

RESTRUCTURIZATION OF RENEWABLE ENERGY SOURCES FOR MORE EFFICIENT BIOFUEL PRODUCTIONS WITH EXTREMOPHILIC MICROORGANISMS

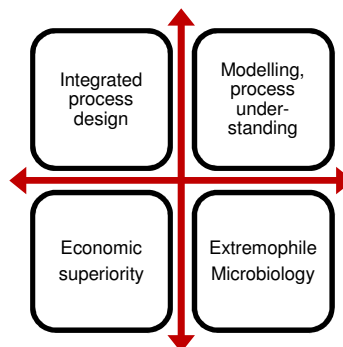
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Our Mission

We make contribution to new biofuel generations: biological methanogenesis and biohydrogen production with special attentions to bioprocess sustainability:

- Design of integrated biological systems
- Achievement of process intensification by waste streams coupling
- "Waste to value" principles: biomaterials production on waste streams
- Maintaining CO₂ neutrality

Interdisciplinary approach



I. Biological methanogenesis

Background

Biological methanogenesis is a promising technology for the production of biomethane and for renewable electricity storage, a "Power to gas" solution.

Technology

- Anaerobic fermentations
- Liquid or gas limited culture conditions
- Intermittent production profiles for a "Power to gas" approach

Advantages

- Very fast kinetic
- Fast responding physiology
- High selectivity and conversion towards the main product
- Low contamination risks
- Extremely stable and reproducible bioprocesses

Potential applications

Biological methanogenesis is one of the most promising technologies for the production of biomethane in the field of renewable electricity storage. Peak of irregularly generated electric energy needs to be

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efficiently stored. For this purpose the utilization of hydrogenotrophic methanogens seems to be a very promising candidate for the development of biological gas conversion processes.

II. Biohydrogen production

Background

Nowadays, biohydrogen is considered the ideal alternative energy source. It can be combusted with water as the only oxidative emission or integrated into coupled bioprocesses systems. Biohydrogen production via dark fermentation with hyperthermophilic strains has reported not only high hydrogen to substrate yields, but also high hydrogen to carbon dioxide yields. This last key physiological parameter plays one of the main important roles considering future bioprocess integrated systems under carbon dioxide neutrality.

Technology / Methodology

- Dark fermentative biohydrogen production.
- Medium optimization for biomass and biohydrogen productivity increases.

Advantages

- No contamination at high working temperatures.
- Use of pentoses (xylose) as substrate, considered otherwise as waste.
- Further use of organic acids and alcohols, by-products of the fermentation, for energy substrate recovery.

Potential applications

- Two-stage biohydrogen production process. Coupling with photofermentation systems.
- Two-stage system for biohydrogen and biomethane production.
- Integrated biohydrogen and bioethanol production system for biomethane production under carbon dioxide neutrality.

III. Biological conversion of waste streams to high value added products

Background

Extreme halophilic microorganisms can grow in conditions with up to saturated NaCl concentrations and therefore have numerous special features. The pink-red halophilic microorganisms are potential sources of carotenoids that are natural antioxidants and also used as food colorants. Halophiles are able to consume a wide variety of organic material; sugars, alcohols, etc. Biological reduction of TOC (total organic carbon) in waste streams with NaCl is a novel industrially applicable biological alternative, a "Waste to value" solution.

Technology

- Recycling waste streams, e.g. from biohydrogen production with NaCl by halophiles
- Bioprocess with extreme halophiles in a corrosion resistant bioreactor
- Production of valuable biomaterials

Advantages

- Process intensification by coupling process streams
- "Waste to value"
- Cost-effective nonsterile bioprocess
- Sustainable waste water treatment alternative

Potential applications

The technology is suitable for saline and non-saline industrial waste streams with organic carbon content, additional NaCl can be required. For instance, the halophilic bioprocess can be coupled with diverse fermentation broths rich in small metabolites.