

VortexChem

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

Chemical Product Formula: $C_{28}H_{22}Cl_2FNO_3$

Chemical Product Name: Flumethrin

Process Title:

EHS Summary:

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

Step-1 (Preparation of Bayticol P acid chloride)

HCl gas : 76 kg / 1000 kg of Flumethrin

SO₂ gas : 130 Kg / 1000 Kg of Flumethrin

Rec. Toluene: 835 kg / 1000 kg of Flumethrin

Aq. effluent: 1648 kg / 1000 kg of Flumethrin

Residue: 29 kg / 1000 kg of Flumethrin

Step-2 (Preparation of Flumethrin)

Rec. Toluene: 3026 kg / 1000 kg of Flumethrin

Aq. effluent: 1605 kg / 1000 kg of Flumethrin

Residue: 89 kg / 1000 kg of Flumethrin

- 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 |
|---------------------------|---|---|--|
| Recovered Toluene | Highly flammable, toxic to nervous system | OSHA PEL: 200 ppm (TWA) ACGIH STEL: 100 ppm | Recovered via distillation and reused in the process |
| SO₂ Gas | Toxic, causes lung irritation. | OSHA PEL: 5 ppm (13 mg/m ³) (TWA) ACGIH STEL: 0.25 ppm | Scrubbed using NaOH or lime solution |
| HCL | Can cause severe respiratory, skin, and eye irritation, burns on contact, | OSHA PEL: 5 ppm (7 mg/m ³) (Ceiling) | Scrubbed using alkaline solution before release |

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|-------------------------|---|--|--|
| | and respiratory distress if inhaled; it's highly corrosive. | | |
| Aqueous Effluent | High COD, BOD, dissolved salts | COD Limit: <250 mg/L BOD Limit: <30 mg/L pH Range: 6.5-8.5 | Treated in ETP with biological, chemical, and RO processes |

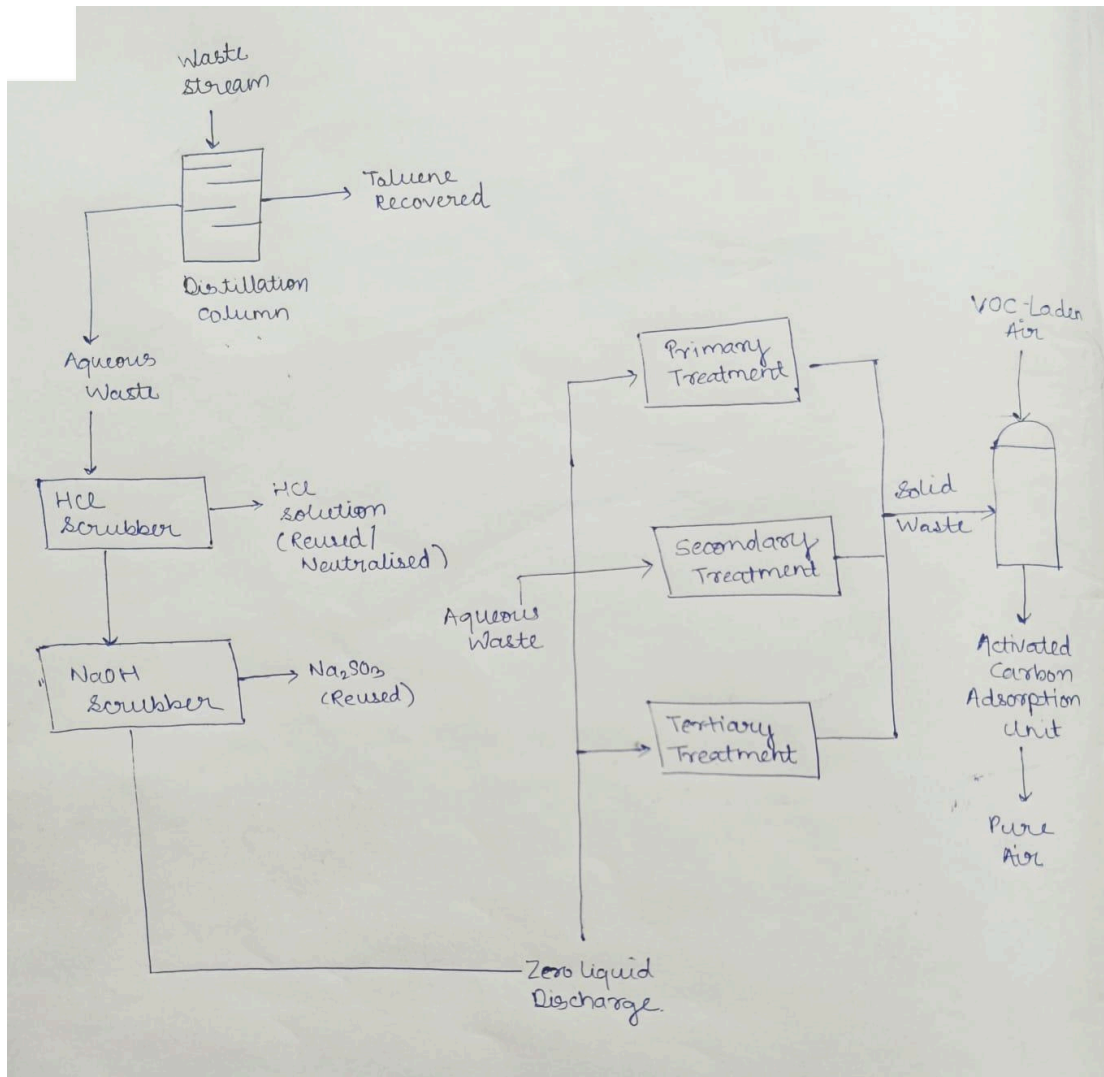
- c. Describe the treatment procedure for wastes with block diagram. Your chemical plant must be a zero liquid discharge plant.

