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Bio-butadiene manufacture from butandiols

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PURPOSE OF THE ABSTRACT

Butadiene is one of the main components of synthetic rubber, and is today almost exclusively produced by steam cracking of naphtha. Main purpose of steam cracking is to produce ethylene, and prices of the co-products like butadiene have always been erratic due to drift between offer and demand.

This has been particularly true since 2010, with the beginning of production of shale gas. Large quantities of natural gas liquids (and particularly ethane in US) have been produced at low price, driven investment on natural gas liquids steam cracker, instead of naphtha steam cracker. In this context, on-purpose technologies to produce butadiene are needed.

IFP Energies Nouvelles and Michelin started in 2011 a collaborative project, co-founded by ADEME, in order to produce butadiene from renewable resources. In this work, we focus on the pioneer studies made by a group of American laboratories [1-9] during World War II, in order to produce butadiene from sugar in a three step process : 1) fermentation of sugar into 2,3-butandiol, 2) esterification of the 2,3-butandiol and finally 3) pyrolysis of the diester. This process was known to produce a butadiene of high purity, but was never industrialized because the only micro-organism capable of producing 2,3-butanediol from sugar was pathogenic.

Recent progress in fermentation makes this process much more attractive. To quote examples, Genomatica produces today 1,4-butandiol from sugar, and Lanzatech produces 2,3-butandiol (and ethanol) from sugar or syngas, both with non-pathogenic micro-organism.

Using modern chemical engineering tools, we propose some improvements of the two last steps of this process.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

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