

Batch Distillation

TO: Engineering Development Branch

FROM: Engineering Division

SUBJECT: Batch Distillation

The specialty chemical division produces batches of deuterated methanol (CH_3OD) at an average rate of 4 kg/day in a binary mixture of 50% by volume ethanol/deuterated methanol. This CH_3OD is worth \$700/kg at 99% purity and \$200/kg at 97% purity and scales linearly between these points. The levelized energy costs for the reboiler are \$0.012/kWh, and it takes 2 hours to recharge the batch system between runs. Recommend the most profitable operating strategy. All other costs are sunk costs (the land, equipment, and facility already exist and cost nothing to use). Develop a design curve that indicates the achievable methanol purity as a function of amount of energy consumed. The objective is to maximize the profit from this operation.

Using the design curve and economics above, recommend an operating strategy that addresses at least the following points:

1. What purity of CH_3OD should be produced to optimize profit and how long will it take to produce one batch at that purity?
2. Should the column be operated at fixed reflux ratio with varying product purity or fixed purity with varying reflux ratio?
3. Should the ethanol product (with whatever deuterated methanol remains in it) be recycled back to the specialty chemical process to be used in the place of the neat ethanol currently being used?