Production of Vinyl chloride monomer via Acetylene-HCl reaction

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Background & Description:

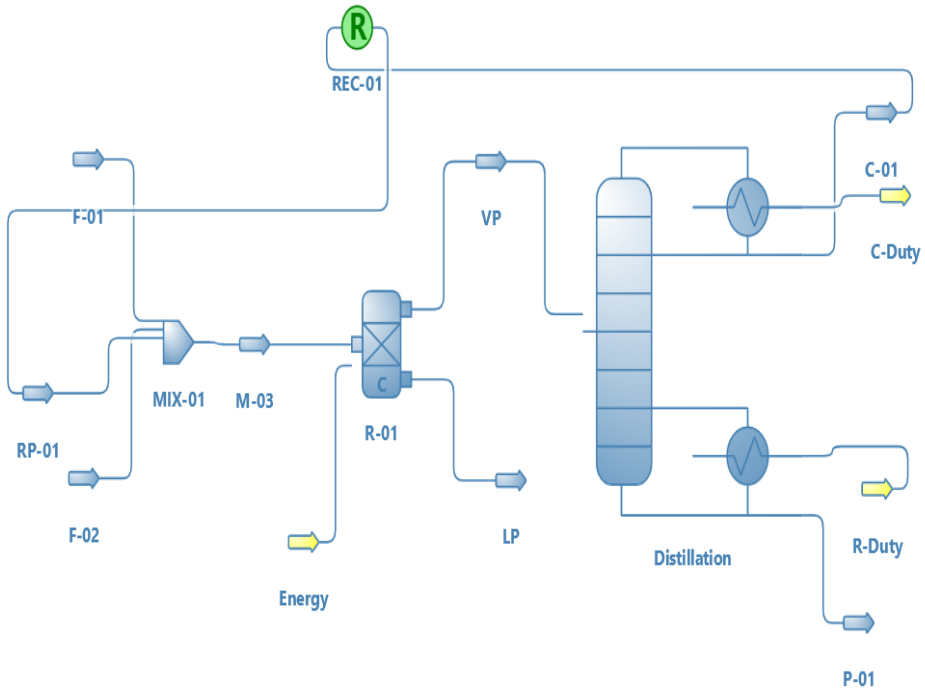
Vinyl chloride (CH2=CHCl) is a halogenated alkane. It is the building block for its polymer polyvinyl chloride (PVC) and other co-polymers with acetate and vinyl chloride. Poly (vinyl chloride), PVC is cost-effective, highly versatile and is used in many construction applications such as water, sewage and drainage pipes, and a variety of extruded profiles. Thousands of rigid, semiflexible and flexible (plasticized) materials and products based on PVC are widely used in practically all spheres of the world economy and will remain so for a very long time. Methods for preparation include:

-Ethylene dichloride thermal pyrolysis
-Acetylene-HCl reaction
-Ethylene dichloride caustic reaction

We have discussed the second method. Acetylene and dry HCl in 1:1 molar ratio are vapor blended by jet mixing in a pipe and passed through a tubular reactor containing carbon pellets impregnated with HgCl2. The temperature in reactor is maintained at 160ºC, and is gradually raised to 200ºC as the catalyst deteriorates. The pressure is maintained at 1 atm. The effluent gases contain vinyl chloride along with unreacted acetylene and hydrogen chloride. The unreacted reactants are recycled. The yield of vinyl chloride is 97%. $C2H2 + HCl \rightarrow CH2=CHCl$

The above reaction takes place in vapor phase and is exothermic in nature. Control of temperature is the most essential parameter to increase the conversion level. Though the acetylene hydrochlorination method has a high rate of conversion and accounts for about 70% of the total VCM production capacity, it utilizes a mercuric chloride catalyst to promote the reaction of acetylene and hydrogen chloride. During the hydrochlorination, the highly toxic mercuric chloride tends to sublime, resulting in the deactivation of the catalyst and also in severe environmental pollution problems. Hence, it is necessary to explore environmental friendly non-mercury catalysts for acetylene hydrochlorination as well as high efficiency novel reactors, with the aim of sustainable PVC production via the acetylene-based method.

Flowsheet:



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Results:

The stream wise results are given below:

Stream Wise Results									
Object	VP	RP-01	P-01	M-03	LP	F-02	F-01	C-01	
Temperature	200	-85.298	-13.3002	-85.2919	200	160	160	-85.298	C
Pressure	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	bar
Mass Flow	1.94552E+06	1.94392E+06	1591.88	1.94552E+06	0	12166.7	8666.67	1.94392E+06	kg/h
Molar Flow	53127.9	53102.4	25.471	53241.2	0	333.691	332.856	53102.4	kmol/h
Molar Flow (Mixture) / Acetylene	9.99444	9.99444	8.65161E-08	342.852	0	0	332.856	9.99444	kmol/h
Mass Flow (Mixture) / Acetylene	260.228	260.228	2.25265E-06	8926.93	0	0	8666.67	260.228	kg/h
Molar Flow (Vapor Phase) / Acetylene	9.99444	0	0	6.54125	0	0	332.856	0	kmol/h
Mass Flow (Vapor Phase) / Acetylene	260.228	0	0	170.316	0	0	8666.67	0	kg/h
Molar Flow (Mixture) / Hydrogen chloride	52790.3	52790.3	0.000605714	52596.2	0	333.691	0	52790.3	kmol/h
Mass Flow (Mixture) / Hydrogen chloride	1.92478E+06	1.92478E+06	0.0220849	1.91771E+06	0	12166.7	0	1.92478E+06	kg/h
Molar Flow (Vapor Phase) / Hydrogen chloride	52790.3	0	0	1042.86	0	333.691	0	0	kmol/h
Mass Flow (Vapor Phase) / Hydrogen chloride	1.92478E+06	0	0	38023.8	0	12166.7	0	0	kg/h
Molar Flow (Mixture) / Vinyl chloride	327.571	302.1	25.4704	302.14	0	0	0	302.1	kmol/h
Mass Flow (Mixture) / Vinyl chloride	20472.6	18880.7	1591.85	18883.2	0	0	0	18880.7	kg/h
Molar Flow (Vapor Phase) / Vinyl chloride	327.571	0	0	0.0867448	0	0	0	0	kmol/h
Mass Flow (Vapor Phase) / Vinyl chloride	20472.6	0	0	5.42139	0	0	0	0	kg/h