VortexChem

Inventors: Nirjala Kushwaha, Prathvi Rathore, Prince Yadav, Khushi Jain

Chemical Product Formula: ($C_{14}H_{17}Cl_2N_3O$)

Chemical Product Name: Hexaconazole

Process Title:

EHS Summary:

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

Step-1 (Preparation of Valerophenone)

Aqueous waste to ETP: 1.452kg / kg of Hexaconazole

Al(OH)3: 2.393kg / kg of Hexaconazole

Residue: 0.03kg / kg of Hexaconazole

Step - 2 (Preparation of Oxirane):

K2SO4: 0.898 Kg / Kg of Hexaconazole

Aq. Waste to ETP: 2.195 Kg / Kg of Hexaconazole

Step - 3 (Preparation of Hexaconazole):

KOH: 0.071kg / kg of Hexaconazole

Residue: 0.44kg

Aq. Waste to ETP: 2.22 Kg / Kg of Hexaconazole

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

Chemical	Safety Concern	Exposure Limits	Additional Information
DMF	Toxic, affects liver and respiratory system	ACGIH TLV: 10 ppm (30 mg/m^3) (8-hour TWA) ACGIH STEL: 15 ppm (45 mg/m^3)	Must be incinerated or recovered via distillation to prevent environmental contamination
Methanol	Highly flammable, toxic by inhalation and skin absorption	NIOSH REL: 200 ppm (260 mg/m^3) (8-hour TWA) NIOSH STEL: 250 ppm (325 mg/m^3)	Requires proper solvent recovery and explosion-proof storage

KOH	Corrosive, causes severe skin burns and eye damage	ACGIH Ceiling Limit: 2 mg/m^3	Requires neutralization before disposal. Proper PPE must be worn.
Aqueous Waste	High COD, BOD, and dissolved solids; potential toxicity	COD Limit: <250 mg/L BOD Limit: <30 mg/L	Must undergo primary, secondary, and tertiary treatment before evaporation in a ZLD system.
Solid Residue (Salts, Catalyst, Unreacted Materials)	May contain hazardous metal residues; needs controlled disposal	No direct exposure limits, depends on composition.	Can be sent for incineration or secure landfill disposal based on hazardous classification.
K2SO4	May cause mild irritation to the skin, eyes, and respiratory tract	ACGIH TLV (Inhalable dust): 1.4ppm (10mg/m3), OSHA PEL: 2.10ppm (15mg/m3)	Use PPE, ensure good ventilation, and store in a dry, cool place away from acids.
Al(OH)3	Aluminum hydroxide can cause respiratory, skin, and eye irritation, and ingestion may lead to gastrointestinal discomfort	OSHA PEL: 15 mg/m^3 ACGIH TLV: 1 mg/m^3	Use PPE and proper ventilation to minimize risks.

