Applicant: SynTech

Inventors: Jai Gaikwad, Apurva, Anshika Singh

Chemical Product Formula: $(C_2H_3Cl)_n$

Chemical Product Name: Polyvinyl Chloride

Process Title: Production of Polyvinyl Chloride using suspension method

EHS Summary:

a. List the wastes generated and their quantity of generation.

Unreacted Acetylene :
Acetylene flow rate = Acetylene flow rate from compound splitter
= 0.5 kmol/day
= 13 kg/day
Hydrogen Chloride (HCl) Gas :
HCl flow rate = HCl flow rate in compound splitter
= 0.58 kmol/day
= 18.2 kg/day
Benzyl Alcohol (Additive) :
Benzyl Alcohol flow rate = Benzyl Chloride flow rate in dryer
= 6.633 kg/day
Wastewater :
Wastewater flow rate = Water flow rate in water removal unit + Water flow rate in dryer
= 2122.2 kg/day + 100 kg/day
= 2222.2 kg/day
Mercuric Chloride ($HgCl_2$) Catalyst Residue & Unteacted VCM :
Extremely small amount

b. What are the current regulations for the above waste materials? (Limits to which it can be disposed in the environment)

Chemical	Safety Concerns	Exposure Limits	Additional Information
Acetylene	Asphyxiant, Flammable	TWA : 2500 ppm	Ensure proper ventilation to prevent accumulation. Remove ignition sources.
Hydrogen Chloride (HCl) Gas	Corrosive, Irritant (respiratory, skin, eyes)	Ceiling : 5 ppm	Use appropriate personal protective equipment (PPE). Neutralize spills with a

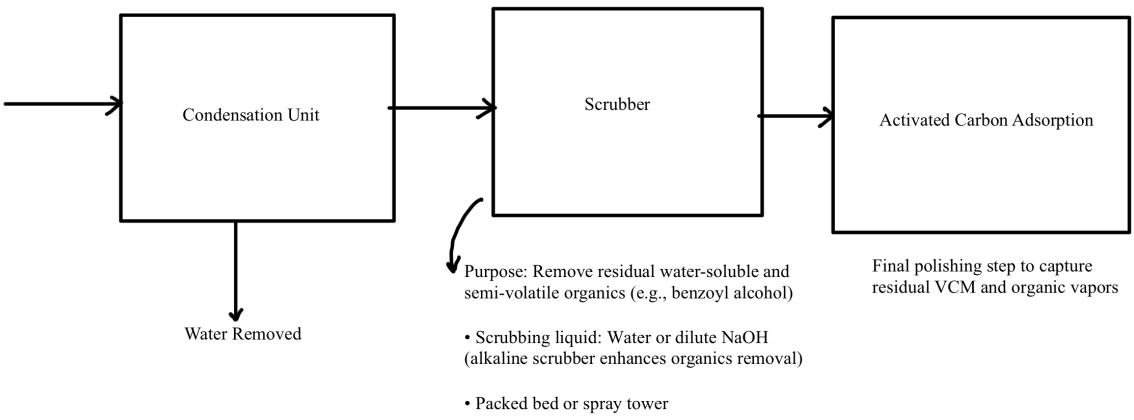
			base (e.g., sodium bicarbonate).
Mercuric Chloride (HgCl2) Catalyst	Highly Toxic, Environmental Hazard, potential carcinogen.	0.01 mg/m3 (as Hg)	Requires specialized handling and disposal as hazardous waste. Mercury is a bioaccumulative toxin.
Benzyl Alcohol	Exposure can cause headache, dizziness, nausea, and in severe cases, respiratory failure.	TWA : 10 ppm	Use appropriate PPE. Minimize skin contact.
Vinyl Chloride Monomer (VCM)	Carcinogen, Flammable	TWA: 1 ppm, Ceiling: 5 ppm	VCM is a known human carcinogen. Strict regulations govern its handling and disposal.

c. Describe the treatment procedure for wastes with a block diagram. Your chemical plant must be a zero liquid discharge plant.

