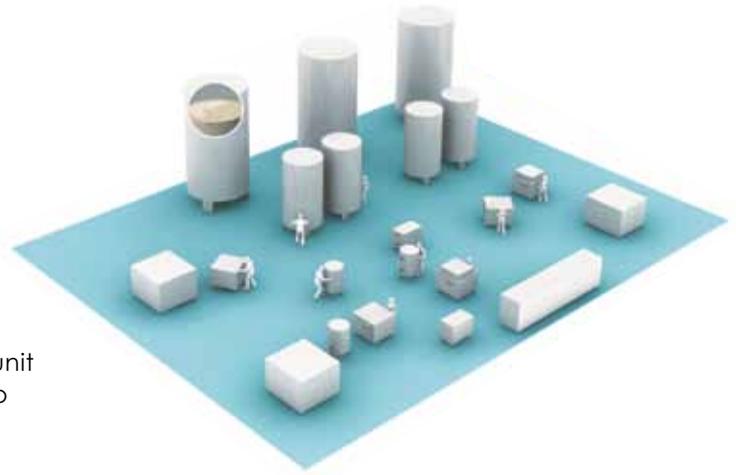


## BIOPROCESS MODULE 3

# Downstream Processing

In this module products are extracted, purified and isolated from the (fermentation) process stream. The unit operations can be combined at the client's request to obtain the desired product.



### Downstream Processing

In the Downstream Processing (DSP) pilot plant products can be extracted and refined. The BPF can handle biofuels and (bio)chemicals. In addition, we are also experienced in handling products from the food and pharmaceutical industry.

Our technical range includes (membrane) filtration, centrifugation, homogenization, (bio)chemical conversions, chromatography, crystallization, electrodialysis, extraction, evaporation, formulation and various drying methods. At the BPF, numerous vessels (ranging from 60 l to 4 m<sup>3</sup>, with different material properties and capabilities) are available for a variety of process steps. The DSP module is located in an ATEX environment, allowing the use of flammable solvents.

### Cell Disruption

Cell disruption is a method or process for releasing biological molecules from inside a cell. The BPF has a pressure homogenizer with a maximum working pressure up to 700 bar.

### Solid-Liquid Separation

Biomass or other solids can be removed from the liquid stream, with a variety of unit operations available, such as several filter presses, centrifuges and membrane filtration.

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# Downstream Processing



## Bioconversions

There are several vessels available for (bio) chemical conversions, ranging from 60 l to 4 m<sup>3</sup>. The vessels have different stirrer-types (rusthon, anchor, angled blade stirrer) enabling (enzymatic) catalysis at both high viscous and reduced viscous conditions. In addition, vessels are available with sieve bottom vessels for enzymatic conversions with enzymes immobilized on carriers.

## Purification

A large variety of purification methods is available, including extraction, membrane filtration and several columns (ranging from 5 l to 170 l) for chromatography.

## Electrodialysis

The BPF is able to perform electrochemical separation processes. This technique can be used as purification method or, when using bipolar membranes, to adjust the pH of a solution without addition of bases or acids.

## Concentration

Several evaporation unit operations are available for concentration such as circulation (glass) evaporators (1 to 80 l concentrate), falling film evaporator (capacity 250 l/h water evaporation) and multiple batch evaporator chemical vessels.



# Downstream Processing



## Crystallization and Chemical Conversions

There are several glass-lined vessels available for (bio)chemical conversions and crystallisation, ranging from 300 l to 600 l. The vessels are equipped with a jacket for cooling and heating (-30°C to 160°C), pH-control and vacuum distillation units.

## Distillation

The bench scale distiller\* can operate under vacuum as well as under atmospheric conditions.

## Drying

The BPF has a large variety of dryers, including a boltz dryer, spray dryer, fluid-bed dryer, double cone dryer, ventilation and vacuum plate dryers.

## Formulation

The BPF has several unit operations for final formulations, including mixing, sieving and milling equipment.

## External equipment

For the execution of a specific project, it might be required that the client wants to test his own equipment or that equipment needs to be externally rented. In addition, it may occur that the available equipment needs some modification. According to the wishes of the client, the above activities can be performed.



\* Available in 2014

# Downstream Processing



### Supporting Equipment and Utilities

Several mobile vessels, pumps, and other auxiliary equipment are available. There is sufficient cooling and freezing storage capacity and the BPF can store flammable liquids.

Process water, demi water, steam (up to 4 bar), nitrogen, 4 bar air and cleaning agents are standard utilities. Finally, the Biotech Campus Delft site has a waste water treatment plant.

### ATEX

The designated ATEX zones (T3) allow the use of flammable materials such as solvents throughout the downstream processing plant.

### Analysis

Standard analytical equipment (including HPLC) is available at BPF for in-process analysis. In addition, a large variety of analytical methods (eg GC, MS, NMR, Malvern) can be arranged for.

### Safety, Health and Environment

The scaling up of laboratory experiments often comes with safety issues, like handling larger amounts of raw materials, dealing with permits of the micro-organism, handling large amounts of flammable and/or toxic chemicals, transport and/or storage of broth or end products, and, finally, disposing of waste materials. Therefore, every new experiment is preceded by a safety study.

### For more information:

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