dedicated to the use of residues to produce high value added products. It is developed with flexibility in mind as to the choice of substrates (conventional residues, industrial wastewater and synthetic media), microbial strains (known, genetically modified or new) and according to appropriate fabrication protocols. Its strategic orientations lie within the scope of the training of highly trained researchers and new initiatives of industrial research for sustainable development. This new facility is equipped with high tech instruments divided into two distinct fermentation lines. All equipments are food grade or better which enables us to work with many different types of substrates and for various purposes. Research carried out by our team includes biofertilizers, bioinsecticides, bioplastics, biodiesel and enzymes. Several pretreatments, formulation and purification steps can be carried out at the plant itself (Continuous centrifuge, spray dryer, freeze dryer, mixing tanks, ultrafiltration system, reverse osmosis, chromatography system, flow cytometer and hydrolyser). It also offers support from highly trained researchers for optimization of the process. The scale up can reach up to 1 500 L which can be centrifuged on site by a pharmaceutical grade continuous centrifuge. This article describes in details the equipment and services that are available at this pilot plant.



Tanks

Two 2 000 L tanks are connected to a chiller that can maintain the fermented broth at 4°C for temporary storage. Three 500 L mobile tanks are on wheels to simplify transfer from one place to another. Two tanks (1500 and 500 L) are used to store the fermented broth before centrifugation and cream (or supernatant) after centrifugation, respectively. One 2 000 L tank is used to decontaminate any waste material that has to be discharged.

All the stainless steel tanks are controlled through the PLC and SCADA. They are sterilizable and cleanable in place and fitted with temperature probes. All fermentors and tanks have a double jacket which enables temperature control.

Post treatment

The most sophisticated equipment presented is a pharmaceutical grade continuous centrifuge which can process up to 300 L per hour. The rotor can turn at 15 000 rpm and is sterilizable and cleanable in place.

A glass spray dryer that can dry up to 3 L of product per hour is on site along with a freeze dryer of 50L capacity for products that are sensitive to heat. For purification of the product, pilot scale ultrafiltration (150 L/m), reverse osmosis (12 L/m) and chromatography systems are available.



Pretreatment

Hydrolysis can be carried out in two different state of the art stainless steel hydrolyzers of 200L and 2 000L.

Fermenters

Four 5 L glass fermentors are available for small scale research and development. Four 15 L and four 150 L stainless steel fermentors can serve either for scale up or for process optimization. Two 2 000 L stainless steel fermentors are the largest scale available.

They are also connected to gas analyzers that can measure CO₂, O₂ and CH₄. The fermentors are sterilizable and cleanable in place and are fitted with pH, dissolved oxygen, foam and temperature probes.



Research support equipment

An inverted phase microscope can be used to evaluate microbial development. A flow cytometer can complete processes that require high efficiency quality control. The basic equipment for genetic identification is also at hand.

Integrated process development and fundraising

The laboratory's mission is the development of bioprocesses and of high value added products accompanied by training of researchers and professionals in the food industry and in environmental biotechnologies. Process optimization and scaling up are the two main work fields that we specialize in. Our team can also collaborate to search for funds for new projects.

