

High Equivalent of Theoretical Plate from Reactive Distillation Unit by Purification of Ethanol on Different Concentration

Agus Aktawan* and Zahrul Mufrodi

Chemical Engineering Department, Faculty of Industrial Engineering, Universitas Ahmad Dahlan, Yogyakarta 55164, Indonesia

Abstract: Distillation used in large number of industry in the world as purification unit. Distillation unit has two kind of separation column, plate and packing. Distillation unit in this research use packing as separation column and type of packing is glass raschig ring. Dimension of distillation unit are; 1.20 m on height, 45 mm on diameter, 2 mm on wall thickness. dimensions of one glass raschig rings are; 0.5 mm of out diameter, 8.5 mm on length, 0.85 mm on wall thickness and 19.5 cm on high of packing. High Equivalent of Theoretical Plate (HETP) is a method to calculate how many plate that equivalent to the high of packing. Both fenske underwood and mc-cabe thiele method was used to calculate the HETP. Data from ethanol purification with different input concentration collected to calculate the HETP. Different concentration of ethanol; 50%, 55%, 60%, 65% and 70% used as input in distillation process. Sample of distillate and bottom took in 76 °C and 82 °C. Concentration of distillate and bottom checked by refraktometer. The best HETP from fenske method is 17.69 and Number of minimum plate (N_{min}) are; 1,10. It's means that 17.69 cm is equal to one plate.

Keywords: : Distillation; HETP; Ethanol Purification

e-mail: agus.aktawan@che.uad.ac.id *

1. INTRODUCTION

Distillation used in large number of industry in the world as purification unit. Purification processes that are used in the industries are filtration, extraction, crystallization, distillation, etc [1]. The separation operation called *distillation* utilizes vapor and liquid phases at essentially the same temperature and pressure for the coexisting zones. Various kinds of devices such as *random* or *structured packings* and *plates* or *trays* are used to bring the two phases into intimate contact. Trays are stacked one above the other and enclosed in a cylindrical shell to form a *column*. Packings are also generally contained in a cylindrical shell between hold-down and support plates. The column may be operated continuously or in batch mode depending on a number of factors such as scale and flexibility of operations and solids content of feed [2].

Widely application of distillation process combined by another process has been used. Experiments in an extractive distillation pilot plant were performed with the objective of firstly exploring different operating conditions and secondly to compare the mass transfer efficiencies produced by [hmin][TCB] and the reference organic solvent N-methyl-2-pyrrolidone [3]. Over the last two decades, especially after the commissioning of large-scale plants for MTBE and methyl acetate production, RD has been seen as a promising reactor/separator that can fulfill multiple objectives simultaneously. Hydrogenation, hydrodesulfurization, isomerization, and oligomerization are some of the unconventional examples to which RD has been successfully applied on a commercial scale. RD can also be used for the recovery of valuable products like acetic acid, glycols, lactic acid, and so on from waste streams [4]. RD also has been used to produce triacetin as bioaditif by conversion until 98.51% [5].

Distillation column has packing to increase the transfer area between gas and liquid. The experiments of the use of glycerol as an entrainer, in substitution of ethylene glycol in an extractive distillation using distillation column packed with Raschig rings, varying the glycerol/feed (ethanol and water) ratio, S/F, from 0.5 to 0.9 [6]. Another experiment about kind of packing and type of packing are SiC ceramic and mellapak structured packings [7],

PACK-2100 [8]. High equivalent of theoretical plate is high of packing that equivalent to a theoretical plate.

were plotted over time to obtain a trend of packing quality over 10 years [9]. Sun [10] found out the relates height equivalent to a theoretical plate (HETP) of a GC column to various flow and kinetic parameters which cause peak broadening.

In this study, we calculate the HETP of distillation column that used to produce triacetin.

2. MATERIALS AND METHODS

A. Materials

In this study, we used ethanol 95% on concentration as raw material. Aquadest was added to varying the concentration of ethanol which became 50%, 55%, 60%, 65% and 70%. Distillation unit in this research use packing as separation column and type of packing is glass raschig ring. Dimension of distillation unit are; 1.20 m on height, 45 mm on diameter, 2 mm on wall thickness. dimensions of one glass raschig rings are; 0.5 mm of out diameter, 8.5 mm on length, 0.85 mm on wall thickness and 19.5 cm on high of packing that shows in fig.1.[11].

