Production of 1,3-Butadiene from Ethanol

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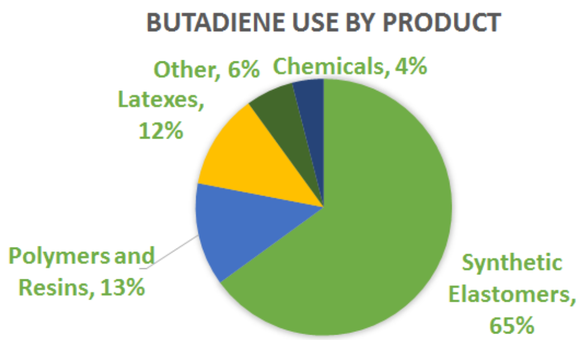
ABSTRACT

Due to the increased reliance on natural gas, the production of 1,3-butadiene as a result of hydrocracking has decreased. This in turn drives the price of butadiene up at a rate that is unsustainable. Given that butadiene is used in many different industries, including the synthesis of rubbers, sealants, and adhesives, a plant was designed using a new production method.

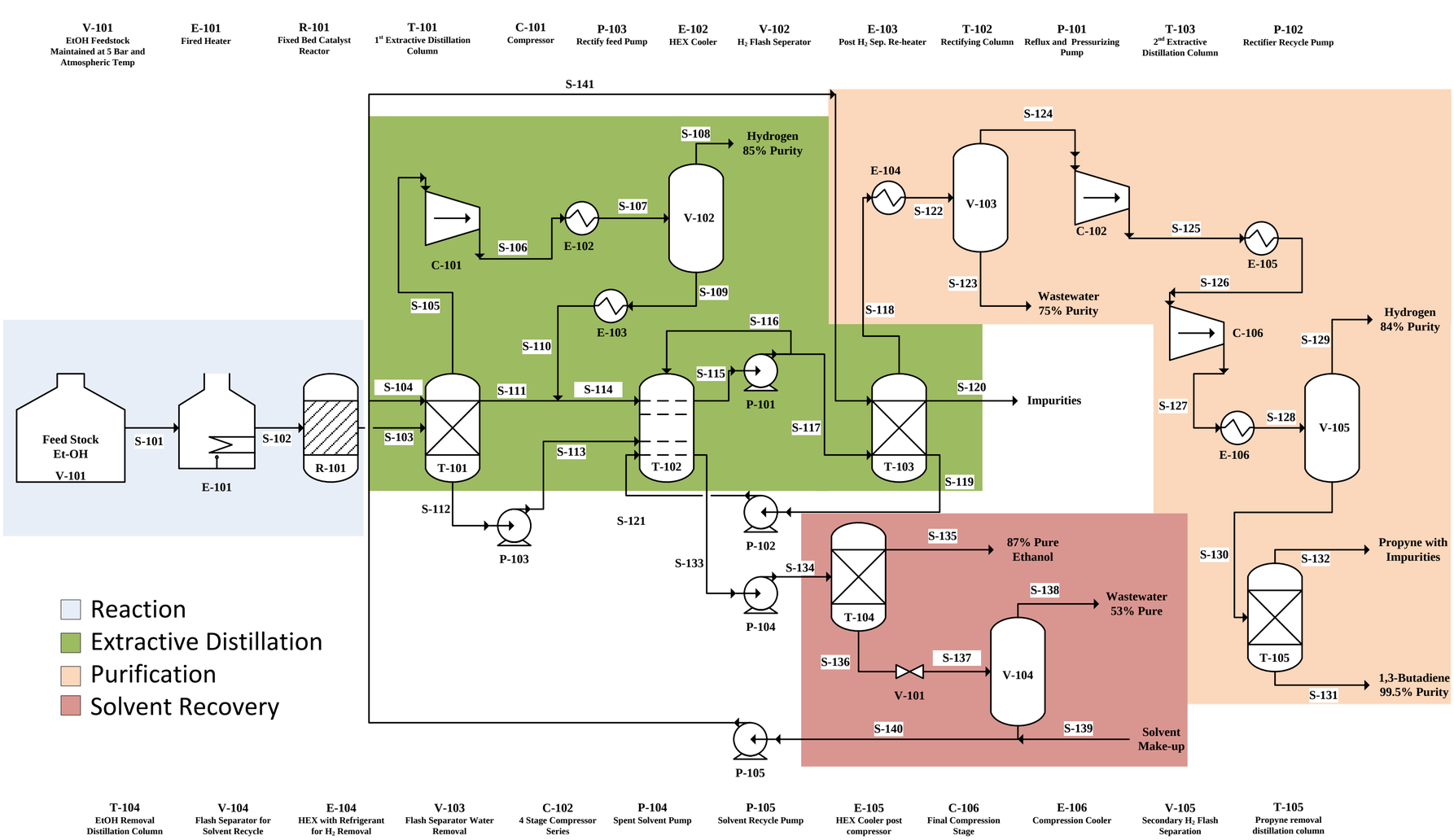
1,3-BUTADIENE USES



ABOUT THE PLANT

The plant is designed to have a production capacity of 200,000 tonnes per year. It is designed to be built in northern Nebraska, as the cost of land and energy is low and there is easy access to ethanol. The plant will take up a plot of approximately 110 acres.

PROCESS FLOW DIAGRAM



THE REACTION

$$2\ C_2H_5OH \rightarrow C_4H_6 + 2\ H_2O + H_2$$

*Side reactions not shown
** Ta/SBA-15-130 catalyst used

ENVIRONMENTAL CONCERNS

1,3-Butadiene, N-methyl-2-pyrrolidone, and hydrogen are all subject to the EPA's Emergency Planning and Community Right-to-Know Act sections 311 and 312, which cover the reporting of hazardous chemicals. MSDS information must be made available to local and state emergency planning personnel and fire departments. Quantities of NMP greater than 100 lbs must be reported, and quantities of butadiene greater than 10,000 lbs must be reported. Under OSHA regulations, plants producing more than 10,000 lbs of butadiene annually must submit a detailed risk management plan.

THE CATALYST

The catalyst to be used in this process is Ta/SBA-15-130. This catalyst was designed specifically for this process and has only been tested in a laboratory setting. Thus, it has not been implemented in an industrial process, and thus the following assumptions were made. It is assumed that there are 2.5 tonnes of catalyst in the packed bed reactor. It was also assumed that half of the catalyst would be replaced every two years. The catalyst was chosen because it has a relatively high conversion, and a high selectivity. The conversion of ethanol with the catalyst is 47.1%. 79% of the ethanol that is converted becomes 1,3-butadiene, and the remaining ethanol can be recycled back into the reactor.

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