CHEMICAL AND BIOCHEMICAL TRANSFORMATIONS OF GLYCEROL FROM RENEWABLE SOURCES TO FINE CHEMICALS AND FUEL COMPONENTS WITHOUT SULFUR

see: *www.chtf.stuba.sk/kot/apvv/vyznam.html*

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Research and development of new catalytic and biochemical methods of production of chemical specialties and fuel components without sulfur, which enhance the appreciation of glycerol from renewable bio-sustainable sources. Mainly catalytic and biochemical transformation of glycerol to 1,3-propandiol, glycerol carbonat, glycidol, oxidation and splitting products of glycerol, copolymers by urea, polyglycerols, development of refining technology of raw glycerol

In the Europe in the near future we can expect outstanding increase in the production of biodiesel and glycerol from renewable sources in connection with implementation of European parliament directive n. 2003/30/ES. Glycerol is an unavoidable byproduct of biodiesel production in the amount of 10 wt.%. The world production of glycerol is on the level of 800 000 t/y (2003), from which now about 25 % is a byproduct of biodiesel production. If the mentioned European parliament directive will be fulfilled, the European glycerol production will increase by further hundred thousand tons/year. The expected overproduction can evoke further decrease of glycerol price, which will open possibility of considerably wider use of glycerol in fields, where till now was not used.

The aim of this project is to examine technological processes of valuation of glycerol phase (formed in the process of trans-esterification of fatty acids), which application can become to be economically prospective and effective.

The first part of the project is focused on the crude glycerol(G) splitting by mineral acid from the point of view of reaction, processing, economy and environment. The refining method – vacuum distillation in the film evaporator, adsorption on ion exchangers and other methods – needs optimum pretreatment of crude material. The study of possibilities of salt removing from crude G (precipitation, water removal, separation, centrifugation, filtration) should be done with the aim of maximum effectiveness of the refining method. In the case of non-distilling refining also the G bleaching should be studied. At the low price of G also the energetic utilization of G is interesting after thermal or catalyst conversion of G to the fuel or its component to diesel in the form of alkyl esters, acetals, ketals, carbonates for lowering of harmful emissions in exhaust gases. The target of the study is the commercialization of biodiesel production by conversion of by-product G to the components of motor fuels for modern engines.

From the products of chemical and biochemical transformation of glycerol is remarkable especially 1,3-propandiol. Its production from other raw materials is expensive. 1,3-propandiol can have wide use, but especially its use in the polyesters instead of or together with 1,2-propandiol or 1,4-propandiol can lend more beneficial properties to fibers and plastic films, particularly in elasticity and durability. The production of 1,3-propandiol from cheaper glycerol can be economically profitable by catalytic or biotechnological processes using non-pathogenic microorganisms. The object of this part of proposed project is the research

of possible using of bacterial strains of Acetobacter genus and relative bacteria in preference. Biological transformations of glycerol phase in aerobic conditions will be concentrated on the basic research in a laboratory scale, with the selection of suitable bacterial strains. The next steps are characterized with the aim to examine the process of bio-transformation and subsequently to optimize the fermentation process in laboratory and pilot scale.

The goal of biochemical way is to develop the process of 1,3-propandiol production by fermentation from raw glycerol, to identify microbial strains for production of 1,3-propandiol and to optimize fermentation. At the same time the possibility of preparation of other bio-chemicals from glycerol, usable by chemical industry will be tested.

The goal of project in the field of catalytic process is to specify the catalyst (from the group of rare metals) and reaction conditions (temperature, pressure, reactor) for selective transformation of glycerol to propandiol and other products. To substantial products of glycerol belong glycerol carbonate, glycidol, copolymers and the products of esterification, oxidation and oligomerisation. Glycerol carbonate is important as a polar nontoxic low volatile solvent or raw material for production of glycidol and some polycarbonates. From glycidol it is possible to produce oxo- and secondary aliphatic oxy- compounds. From copolymers of glycerol are important the copolymers by urea, as a component of nitrogen containing fertilizers by regulated resorption of nitrogen. The oligomers of glycerol can be applied in the production of special polyurethanes, wetting and preserving reagents of wood and paper, antistatic agents of fibers and other products, where till now cheaper and more toxic polyetyleneglycols were used.

Wide intention of the project with an orientation of a various approaches of glycerol using offers a complex solution for its utilization. This fact is reasoned with regard to enormous expected increase of the glycerol production from renewable resources. Extended range of procedures for glycerol conversion is also given by recent situation in the field of industry. Existing companies with a different capacity of their production from the large suppliers to the small ones have the different opportunities for technology application. For the different business activities various appropriate technological procedures can be optimal (marketing potential, glycerol production capacity, logistics).