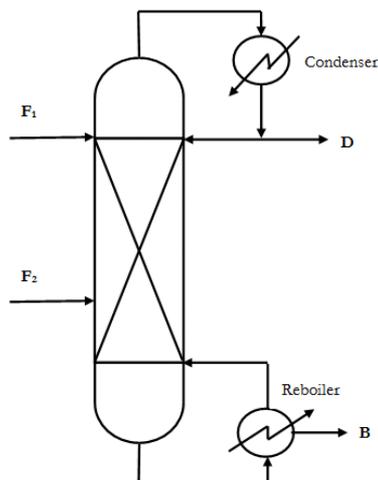


Fig.1. Distillation column

B. Methods

Distillation column was used to purify the ethanol solution which has different input concentration. The process was taken in 1 hour. And during distillation process, sample of distillate was taken from upper side of distillation column that have been condensed through a condenser. The sample of residue or bottom result was taken from bottom side of distillation column. After we took the distillate and bottom result, we checked the refractive index using refractometer. Refractive index from distillate and bottom results was converted to get the concentration of the sample. Concentration of distillate and bottom results was used to calculate the HETP.

3. RESULTS AND DISCUSSION

In this study we got the refractive indexes of distillate and bottom result which is converted to concentration. From concentration of distillate and bottom result we calculate the N_{min} and HETP value by fenske underwood and McCabe methode. The calculation results show in fig.2 and fig.3 below;

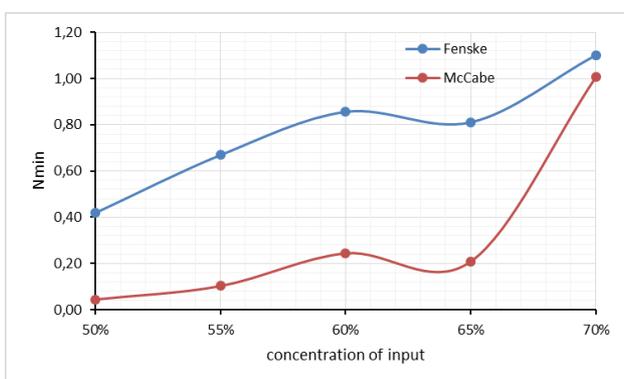


Fig.2. N_{min} value

Fig.2. shows N_{min} value from different concentration of input. This figure shows that increasing in concentration of input will increase the N_{min} value. Concentration 70% of input gave maximum N_{min} value that is 1.10 for fenske methode and 1.01 for mccabe methode.

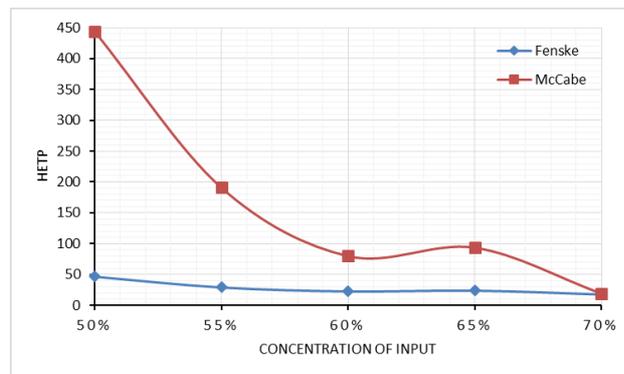


Fig.3. HETP value

Fig.3. shows HETP value from different concentration of input. This figure shows that increasing in concentration of input will decrease the HETP value. For maksimum N_{min} value, the HETP value for fenske methode is 17.69 and for mccabe methode is 19.36.

4. CONCLUSIONS

The best HETP from fenske methode is 17.69 and Number of minimum plate (N_{min}) are; 1,10. It's means that 17.69 cm is equal to one plate.

ACKNOWLEDGMENTS:

All authors would like to sincerely acknowledge to Research and Development Center, Universitas Ahmad Dahlan through PDP project no. PDP-203/LPP-UAD/III/2016.

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