

Consulting Services and Tools for Bioprocess Optimization



Services for Bioprocess Technology

Main Focus:

- ✓ Cost-effective consulting and solutions to special processing problems, such as mass transfer, foam formation, product quality, nutrient formulation, ...
- ✓ Contract research & process development and optimization for biocommodity production plants and several unit operations
- ✓ Feasibility studies and advice for investments in equipments, units and plants
- ✓ Simulations for process optimization based on mathematical models



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Examples

Solutions to foam problems in biocommodity and pharmaceutical production

Foam is produced in many biological processes; in most cases, however, this is not desired. A strong foam production causes the blocking of exhaust gas or vent filters. Furthermore it produces flotation effects and physiological changes of the fermentation process. Large amounts of foam formation also lead to product losses in downstream processing and packing. Therefore, an efficient foam management is highly important. FRINGS offers a wide range of services to help you solve your foam problems.



Nutrient formulation

Improved nutrient compositions, especially for traditional fermentation processes, provide the potential to enhance the production process and the product quality. Frings has been developing microbial nutrients for several decades. Every year hundreds of tons of nutrient compositions are delivered to our customers worldwide. This enables us to create customized recipes for your production.



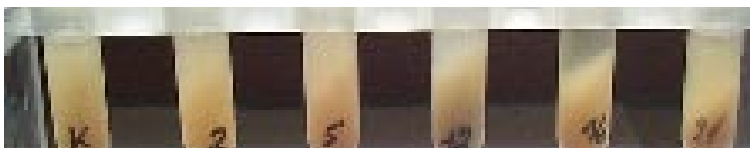
Process control optimization for recombinant yeasts

Many fed-batch processes for the fermentation of recombinant yeasts still use the oxygen spike method for the control of substrates. This method is easy to use, but does not take into account the optimum metabolic states of the organisms. Our reference list includes a number of different projects for the implementation of optimized methanol and RQ controlled feeding strategies with online alcohol and exhaust gas measurement in *Pichia pastoris* and *Saccharomyces spec.* fermentations.



Optimization of raw materials and enzyme cocktails for complex fermentation media

The increasing prices of raw materials for industrial biocommodity production forces biocommodity producers to seek alternative sources. Frings provides methods to optimize the treatment of low-quality molasses by using starch-based carbon sources with innovative liquefaction and saccharification technologies and new enzymes. The use of bulk waste materials could be another alternative.



Improvement of oxygen transfer rate

Enhanced mass transfer and reduced energy consumption in aerobic fermentation are key factors for cost reduction in a biotech plant. We offer services and equipment, including feasibility studies, lab scale trials and all scale-up activities. Increased oxygen transfer rates can be achieved by improving the existing stirring devices or by installing highly efficient aeration systems.



Process analysis and on-site consulting

Our vast experience in the field of bioprocess optimization enables us to provide on-site consulting to our customers. Do you need advice on how to solve foam or mixing problems in a pharmaceutical plant? Do you require information regarding the process chain in a yeast plant? Frings is your reliable and competent partner. We offer a variety of measuring equipments, test reactors and specifically designed devices to be installed at the customer's facilities for integrated process optimization on site.

Laboratory processes and optimization

Our laboratory and pilot plant is equipped with sterile PROREACT bioreactors ranging from 10 L – 1,500 L (including peripheral systems).

20 fully automated, auto-sterile fermentation systems (ACETATOR type) provide capacities from 8 L – 2,000 L.

For the measurement of hydrodynamics and mass transfer tanks up to 50,000 L are used.

Frings has developed standard protocols for several fermentation systems, such as *Saccharomyces spec.*, *Kluyveromyces spec.*, *Ralstonia spec.*, *Gluconobacter spec.*, and many more. Test fermentations with recombinant *E.coli*, *Pichia pastoris* or other expression systems are run and can be performed by our transportable PRO-REACT bioreactors.

Calculations, balancing and feasibility studies

To determine the actual status of a process and to calculate the performance of different process strategies and alternative installations, a number of numerical tools and expert knowledge are used.

Innovative dynamic modeling with MATLAB or MODELMAKER allows for computer-aided process simulation. For the optimization of hydrodynamics a number of computer programs based on dimension analysis and CFD are available.

Apart from classical feasibility studies, our range of services includes the basic and detail engineering and many other services.