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DOWN-STREAM PROCESSING IN BIOBUTANOL PRODUCTION WITH RESPECT TO ITS PROPERTIES AS A COMPONENT OF MOTOR FUELS.

Karel Melzoch[1], Petra Pataková[1], Petr Fribert[1], Mojmír Rychtera[1], Milan Pospíšil[2] and Gustav Šebor[2]

Institute of Chemical Technology Prague, [1]Department of Fermentation Chemistry and Bioengineering, [2]Department of Petroleum Technology and Alternative Fuels, Technicka 5, 166 28 Prague 6, Czech Republic, fax: +420 220 445 051, karel.melzoch@vscht.cz

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Introduction. Butanol is a fermentation product of anaerobic bacteria, esp. from genus *Clostridium*. Butanol proved to be an excellent basis for synthesizing butyl acetate used in printing ink, in leather and coatings manufacturing, and as synthetic fruit flavoring in foods. And fermentation became the method of choice for its production. Until the seventies of the last century, 66% of the butanol used worldwide was produced biotechnologically. A new, but very important application came up recently. Bio-based butanol is expected to play a major role in the next generation of biofuels. It can be produced fermentatively from renewable resources and, thusly, lowers greenhouse gas emissions and dependence on crude oil. The energy content of butanol is much higher than that of ethanol, so fuel consumption is similar to that of pure gasoline, whereas in the case of ethanol blends, consumption goes up. Butanol usage does not require modifications to car engines. For example, two major global players, BP and DuPont, also announced the start of fermentative butanol production for use as a biofuel in 2007 [1].

Three major factors determine the economic competitiveness of the biotechnological butanol production: substrate cost, low product yields versus solvent/butanol toxicity, cost for downstream processing. At the present butanol has also been produced from low cost substrates and waste products. Final solvent concentration at the end of the fermentation is usually approximately 2%. Molecular biology has allowed a detailed understanding of genes and enzymes, required for solventogenesis. Thus, construction of strains with improved fermentation ability is now possible. Tailor-made strain construction is also currently used to improve solvent/butanol tolerance and product yields. Advances in continuous culture technology and improved downstream processing also add to economic advantages of a new generation biotechnological process [2].

Methods. The distillation was traditional technique used for product recovery. Since butanol has a higher boiling point than water, this procedure uses up a lot of energy and is therefore very cost-intensive, especially at low butanol concentrations. Other means of recovery are adsorption, gas stripping, liquid–liquid extraction, and membrane-based processes such as perstraction, pervaporation, and reverse osmosis. Our work was focused to liquid extraction by gasoline and gas stripping with nitrogen and fermentative gas. Substrates and products were determined by GC and HPLC methods.

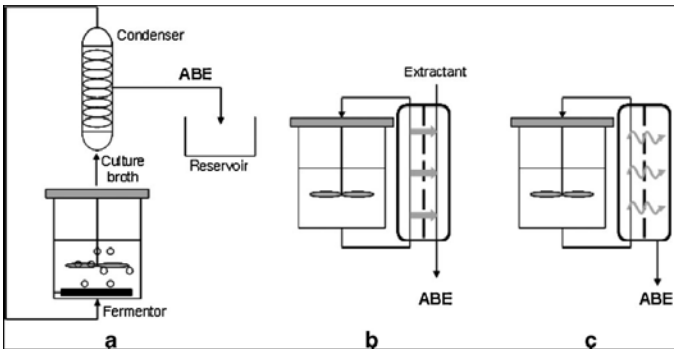

Fig. 1 Integrated systems for fermentation and in situ solvent recovery: fermentation coupled with (a) gas stripping, (b) liquid–liquid extraction (perstraction), (c) pervaporation [3].

Results and discussion. We investigated the efficiency of two systems (extraction by gasoline and gas stripping) for butanol recovery in the presence of the other solvents like acetone, and ethanol. We received data from as model mixture so real fermentation media. Gas stripping was used as an integrated system directly connected with the bioreactor and 3-times higher butanol amount can be achieved during the fermentation.

Conclusions. These studies are beneficial in commercialization of butanol production by fermentation and recovery by gas stripping and have a positive impact on the economics of biobutanol production.

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References.

1. Durre P. (2008). Fermentative Butanol Production. *Ann.N.Y. Acad.Sci*. 1125: 353 - 362.
2. Ezeji T.C. et al. (2005). Improving performance of a gas stripping-based recovery system to remove butanol from *Clostridium beijerinckii* fermentation *Bioprocess Biosyst Eng* 27: 207–214.
3. Lee, S.Y. et al. (2008). Fermentative Butanol Production by Clostridia. *Biotechnol.Bioeng.*101(2): 209 – 228.