

# 4-Stage Refrigeration Process with Propylene, Ethylene, Methane and Nitrogen

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## Background & Description:

Compression refrigeration is widely used in chemical processes to cool process streams to below-ambient temperatures. A single stage (one evaporator, one compressor, one condenser and one expansion valve) can be used down to temperatures of about  $-40^{\circ}\text{C}$  using several refrigerants such as R134A, ammonia and propylene. Lower temperatures require multiple stages using progressively lower-boiling refrigerants in each stage.

In this flowsheet, there are four refrigeration cycles having Nitrogen, Methane, Ethylene and Propylene as refrigerants respectively. In the first cycle, temperature goes down to  $-195^{\circ}\text{C}$ ; in second cycle, temperature goes down to  $-173.296^{\circ}\text{C}$ ; in third cycle, temperature goes down to  $-106.465^{\circ}\text{C}$ ; in fourth cycle, temperature goes down to  $-25.5859^{\circ}\text{C}$ .

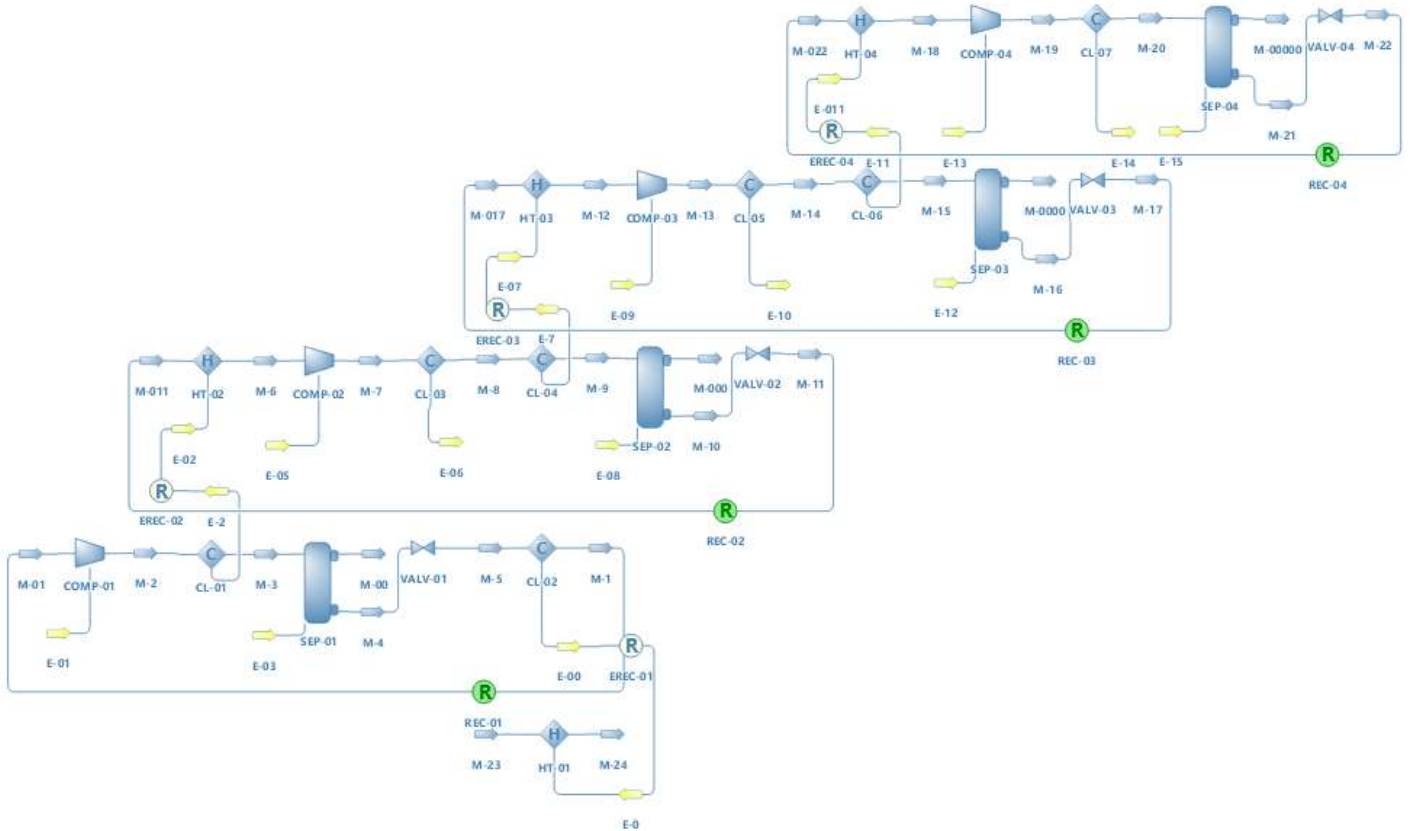
## System of Units:

Temperature :  $^{\circ}\text{C}$ ,  
Pressure : bar,  
Molar flow :  $\text{Kmol/h}$ ,  
Mass flow :  $\text{kg/h}$

## Property Package:

UNIQUAC

**Flowsheet:**



**Results:**

Object	M-23	M-022	M-017	M-011	M-01	
Temperature	-190	-25.5859	-106.465	-173.296	-195	C
Pressure	1.92022	2.5	0.863	0.34	1.12468	bar
Molar Flow	636	3464	2562	2122	1268	kmol/h
Molar Fraction (Mixture) / Ethylene	0	0	1	0	0	
Molar Fraction (Mixture) / Propylene	0	1	0	0	0	
Molar Fraction (Mixture) / Nitrogen	1	0	0	0	1	
Molar Fraction (Mixture) / Methane	0	0	0	1	0	

Object	E-7	E-2	E-11	E-00	
Energy Flow	5165.11	4724.71	8846.36	891.466	kW