

# Recovery of 1,4-Dioxane and Acetonitrile from Wastewater

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## Background & Description:

1,4-Dioxane is used in many industries. It is used as an industrial solvent, a laboratory reagent, and in the manufacture of other chemicals. Acetonitrile is commonly used as a solvent in major industries, and it is widely used in the pharmaceutical industry.

Both solvents readily form binary and ternary azeotropes that are harmful to the environment and incompatible with sustainable development. Common distillation cannot separate ternary mixtures completely, and thus the most effective method to separate this ternary mixture is triple column pressure swing distillation.

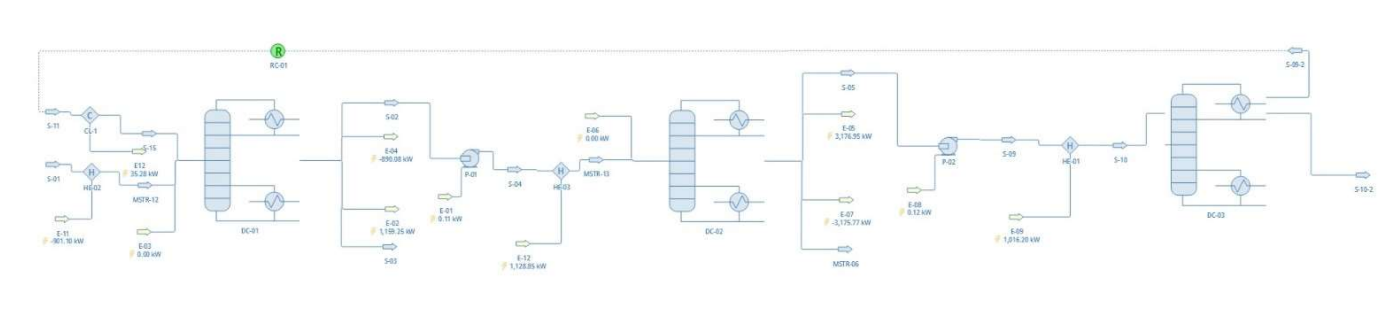
The flowsheet is set at 100 kmol/h with components of 16 mol% dioxane, 70 mol% water, and 14 mol% ACN according to the processing capacity and sample of a pharmaceutical plan. The fresh feed is preheated to 50.8 °C, and the recycle feed from DC-03 is cooled to 45.3 °C before being fed to DC-01. The distillate, where the component is close to the azeotrope at 0.3 bar, is cooled in a condenser and then split into two streams: one is recycled back to DC-01 and another is fed to DC-02. 99.9% of the water is obtained from the bottom. In DC-02, the distillate from DC-01 is fed after preheating it to 80.2°C under pressure of 1.12 bar, where 99.9% of the product dioxane is achieved from the bottom and the distillate component is close to the azeotrope at atmospheric pressure. Then, a part of the distillate is fed to DC-03 after preheating it to 97.7 °C. The last product is 33.3% ACN, which is obtained at the bottom of DC-03 along with water vapour. The distillate from DC-03 is recycled into DC-01.

## System of Units:

Temperature: °C,  
Pressure: bar,  
Molar flow: Kmol/h,  
Mass flow: kg/h

**Property Package:** Peng Robinson (PR)

Flowsheet:



Results:

Master Table 1				
Object	S-10-2	S-06	S-03	
Temperature	98.527	101.34	69.0738	C
Pressure	2	1.01325	0.3	bar
Molar Flow	48.6803	3.64474	47.675	kmol/h
Mass Flow (Overall Liquid)	1965.15	321.095	859.16	kg/h
Molar Fraction (Overall Liquid) / 1,4-dioxane	0.209551	0.9999	7.67203E-05	
Molar Fraction (Vapor) / Water	0.453186	0.000515551	0.999859	
Molar Fraction (Mixture) / Acetonitrile	0.332764	4.63616E-07	2.32797E-05	