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# Waste to Value – technology to transform waste streams into valuable products

## Production of valuable bio-products from waste streams with organic content

Waste streams from industrial processes are often rich in organic carbon – e.g. from chemical, pharmaceutical, paper, pulp and food industry or from processing of biofuels. Their disposal or recycling can be both complex and expensive.

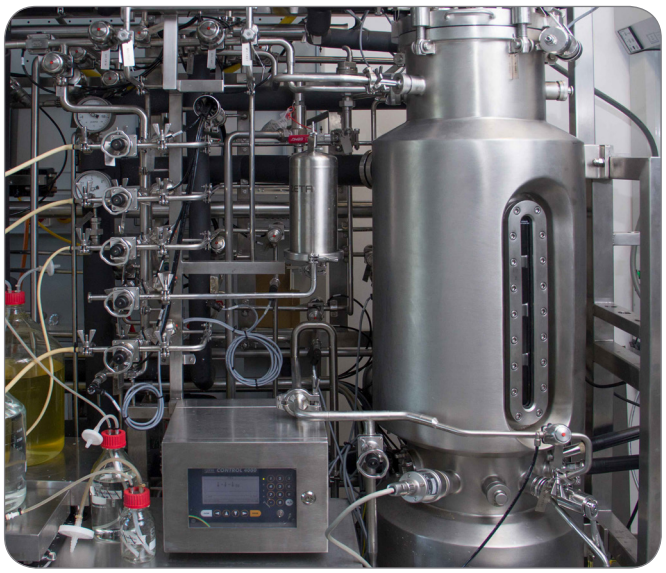
### Objectives and mission

The mission of the research team Bioprocess Technology at TU Wien, headed by Prof. Christoph Herwig, is the concept of the Bio-Refinery. This means on one hand process intensification by coupling of different processes and on the other hand transformation of waste streams to valuable substances ("Waste to Value principle").

With our innovative technology the profitability of these production processes can be improved. Microorganisms are able to form valuable products by using the organic carbon compounds from the waste water, such as organic acids, sugars and aromatic compounds.
As a result, total organic carbon content (TOC), which is an indicator of wastewater pollution, is reduced significantly.

### Approach

Halophilic microorganisms offer a number of advantages compared strains that are used in biotechnology conventionally. They are capable of growing on extreme saline medium. Those extreme environments limit the competition of other microorganisms and make it possible to work under non-sterile conditions. As a result, the processes are simpler and considerably less expensive, which is especially relevant for industrial uses. Additionally halophilic microorganisms are able to live on a wide variety of carbon sources, organic acids, diverse sugars and the sugar alcohol glycerol. Further they are incredibly resistant to organic substances which are inhabitants for most of the conventional microorganisms.



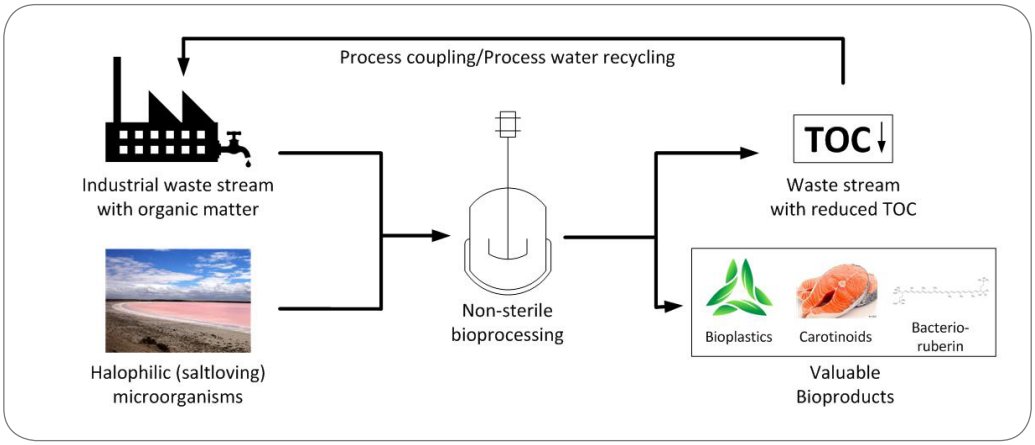
Bioreactor of industrial scale (60 liters)

Halophilic microorganisms produce secondary metabolites that are rare, valuable and interesting for the pharmaceutical and food industry. They also can be used for production of biopolymers and genetically modified products. One of the advantages of working with extreme halophilic organisms is that it allows easy down-streaming as disruption of cells occurs automatically in water due to osmotic shock.

Quantitative bioprocess development was performed on defined synthetic medium. In this way different waste streams with differing chemical compositions could be modeled. Kinetics, stoichiometry as well as maximum productivity were determined with special attention to the critical parameters that are affecting scale-up. As medium for halophilic organisms contains high amounts of salt the cells need to be processed in a corrosion resistant bioreactor.

## Experience

Quantitative data on stoichiometry and growth kinetics have been evaluated for various carbon sources. For this study carbon sources were chosen that are common in industrial waste streams.




Conversion of >95% organic content of waste streams into valuable products, like carotenoids or biopolymers

Extreme halophiles are known to produce a variety of valuable lipophilic compounds with many potential applications from food coloring agents to anticancer agents. Bacterioruberin is one of the most interesting examples in this group.

The bioplastic poly-hydroxybutyrate (PHB) is a polymer synthesized intracellularly in extreme halophiles and stored there as carbon and energy reservoir. Interest in PHB is rising as it is a biodegradable thermo-polyester with properties similar to those of pertrochemically derived plastics.

High biological activity and volumetric productivity are considered as prerequisites for efficient bioprocesses, extreme halophiles, however, have low growth rates. To overcome this physical limit and to achieve increased volumetric productivity, the produced biomass must be retained in a bioreactor. Our department has long term experience in bioreactor setups with cell retention focusing on maximizing the volumetric productivity; 10-fold productivity has been achieved compared to continuous cultures.

## Results

Exploiting the benefits of controlled bio processing of halophiles we can transform industrial waste streams that contain organic compounds into a stream of valuable products for food, cosmetic and chemical industry ("waste to value" - technology).

This newly developed process can be carried out under non-sterile conditions and is therefore realizable for industrial scale.

Our innovative halophilic bioprocessing can be applied for a wide range of processes with the goal to improve their profitability.

## Benefits for you

- Suitable for any waste streams with organic residues
- Extremophiles convert over 95 % of organic carbon to valuable products
- Suitable for industrial waste waters with extreme conditions: pH 5 to 11 and salt concentrations up to 25 % NaCl
- Better cost efficiency by closing the material cycles and coupling of industrial processes
- Easy extraction of products by osmotic shock
- Continuous and robust bioprocesses without insterility problems due to the use of extreme halophilic micro-organisms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