Cost Efficient Production of Biodegradable Polyhydroxyalkanoate (PHA) Biopolymers

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Abstract

Cost efficiency in biopolymer production is mainly determined by the price for required raw materials; they contribute with up to 50% to the entire process expenses. Several studies underline that PHA production from pure substrates can be considered as optimized to a high extent. Thus the enhancement of economics of biopolymer production has to be forcefully aspired. Viable strategies to reach this goal are identified in substituting pure substrates by cheaper carbon substrates or by integrating PHA production into energetically autarkic production lines of the carbon source. The research of the authors of this study that is carried out in narrow cooperation with industrial partners provides novel strategies for the enhancement of cost-efficient PHA production.

Industrial plant for PHA production
(here: PHBISA, Brazil)

Scale up

Downstream Processing & Refining

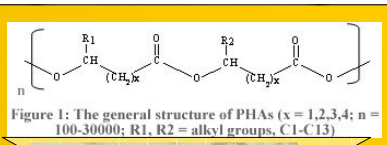
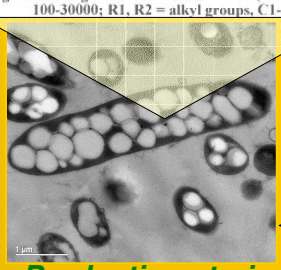


Figure 1: The general structure of PHAs (x = 1,2,3,4; n = 100-30000; R1, R2 = alkyl groups, C1-C13)



Production strain

Scale up

Scale up

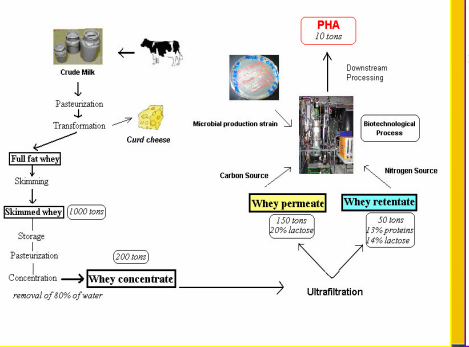
Research on laboratory scale

Cost-Efficient Carbon Source

Vendible, compostable biopolastic items
(Seebach, ETH Zürich)

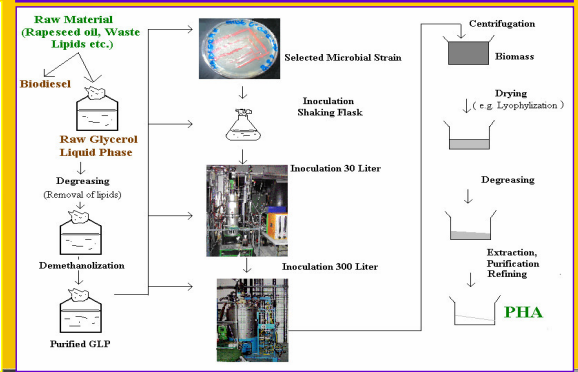
Whey Lactose

from Dairy Industry



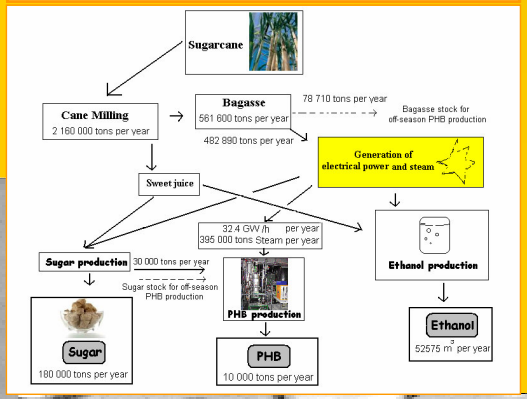
Glycerol Liquid Phase

from Biodiesel Production



Cane Sugar –

Integrated process of Saccharose, Bioethanol and PHA Production in Brazil



Conclusion:

The presented examples demonstrate that a variety of surplus materials are available from agro-industry which are of special interest for PHA-biopolyester production. Exemplarily, surplus whey lactose from dairy industry and raw glycerol liquid phase from biodiesel production are discussed as carbon source for industrial production of bio-inspired plastic materials. The application of waste- and surplus materials unites the enhancement of cost efficiency in PHA production and the decrease of the amounts of pollutants.

Independent from the raw material, an industrial plant for PHA production from waste- and surplus materials should be integrated into existing process lines, were the raw materials directly accrue. The selection of the appropriate raw material for PHA production mainly depends on the location of the production (whey or GLP in Europe, cane sugar in Brazil).

In future, the economic improvement of the entire process chain encompassing the upstream processing of the raw material, the fermentation strategy for the biotechnological PHA production, sustainable energy supply and the downstream processing has to be forcefully aspired for make the decisive step forward to cost efficient production of "green plastics".

References

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