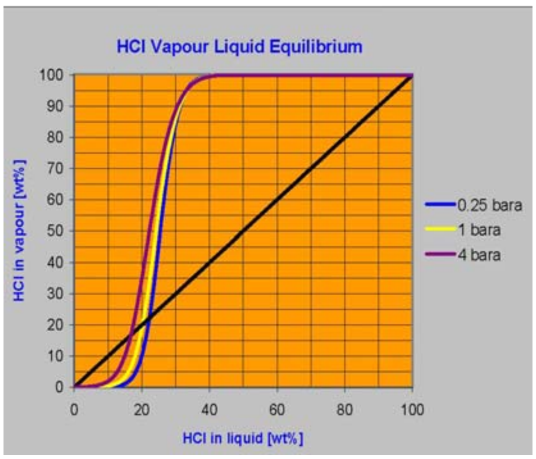
Hydrochloric Acid Concentration

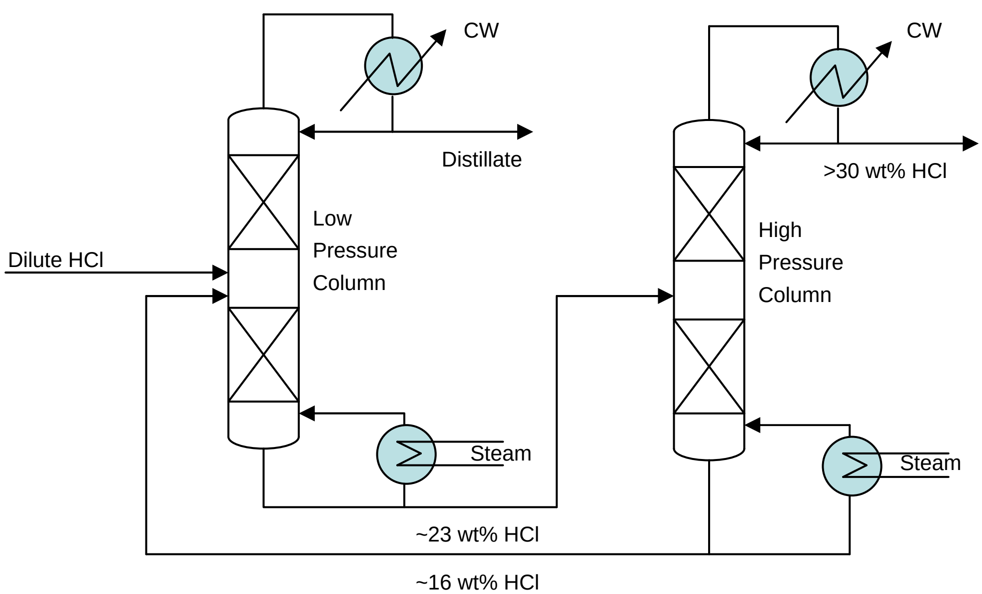
Concentration of hydrochloric acid from dilute streams presents a challenge due to the presence of a maximum azeotrope at relatively low concentration (~20.2 wt% at atmospheric pressure). Chemetics offers two process solutions to produce Hydrochloric Acid at concentrations above this azeotrope:

Dual Pressure Process



This process takes advantage of the fact that the azeotrope concentration changes with pressure. At lower pressure, the azeotrope concentration is increased. Operation of two Distillation columns operating at different pressure allows one column to operate with a feed stream below the azeotrope (removing water from the system) whereas the second column operates with a feed stream above the azeotrope (removing the concentrated product acid). A large recycle stream exists between the columns as only part of the water/product is removed in each pass (See basic flowsheet below). It is common to operate with the low pressure column at ~0.25 bara (azeotrope ~23 wt%) and the high pressure column at approx. 3 barg (azeotrope ~16 wt%).

Dilute HCl solution is fed to the Low Pressure Column. The top product from this column is water, the bottom product is ~23 wt% HCl, which is fed to the High pressure column. In the High pressure column, the top product is the 30 wt% (or higher) HCl product solution and the bottom product is the azeotrope mixture at ~16 wt%. This low strength acid is returned to the low pressure column to remove water from the system.



