AU J.T. 8(4): 185-190 (Apr. 2005)

Furfural – Gold from Garbage

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Abstract

Furfural production using continuous feeding process was discussed by using the Westpro modified Chinese Huaxia Furfural Technology as an example. The technical process, equipment required, raw materials needed, unit operations, operation parameters, operation staff, available byproducts, economic considerations, possible markets, and land area considerations are mentioned. The production and uses of some important furfural derivatives, such as furfuryl alcohol, tetra hydro furfuryl alcohol, acetyl furane, furoic acid, methyl furane and tetrahydrofuran THF are identified. Current world production of furfural is about 250,000 t/a, at a stable price of $1,000/t; and it is being projected to 225 thousand metric tons per annum.

Keywords: *Batch process, cellulose, continuous processes, corn cobs, fixed-bed reactors, oat hulls, pentosans, rice hulls, sugar cane bagasse, Quaker Oats technology.*

Introduction

Furfural[1] is produced from agricultural waste biomass that contain pentosans, which are aldose[2] sugars, composed of small rings formed from short five-member chains, that constitute a class of complex carbohydrates, present in cellulose of many woody plants such as corn cobs, sugar cane bagasse, rice and oat hulls etc. (Brady, *et al.* 2000). Furfural is a clear, colorless motile liquid with a characteristic 'almond-benzaldehyde' odor. The molecular formula is $C_5H_4O_2$. Its synonyms are: 2-furancarboxaldehyde, furaldehyde, 2-furanaldehyde, 2-furfuraldehyde, fural, furfurol.

When exposed to sunlight in the presence of oxygen auto-oxidation occurs and it darkens to a dark red/brown color (Brenkem Consultants Asia Co. 2004).

In theory, any material containing pentosans can be used for the production of furfural. Technically furfural is produced by acid hydrolysis of the pentosan contained in woody biomass. Almost all furfural plants employing the *batch process* use the Quaker Oats technology developed in the 1920's. They all operate at less than 50% yield, needs a lot of steam and generate plenty of effluent waste. Moreover their operating costs are high. Hence such plants throughout the world are closing, with the exception of simple low cost Chinese plants (Dalin Yebo Trading 2004).

Some have resorted to *continuous processes*. Westpro modified Chinese Huaxia Furfural Technology is an example of a leading current continuous process furfural technology (Westpro 2004). It uses fixed-bed reactors and continuous dynamic refining, which gives high yields of furfural, including byproducts, at low production costs. The technology requires only low capital investment and is thus especially suited for developing countries, and also for relatively poor communities that are facing economic difficulties, such as refugees displaced across their national borders into neighboring countries where agriculture thrives.

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[1] The International Union of Pure and Applied Chemists (IUPAC) names for aldehydes end in –al. Hence furfural has an aldehyde – CHO functional group (McMurray and Fay 2004).

[2] Sugars that contain aldehyde functional groups. The word aldose is a combination of two words: -ald stands for aldehyde and -ose stands for sugars. Names of sugars end in –ose. Examples are glucose, fructose, sucrose (McMurray and Fay 2004).