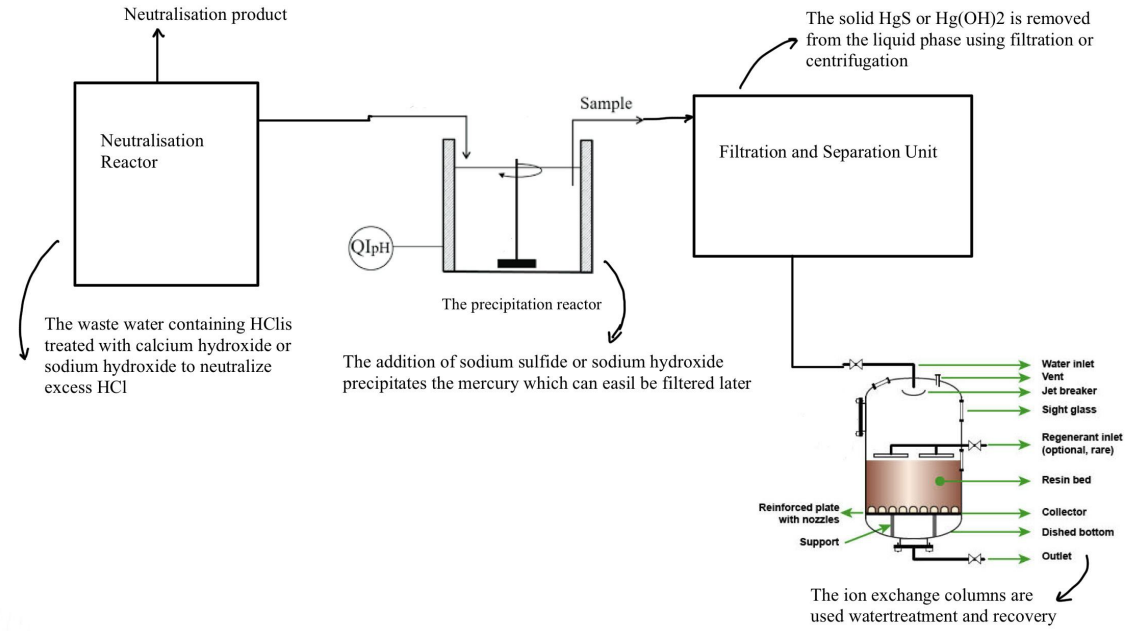
1) Wastewater Treatment :

O1

2) Vent gases Treatment :



3) Separation of HCl and HgCl2 from water :



d. Are there any safety concerns for the chemicals? Give exposure limits: Time Weighted Average (TWA) for 8 hours and short-term exposure limit (STEL) for 15 minutes.

Chemical	Health Concerns	TWA (ppm)	STEL (ppm)
Acetylene	High concentrations can cause dizziness, headache, and asphyxiation; it is also a highly flammable gas.	2500	Not Established
Hydrogen Chloride (HCl) Gas	Causes respiratory tract irritation, coughing, and choking; high concentrations can lead to pulmonary edema.	5 (Ceiling)	Not Established
Mercuric Chloride ($HgCl_2$)	Highly toxic; can cause kidney damage, respiratory failure, and is a potential carcinogen.	0.01 (as Hg)	Not Established
Benzyl Alcohol	Exposure can cause headache, dizziness, nausea, and in severe cases, respiratory	10	20

	failure.		
Vinyl Chloride Monomer (VCM)	Carcinogenic,causes liver and kidney damage, leads to skin and eye irritation	1	5

References: Provide reference for a material safety data sheet/industrial safety report/weblink.

Unreacted Acetylene: - OSHA Table Z-1

Hydrogen Chloride (HCl) Gas: OSHA Chemical Data: Hydrogen Chloride

Mercuric Chloride ($HgCl_2$) Catalyst Residue: OSHA Table Z-2

Unreacted Vinyl Chloride Monomer: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1017?utm_source=chatgpt.com

Benzyl Alcohol Waste: NIOSH Pocket Guide

https://www.crowcon.com/us-en/article/toxic-gas-exposure-limits-and-alarm-levels/

https://newcastlesafetyservicing.com/stel-and-twa/

https://www.chemtronicsindia.com/pdf/9.9%20ACGIH%20-%20threshold-limit-values-%28tlv%29.pdf

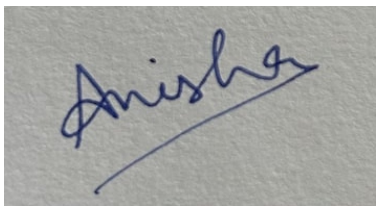
https://safety.fsu.edu/safety_manual/Threshold%20Limit%20Values%20and%20Flammability%20of%20Some%20Commonly%20Used%20Gases.pdf

https://studylib.net/doc/25478437/threshold-limit-values--tlv-

https://automation.honeywell.com/content/dam/his-sandbox/marketing/gas-and-flame-detection/documents/RS_app-notes_technical-note-119_calculating-stel_2c-twa_2c-min_2c-max_2c.pdf

List the contributions of each author:

- Apurva determined the waste generation quantity.
- Apurva carried out the literature search and found the current regulations.
- Jai Gaikwad found the necessary treatment steps and prepared the block diagram.
- Anshika Singh obtained TWA and STEL data.

Name	Roll No	Signature
Anisha Nanda	230145	
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