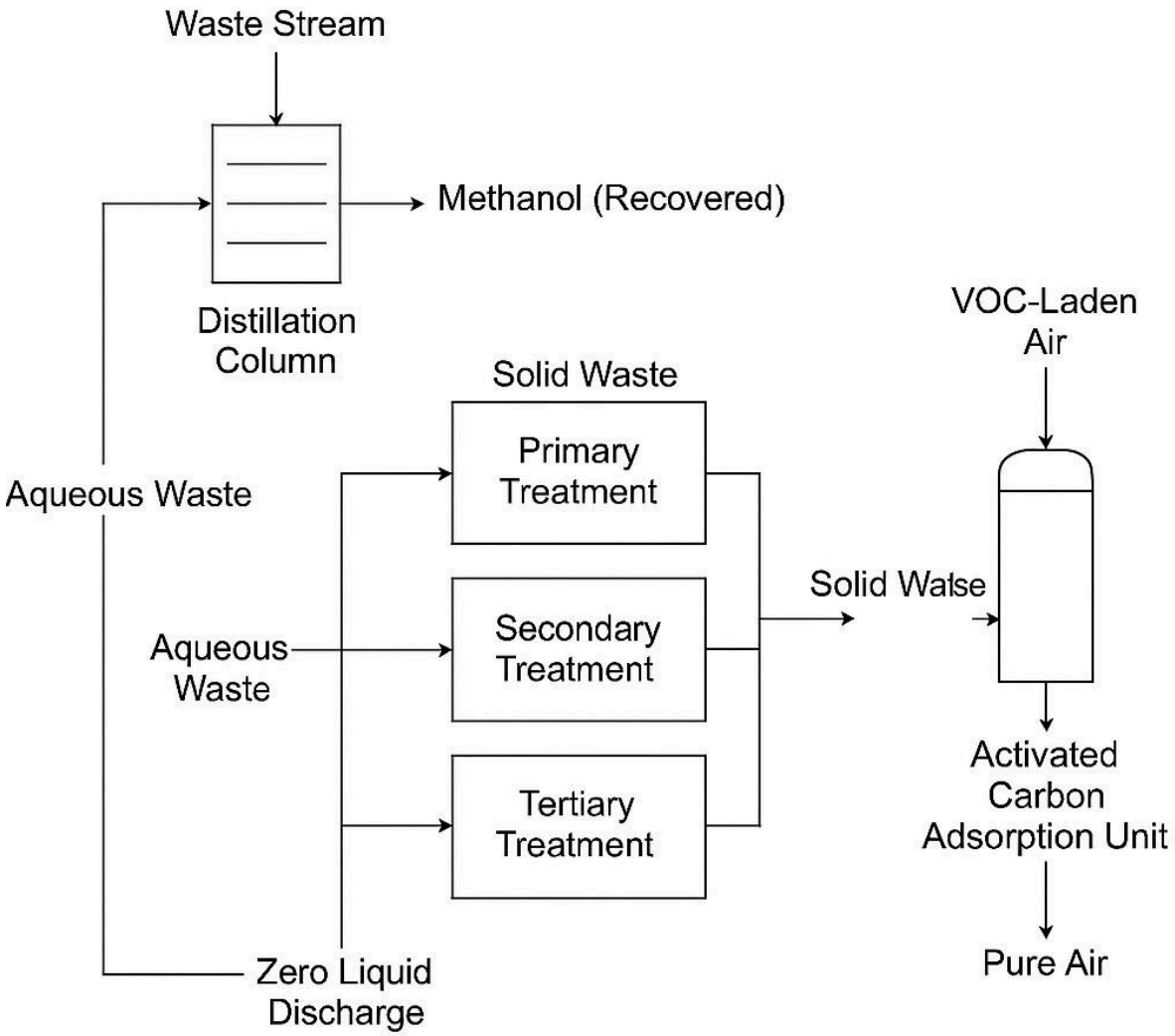
c. Describe the treatment procedure for wastes with block diagram. Your chemical plant must be a zero liquid discharge plant.

Methanol Recovery: Waste stream containing methanol is processed in a distillation column to recover and reuse methanol, reducing solvent waste.
Aqueous Waste Treatment: Wastewater undergoes primary (neutralization & filtration), secondary (biological treatment), and tertiary (reverse osmosis &

evaporation) treatment in the Effluent Treatment Plant (ETP). Multiple Effect Evaporator (MEE) & Crystallizer ensure Zero Liquid Discharge (ZLD).

Solid Waste Management: Salts, catalysts, and unreacted materials are separated. Non-hazardous residue is sent to a secure landfill, while hazardous waste is incinerated safely.

VOC Emission Control: Volatile Organic Compounds (VOCs) from DMF and methanol emissions are captured using an activated carbon adsorption unit, ensuring safe air release.



