Simulation and Optimisation of Bioethanol Purification using Extractive Distillation with Additive Solvent

ABSTRACT

In this study, simulation and optimisation of the purification of bioethanol from an azeotropic mixture was done using the Aspen HYSYS and the Response Surface Methodology (RSM), respectively, to achieve an acceptable bioethanol content with minimal energy use. The objective of this study is to develop the simulation process of bioethanol production from a fermentation effluent. Additionally, the effects of parameters such as solvent temperature, number of entrainer feed stage, mass flow rate and third components of the process for production of bioethanol were studied. As bioethanol is a product of biofuel production, the main challenge facing bioethanol production is the separation of high purity ethanol. However, the separation of ethanol and water can be achieved with the addition of a suitable solvent such as 1,3-butylene glycol (13C4Diol), mixture 13C4Diol and ethylene glycol (EGlycol) and mixture 13C4Diol and glycol ethyl ether (DEG) in the extractive distillation process. For the 13C4Diol mixture, the temperature of entrainer is 90o C with 1500 kg/hr of entrainer rate, while the number of entrainer feed stage is one. The optimum conditions for mixture 13C4Diol and EGlycol require a temperature of entrainer of 90.77o C with an entrainer rate of 1500 kg/hr, while the number of entrainer feed stage is one. Lastly, for optimum conditions for the mixture 13C4Diol and DEG, the temperature of entrainer should be 90o C with an entrainer rate of 1564.04 kg/hr, while the number of entrainer feed stage is one. This study shows that process simulation and optimisation can enhance the removal of water from an azeotropic mixture.