Double Distillation Column Process for Separation of Azeotropic Mixture (Pyridine-Water) using Pressure Swing Distillation(PSD).

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Background and Description:

Pressure Swing Distillation (PSD) is the Process to be utilised to Separate the Pressure sensitive mixture with the close boiling point or forming Azeotrope . PSD is special Distillation technique in which no new additive is added.

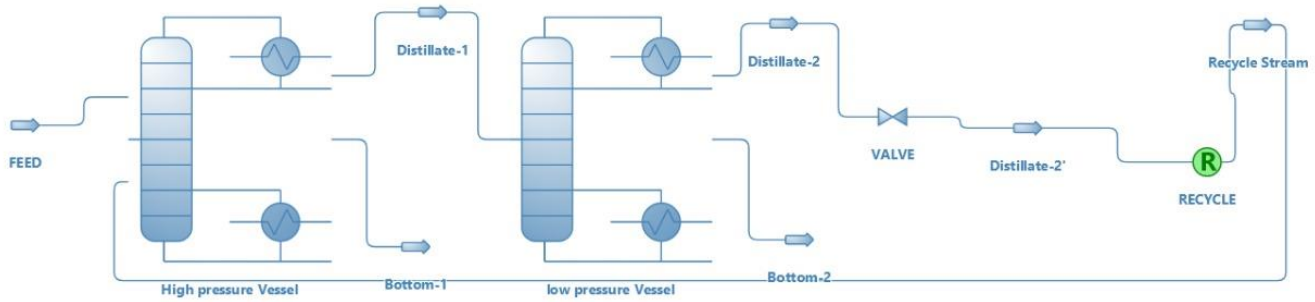
Boiling point of pyridine is 115°C and Water is 100°C. But when they mix and mixture is form then, boiling point of mixture is 92.6°C (when 43% water and 57% pyridine is present). That's why we use PSD technique to separate.

Process:

Here, firstly feed (FEED) is introduced to 1st distillation column (High pressure Vessel) in which high pressure is generated. From column, there are two products are come one is topmost product(Distillate-1) in which mixture of pyridine and water is present but in that pyridine as in lower amount as compare amount of water And second one is bottom product(Bottom-1) in which high concentrated pyridine is taken out.

After that Topmost product of 1st column is going to Low pressure Vessel (Distillation column), in which low pressure is generated, there are also two products come from second distillation column same as first but it has different composition. Topmost product (Distillate-2) has small amount of Pyridine and water both which is then recycled to the first distillation column with help of recycler (RECYCLE) and Bottom product (Bottom-2) has water composition around 97%.

Flowsheet:



Results:

1. Feed table.

FEED PROPERTIES TABLE			
FEED	Molar Fraction (Mixture) / Water	0.43	
FEED	Mass Fraction (Mixture) / Water	0.146622	
FEED	Molar Fraction (Mixture) / Pyridine	0.57	
FEED	Mass Fraction (Mixture) / Pyridine	0.853378	
FEED	Temperature	25	C
FEED	Pressure	5	bar
FEED	Mass Flow	150	kg/h
FEED	Molar Flow	2.83911	kmol/h
FEED	Volumetric Flow	0.15203	m3/h

From above table, we see all the feed data applied on the process of separation.

2. Bottom-1 table (pyridine).

BOTTOM-1(pyridine) PROPERTIES TABLE			
Bottom-1	Temperature	176.358	C
Bottom-1	Pressure	5	bar
Bottom-1	Mass Flow	103.301	kg/h
Bottom-1	Molar Flow	1.32644	kmol/h
Bottom-1	Volumetric Flow	0.128993	m3/h
Bottom-1	Molar Fraction (Mixture) / Water	0.02	
Bottom-1	Mass Fraction (Mixture) / Water	0.00462653	
Bottom-1	Molar Fraction (Mixture) / Pyridine	0.98	
Bottom-1	Mass Fraction (Mixture) / Pyridine	0.995373	

From the above table, we see that how much pyridine is separated and collected under given conditions of pressure and temperature.

3.Bottom-2 table (water).

BOTTOM-2(WATER) PROPERTIES TABLE			
Bottom-2	Temperature	96.0182	C
Bottom-2	Pressure	1.01325	bar
Bottom-2	Mass Flow	2.4734	kg/h
Bottom-2	Molar Flow	0.124618	kmol/h
Bottom-2	Volumetric Flow	0.00257922	m3/h
Bottom-2	Molar Fraction (Liquid Phase 1) / Pyridine	0.03	
Bottom-2	Molar Fraction (Liquid Phase 2) / Pyridine	0	
Bottom-2	Molar Fraction (Mixture) / Water	0.97	
Bottom-2	Mass Fraction (Mixture) / Water	0.88044	

From above property table, we can read how much separation occur from second column.

References- **Dryden's Outlines of Chemical Technology** for the 21st Century: Rao and M Gopala and Shreves **Chemical Process Industries** Handbook 5th Edition. Also from spoken tutorials from fossee project IIT Bombay.