



Catalytic hydrogenolysis of sorbitol to polyhydric alcohols
by Robert N Currie

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
Chemical Engineering
Montana State University
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Abstract:

The production of polyhydric alcohols from a renewable resource, such as from hydrogenolysis of sorbitol is greatly needed in an era of increasing dependence on petroleum. Significant work has already been conducted on the hydrogenolysis of sorbitol in batch type processes. However, to make hydrogenolysis of sorbitol a feasible alternative to other methods of producing polyhydric alcohols more work is needed in the area of continuous processes.

The greatest problem to date is maintaining catalyst activity for an industrially feasible operating period. This deactivation is reportedly associated with the acidic conditions during the reaction. The reported research provided data and correlations on catalyst life while maintaining a high degree of conversion. This was done by testing and optimizing the use of different types and concentrations of co-catalyst. The product stream pH could also be controlled by the type and , concentrations of cocatalyst in the feed. The co-catalyst that yielded the highest conversion of sorbitol was sodium hydroxide, at the detriment of decreased glycerol concentration in the product stream. Barium hydroxide was the optimum co-catalyst with respect to overall sorbitol conversion to glycerol. A corresponding decrease in product pH with conversion was observed in this research for continuous hydrogenolysis of sorbitol. The catalyst life for this continuous system was extended to 460 hours while maintaining a high to moderate conversion.

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TO POLYHYDRIC ALCOHOLS,**

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A thesis submitted in partial fulfillment
of the requirements for the degree

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MONTANA STATE UNIVERSITY
Bozeman, Montana

August 1991

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APPROVAL

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Robert N. Currie

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ACKNOWLEDGMENTS

I wish to thank the staff of the Chemical Engineering Department of Montana State University for their advice and assistance during the course of this research. I would like to extend my thanks in particular to Dr. McCandless whose guidance enabled me to complete this degree. I wish to thank Archer Daniel Midland, Decatur, Il., for its technical and financial support. I wish to thank my parents without whom I would have developed neither the desire to learn nor the will to succeed, and to my wife for her daily support. I thank God without whom none of this would have been possible.

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ABSTRACT

The production of polyhydric alcohols from a renewable resource, such as from hydrogenolysis of sorbitol is greatly needed in an era of increasing dependence on petroleum. Significant work has already been conducted on the hydrogenolysis of sorbitol in batch type processes. However, to make hydrogenolysis of sorbitol a feasible alternative to other methods of producing polyhydric alcohols more work is needed in the area of continuous processes.

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CHAPTER 1

INTRODUCTION

The production of polyhydric alcohols from a starch feedstock has been of significant interest since the early 1930s. During World War II glycerol was in high demand for the production of trinitroglycerin (TNT). The primary feedstock for producing glycerol, animal fat, could not fulfill the increase in demand caused by the war. Alternate methods of glycerol production were developed including the hydrogenolysis of saccharides. During World War II, a German plant was built by I.G. Farbenindustrie, A.-G., Werke, Hoechst for the production of a glycerol substitute, "glycerogen", which was of suitable quality for cosmetics or as a humectant [1]. This "glycerogen" contained significant amounts of ethylene glycol and propylene glycol, making "glycerogen" unsuitable for use in the manufacturing of TNT or pharmaceuticals. Today these by-products, as well as the glycerol have developed into new markets and are in high demand. Currently polyhydric alcohols are economically produced from petroleum fractions. However, the conversion of non-petroleum and renewable resources to polyhydric alcohols is desirable in an era of increasing dependence on petroleum [2]. One such reaction is the hydrogenolysis of sorbitol to

polyhydric alcohols shown in Figure 1. However, significant side reactions also occur under the hydrocracking conditions. The two principle ones are shown in Figures 2 and 3.

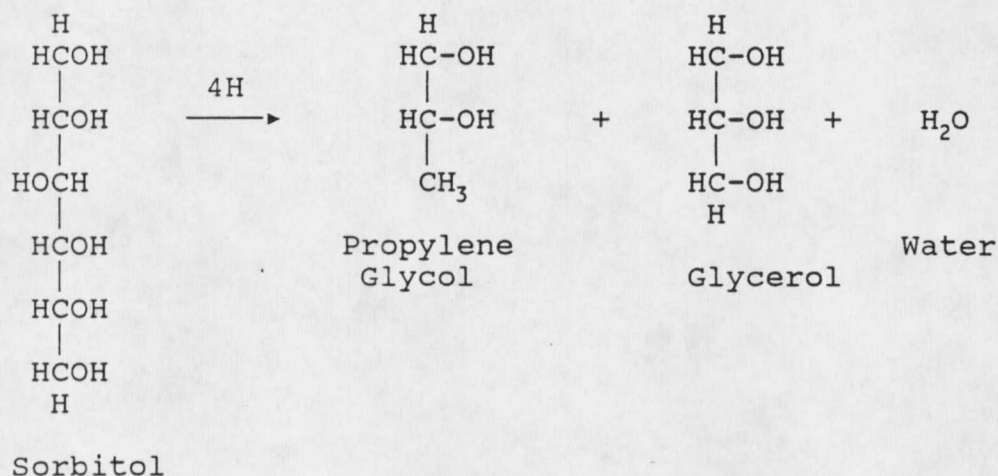


Figure 1 Hydrogenolysis of sorbitol.

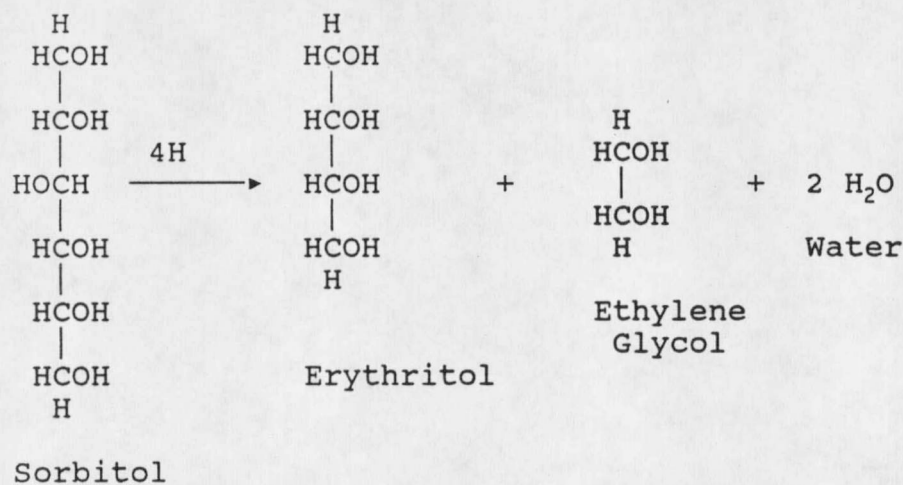


Figure 2 Formation of by-products.