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	STEL
DMF	Acute dermal toxicity Category 4 (H312) Acute Inhalation Toxicity - Vapors Category 4 (H332) Serious Eye Damage/Eye Irritation Category 2 (H319) Reproductive Toxicity	10 ppm (30 mg/m^3) (8-hour TWA)	15 PPM (45 kg/m^3)
Methanol	Headache, nausea, vomiting, blindness; can be fatal	200 ppm (260 mg/m^3)	250 ppm (325 mg/m^3) (Some countries have a lower TWA)
KOH	Severe irritation of eyes, nose, and throat; cancer. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath.	2 mg/m^3	2 mg/m^3
K2SO4	May cause mild irritation to the skin, eyes, and respiratory tract; ingestion in large amounts can cause nausea.	OSHA PEL: 10 mg/m^3 (TWA - 8 Hour)	No official STEL limit, but generally 1.5x to 3x TWA (~3.15 - 6.30 ppm)
Al(OH)3	Aluminum hydroxide can cause respiratory, skin, and eye irritation, gastrointestinal issues if ingested,	OSHA PEL: 15 mg/m^3 ACGIH TLV: 1 mg/m^3 (8 Hour TWA)	OSHA STEL: No specific STEL is set for aluminum hydroxide; the general PELs apply (15 mg/m^3 total dust, 5

	and potential bone or neurological effects with long-term exposure.		mg/m^3 respirable fraction).

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

https://1drv.ms/b/c/2912534b23cccb88/Ef3i6ndcdftMko76lbF6CMQBmflQEW2QTrRMyt-MaLUkFA?e=pFDh6m

https://www.osha.gov/chemicaldata/481

https://1drv.ms/b/c/2912534b23cccb88/EawvQtN6sDFPrZWjnFx9LHcB25sf70np005nn2tXpm0b4A?e=3eopTu

https://1drv.ms/b/c/2912534b23cccb88/ES2HMCvdDEtJubgAWhBKDS0Bq3p8eyBY8GDVE7Lt4GRaRA?e=Lbl2n1

https://1drv.ms/b/c/2912534b23cccb88/Eem5ThzjetZEhX8ybF8kPCwB3K8mMpQy_jxs5nvcYDwB2Q?e=SwcdeE

https://www.osha.gov/chemicaldata

https://www.wef.org/

https://www.who.int/about

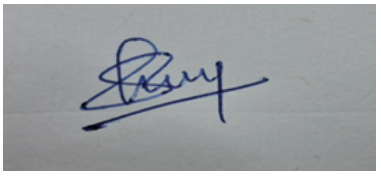
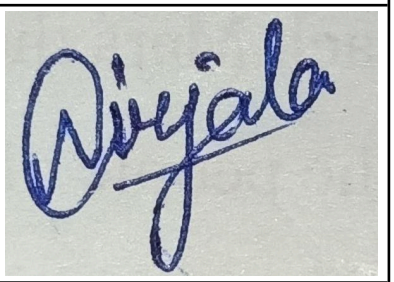
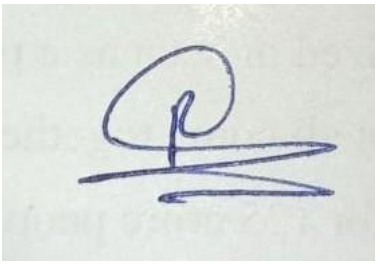
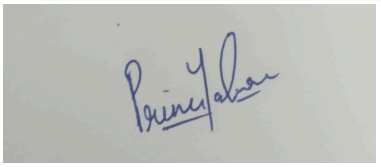
https://www.niehs.nih.gov/

https://datasheets.scbt.com/sc-203365.pdf

List the contributions of each author:

- Prince and Khushi determined the waste generation quantity.
- Nirjala and Khushi carried out the literature search and found the current regulations.
- Nirjala ,Prathvi and Prince found necessary treatment steps and prepared the block diagram.
- Nirjala and Prathvi obtained TWA and STEL data.

Sign the pdf and upload.

Name	Roll No	Signature
CEO - Kumar Shubham	230587	
Nirjala Kushwaha	230704	
Prathvi Rathore	230780	
Prince Yadav	230792	
Khushi Jain	230560