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Enhancement of Ethanol Separation from Aqueous Solution by Adsorption Technique

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***Abstract*— Because of the huge industrial development and the high dependency on fossil fuel leading to high air pollution which causes a variety diseases such as respiratory diseases and disaster of global warming all these severe results encourage the researchers to figure out an alternative fuel which has a low environmental impact, the promised one is the bioethanol. The basic process to produce bioethanol is the fermentation for biomass, the most challenging of this process is the separation of bioethanol. This work concerns with modification of bioethanol separation from simulation aqueous solution of the fermentation by adsorption method. The study assesses different types of the feedstock of the fermentation as adsorbents based on the selectivity and capacity. The capacity values via water for yellow corn, wheat bran, rice straw and wheat straw were 0.24, 0.28, 0.15 and 0.14 respectively, and the selectivity values via water were 4, 2, 3, and 2.2 respectively. The first ethanol separation stage of adsorption (after the fermenter) used sepabeads207 to purify ethanol from 10 wt% to 50 wt% used in previous study. In this study, the second separation stage was established including crushed y-corn and wheat bran giving ethanol purity of ~60wt%. The third separation step used y-corn and rice straw to introduce a bioethanol ratio for ~70wt%.**

***Keywords*— Adsorption, ethanol, crushed corn, wheat bran, rice straw, wheat straw.**

I. I. INTRODUCTION

The global warming is a crucial and fatal ecumenical problem around the world [1]. This problem is related directly with emissions of fossil fuel combustions and other industrial gases such as CFC, hydrocarbons, CO_2 and other types of greenhouse gases [2]. The huge amounts of these effects on atmosphere and environment come from using fossil fuels (oil, gas and coke). The revolution of industry was built, essentially, on this type of fuel because of its availability in large quantities [3]. To occupy this disaster and resolve it (even partially), the researchers persevere to find an alternative fuel that can be used side by side with fossil fuels to decrease the dependency on it (one day will disappear) and decrease the excess of the CO_2 and other greenhouse gases in atmosphere [4].

Using renewable fuel leads to decreasing the problems of excess of CO_2 emissions, global warming and other environmentally damages by inserting the effluent in the closed cycle (combustion of biomass emits effluent to atmosphere and photosynthesis pulls this effluent to form biomass again and so on) [2]. One of reliable alternative fuel is the bioethanol, also named ethyl alcohol (C_2H_5OH).

It is a colorless liquid, biodegradable, low in toxicity, non-smoke flame and produces little pollution to the environment because it has a high ratio of H/C [5], which is produced by bioprocess depending on biomass.
It is used as fuel for gasoline engines that have already been built (may need to be fabricated) and also as fuel oxygenated to enhance the octane number of gasoline with low quality by mixing a certain ratio to produce a blind (such as E85, ethanol=85, gasoline=15) [6], also the bioethanol can be used for combustion in different applications because it burns in clean flame without smoke [7].

Alternative fuel should be sustainable and economical to be successful in replacing traditional fuel [8]. There are different ways to produce sustainable fuel based on biomass such as direct combustion, pyrolysis, chemical conversion, biological conversion [2].

The promised way to produce bioethanol is the fermentation process (classified under biological conversion) [9]. The fermentation process depends upon the biomass as a renewable source. The bioethanol which produced from the fermentation process has purity with about 10wt% (based on the microorganism and the fermented substrate) [10]. The challenge of producing bioethanol as a fuel is the purification process.

There are many techniques for separating bioethanol from an aqueous solution (fermentation's broth) and purify it. Classical distillation [11], azeotropic distillation [12], extractive distillation with salts [13-14]. pervaporation [15], [16] and adsorption [17].

All distillation processes are effective processes for getting high purity for bioethanol (~95wt%) but, they are suitable for high concentration of ethanol (start with high concentration e.g. 70%) and a large amount, the

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