

# Bio-ethanol Dehydration in a Heat Pump Aided Extractive Dividing-wall Column

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## INTRODUCTION

Large-scale production of bio-ethanol fuel requires energy demanding separation steps to concentrate the diluted streams from the fermentation step and to overcome the azeotropic behavior of the ethanol - water mixture. In the present work, a novel heat pump aided extractive dividing-wall column (H-E-DWC) is designed to substitute the conventional separation approach which consists of three distillation columns performing several tasks with high energy penalties.

## THEORY

Heat pump systems can be used to upgrade the low quality energy in the condenser to drive the reboiler. In this work, the vapor compression technology is used to upgrade the heat by compressing the vapor distillate or a working fluid.

Dividing-wall columns is one of the process intensification technologies, which can separate three or more chemical compounds in just one column, hereby reducing the costs and energy consumption in industrial scale.

## METHODS

This study proposes an innovative distillation setup - based on a novel H-E-DWC, which is able to concentrate and dehydrate bioethanol in a single step, by integrating all units of the conventional sequence into only one distillation column. Aspen Plus is used to simulate the H-E-DWC which is shown in Figure 1. The energy consumption of the conventional separation approach, E-DWC, and H-E-DWC is compared through simulation.

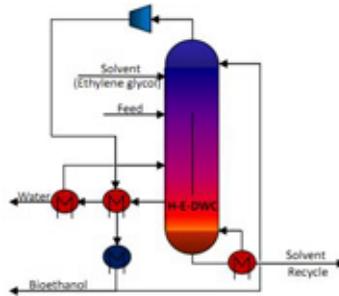


Figure 1. Heat pump aided extractive dividing-wall column (H-E-DWC) to bioethanol dehydration

## RESULTS

In this work, a mixture of 10.0 wt% ethanol and 90.0 wt% water is concentrated to 99.6 wt% and 99.8 wt%, respectively. Compared to the conventional separation approach, simulation results from Aspen Plus show that 66.6% of the cold utilities and 49.9% of the heat utilities are saved by using H-E-DWC.