HCl and SO₂ gas treatment: They undergo a scrubbing process where using alkaline solution like NaOH, and converted to salts for reuse or release.

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 toluene vapors due to solvent recovery, residual HCl and SO₂ emissions, minor organic trace solvents are captured using an activated carbon adsorption unit, ensuring safe air release.



- e. 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 |
|----------------|---|---|---|
| Toluene | Flammable, neurotoxic | 200 ppm | 100 ppm |
| HCL | Can cause severe respiratory, skin, and eye irritation, chemical burns, coughing, shortness of breath, and lung damage if inhaled or contacted. | ACGIH TLV-TWA: 2 ppm (8-hour workday) OSHA PEL: 5 ppm (8-hour TWA) | ACGIH STEL: 5 ppm for a 15-minute exposure. OSHA STEL: 5 ppm (15-minute exposure limit). |
| SO2 | Toxic, causes lung irritation, damage, and in high exposures, pulmonary edema and systemic toxicity. | OSHA PEL: 5 ppm (13 mg/m ³) (8-hour) NIOSH REL: 2 ppm (5 mg/m ³) | ACGIH STEL: 0.25 ppm. NIOSH REL: 5 ppm (13 mg/m ³) |

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

<https://1drv.ms/b/c/2912534b23cccb88/ETwdpbnsCYZBi7iFUur5XHgBlyG8mNXsMISRiLZ8IOsqhg?e=UwH8gR>

<https://www.osha.gov/chemicaldata>

<https://www.cdc.gov/niosh>

<https://www.who.int/about>

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

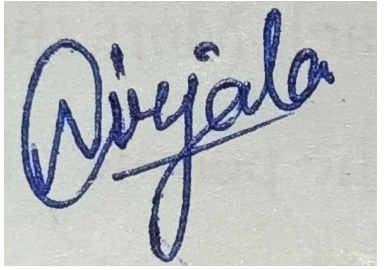
https://environmentclearance.nic.in/writereaddata/Online/TOR/10_Feb_2022_18360085055790452AdditionalDocuments.pdf?utm_source=chatgpt.com

List the contributions of each author:

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

Sign the pdf and upload.

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