Pressure Swing Distillation System for Methylal/Methanol

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Background

Industrially, methylal is used as a solvent in synthesis of aerosol, the manufacture of perfumes, resins, adhesives, insecticides, paint strippers and protective coatings. It is also a cleaning diesel additive and substitution for freon.[2]
Methylal is synthesized by reaction of methanol with formaldehyde or paraformaldehyde in the presence of a catalyst. Because of the high nonideality in the liquid phase, a minimum-boiling azeotrope is formed between methylal and methanol.[1]
To obtain highly pure methylal for some industrial purpose, We must have to break that azeotrope. For that; There are so many methods like extractive distillation, membrane pervaporation, pressure swings distillation etc.When the Azeotrope is pressure sensitive, pressure swing distillation is used to obtain highly pure compound.

Azeotropic data of Methylal/Methanol

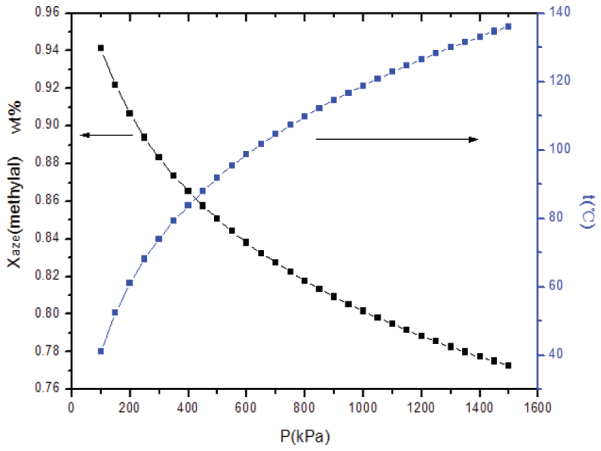

Figure 1: Effect of pressure on azeotropic composition and temperature.[1]

As shown in the figure, at atmospheric pressure(100 kPa) azeotropic composition is near 94 wt% of methylal and at 1200 Kpa the azeotropic composition is changed to 79 wt% of methylal.

compiled in LaTeX

Description of Flow-Sheet

Here, We use two distillation column with different pressure(100 kPa and 1200 kPa). In low pressure column we enter a feed; This feed are concentrated near the azeotropic composition at 100 kPa,and the Methanol are collected from the bottom. The top stream of low pressure column are now enter to the high pressure column where it's composition are changed with the azeotropic composition at 1200 kPa, and the pure methylal are collected from the bottom of that column and the top stream of high pressure column are recycled to the low pressure column.The composition of feed and other data of columns are given in the result section.

Result

Table 1: Columns Data

Name	**Low-Pressure Column**	**High-Pressure Column**
Total Stage	16	28
Pressure (kPa)	100	1200
Feed (kg/hr) (%wt/wt) (%wt/wt) (%wt/wt)	3000 Water(0.3%) Methylal(85.8%) Methanol(13.9%)	4355 Water(0.05%) Methylal(92%) Methanol(7.9%)
Feed Stage	5 from top	10 from top
2nd Feed(kg/hr) (%wt/wt) (%wt/wt) (%wt/wt)	1780.5 Water(0.13%) Methylal(80.6%) Methanol(19.2%)	-
2nd Feed Stage	12 from top	-
Top(kg/hr) (%wt/wt) (%wt/wt) (%wt/wt)	4355 Water(0.05%) Methylal(92%) Methanol(7.9%)	1780.5 Water(0.13%) Methylal(80.6%) Methanol(19.2%)
Bottom(kg/hr) (%wt/wt) (%wt/wt) (%wt/wt)	425.8 Water(2.1%) Methylal(0.2%) Methanol(97.6%)	2574 Water(0%) Methylal(99.95%) Methanol(0.05%)

References

[1] Baoru Yu, Qiaoyi Wang, and Chunjian Xu;"Design and Control of Distillation System for Methylal/Methanol Separation. Part 2: Pressure Swing Distillation with Full Heat Integration" Ind. Eng. Chem. Res., 2012

[2] Qiaoyi Wang, Baoru Yu, and Chunjian Xu;"Design and Control of Distillation System for Methylal/Methanol Separation. Part 1: Extractive Distillation Using DMF as an Entrainer", Ind. Eng. Chem. Res., 2012