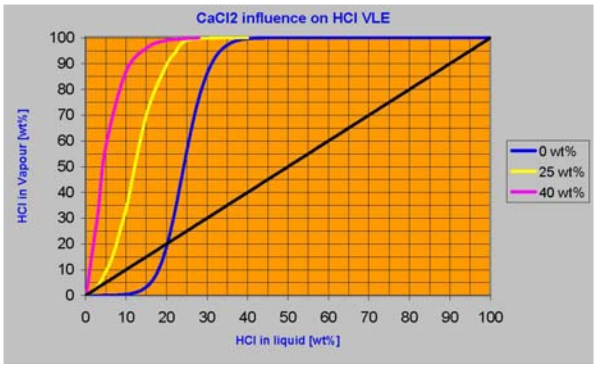
For more information please contact us at spent.acid@jacobs.com

Chemetics Inc., #200 – 2930 Virtual Way, Vancouver, British Columbia, Canada V5M 0A5 Tel +1.604.734.1200 Fax +1.604.734.0340

www.jacobs.com/chemetics

Extractive Distillation

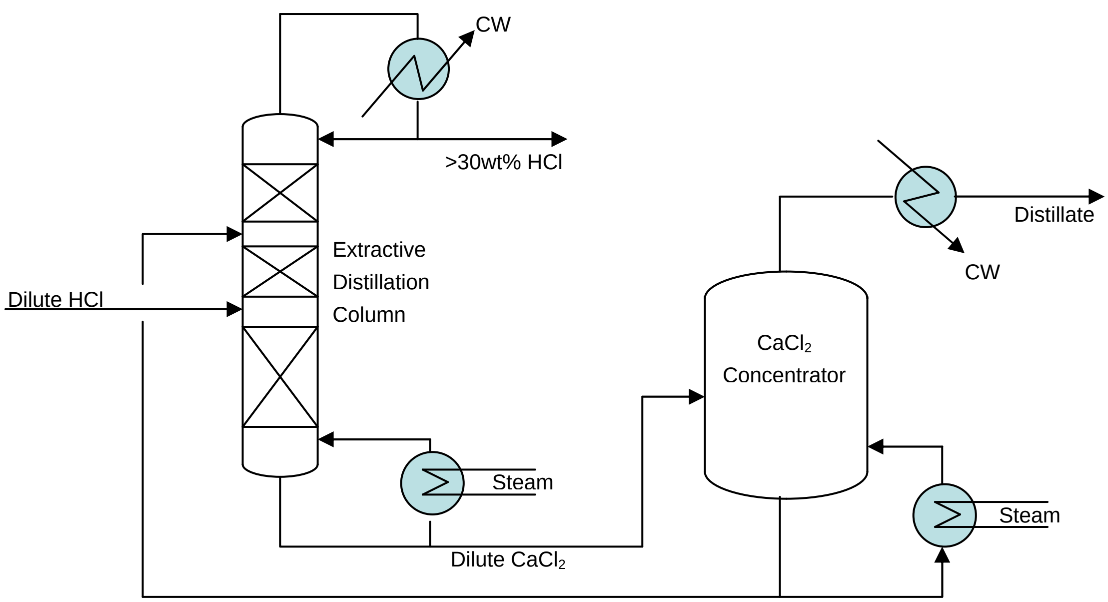
The relative volatility of the HCl can be changed by adding third component to the mixture. The change in volatility either moves or eliminates the azeotrope. This additional chemical must be chosen carefully. Not only should this chemical have a significant effect on the nitric acid VLE, it must also have a low vapour pressure, exhibit low toxicity and be stable at the temperatures in the distillation column.



Both Calcium Chloride and Magnesium Chloride satisfy these requirements and are commonly used. The graph on the left shows how the H_2O-HCl vapour liquid equilibrium changes when calcium chloride is added into the mixture. It is clear that adding more than 25 wt% calcium chloride will be sufficient to achieve the desired effect of eliminating the azeotrope completely. The addition of Magnesium chloride has a similar effect.

The extractive agent is re-concentrated in a separate concentration unit to remove the water and is returned to the extractive distillation column. See basic flowsheet below.

In order to minimize the amount of water that needs to be removed in the extractive distillation, it is often advantegeous to operate a normal distillation at reduced pressure upstream of the extractive distillation column. Depending on the concentrations, this column can sometimes be heated with the overheads from the concentration unit for the extractive agent.



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