Applicant: ProChem Innovations

Inventors:

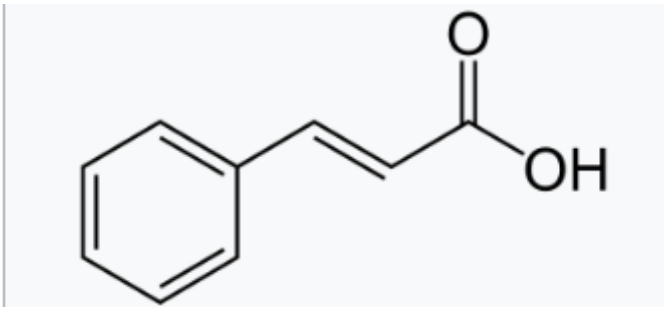
- Akansha Ratnakar
- Lovedeep Sharma
- Kishor Brahmane

Chemical Product Formula: C9H8O2

Chemical Product Name: (E)-3-phenylprop-2-enoic acid/ (Cinnamic acid)

Process Title: Perkin Reaction

Chemical Structure:



EHS Summary:

A) Safety concerns:

1.Exposure to chemicals:

- Benzaldehyde can cause irritation to the eyes, skin, and respiratory tract upon exposure. It may also cause headaches, dizziness, and nausea. Prolonged or repeated exposure may lead to sensitization or allergic reactions.

- Acetic anhydride is highly corrosive and can cause severe burns upon contact with skin or eyes. Inhalation of its vapors can irritate the respiratory tract and lead to coughing, difficulty breathing, and lung damage.
- Toluene and xylene are both volatile organic compounds (VOCs) that can cause irritation to the eyes, nose, and throat. Prolonged exposure can lead to headaches, dizziness, and neurological effects.

2. Fire hazards:
   - The preparation of cinnamic acid involves various chemicals and processes that can pose fire hazards if not handled properly.
3. Handling and storage:
   - In the production of cinnamic acid, handling and storage concerns arise due to the hazardous nature of certain chemicals involved,potential reactivity, and environmental impact. Store chemicals in dedicated storage areas that are well-ventilated, cool, dry, and away from sources of heat, ignition, or direct sunlight. Use appropriate storage containers, such as chemical-resistant cabinets or shelves, to prevent spills, leaks, or contamination.

B) Waste generation in preparation of cinnamic acid:

- Sodium acetate: While sodium acetate itself is not highly toxic, its elevated levels in water can affect aquatic life by altering pH levels, disrupting osmoregulation, and impacting aquatic ecosystems.

- Benzaldehyde and acetic anhydride: both of them are toxic for aquatic life and highly flammable substances with low

flash points.They are volatile organic compounds which lead to air pollution when released into the environment.

- Acetic acid: It can be corrosive to metals and certain materials. If disposed of improperly, acetic acid waste corrodes storage tanks, pipelines, and other equipment, leading to leaks, spills, and environmental contamination.
- Solid waste: The production of cinnamic acid typically generates solid waste primarily in the form of by-products, impurities, and unused reactants. The specific composition and quantity of solid waste can vary depending on the synthesis method and purification techniques employed.
- Water waste: There is a lot of waste water produced in preparation of cinnamic acid from different steps such as Reaction and Workup steps, Purification Processes, Cleaning and Maintenance, etc.

C) Treatment procedure for waste produced:

- Benzaldehyde and Acetic anhydride: We can reuse this mixture if it is in good quality or else we can dispose of it by following procedure: If benzaldehyde waste is in solution form and acidic or basic, it may need to be neutralized before further treatment. Benzaldehyde waste can be passed through a bed of activated carbon to adsorb the benzaldehyde molecules before disposal. Once benzaldehyde waste has been treated and rendered non-hazardous, it can be disposed of in accordance with local regulations for industrial wastewater discharge or hazardous waste disposal.

- Sodium acetate :It is managed by first neutralizing it to a safe pH level, often using chemicals like sodium hydroxide or sulfuric acid. This neutralization process helps reduce the impact of the waste on aquatic ecosystems by minimizing pH fluctuations. Additionally, dilution with water is sometimes employed to further decrease the concentration of sodium acetate before disposal. Depending on the specific waste characteristics and regulations, it also employs advanced treatment methods such as chemical precipitation or filtration to remove contaminants before discharge. Proper documentation of waste disposal activities is crucial, as it ensures compliance with environmental regulations and facilitates tracking of the waste management process.

- Acetic acid: It is handled by employing corrosion-resistant materials in storage tanks, pipelines, and equipment to prevent leaks and spills. Proper disposal methods include neutralization to a safe pH level, dilution with water, and adherence to environmental regulations. Advanced treatment techniques like chemical precipitation or filtration may also be used to remove contaminants before disposal. By implementing these measures and maintaining compliance, industries mitigate the risk of environmental contamination and ensure responsible management of acetic acid waste.

D) Permissible Concentration of waste produced in Work Area :

- Acetic Acid:

  1.European Agency for Safety and Health at Work (EU-OSHA) - European Union:

  >Indicative Occupational Exposure Limit (IOEL) Time-Weighted Average (TWA): 10 parts per million (ppm) for an 8-hour workday.

- Sodium Acetate

  >EU-OSHA also does not specify a numerical limit for sodium acetate exposure due to its solid nature. It focuses on controlling exposure through engineering controls and personal protective equipment.

- Benzaldehyde:

  > European Agency for Safety and Health at Work (EU-OSHA) - European Union:

  >Indicative Occupational Exposure Limit (IOEL) Short-Term Exposure Limit (STEL): 10 parts per million (ppm) for a 15-minute period.

References:

>https://www.nj.gov/health/eoh/rtkweb/documents/fs/0005.pdf

>https://nj.gov/health/eoh/rtkweb/documents/fs/0196.pdf#:~:text=Benzaldehyde%20can%20affect%20you%20when%20breathed%20in%20and,exposure%20can%20cause%20a%20skin%20rash%20to%20develop.

>https://www.cdc.gov/niosh/npg/npgd0003.html

>https://www.bing.com/ck/a?!&&p=989af469eaac88feJmltdHM9MTcxMjE4ODgwMCZpZ3VpZD0yODRmZDg2Ni01YmM3LTZjMmEtMzMxMy1jYmVkNWEzNTZkNWMmaW5zaWQ9NTM0Mg&ptn=3&ver=2&hsh=3&fclid=284fd866-5bc7-6c2a-3313-cbed5a356d5c&psq=waste+water+treatment+regulations+in+chemical+industries&u=a1aHR0cHM6Ly9saW5rLnNwcmluZ2VyLmNvbS9jaGFwdGVyLzEwLjEwMDcvOTc4LTMtMDMwLTYxMDAyLTIfMw&ntb=1

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Inventors:

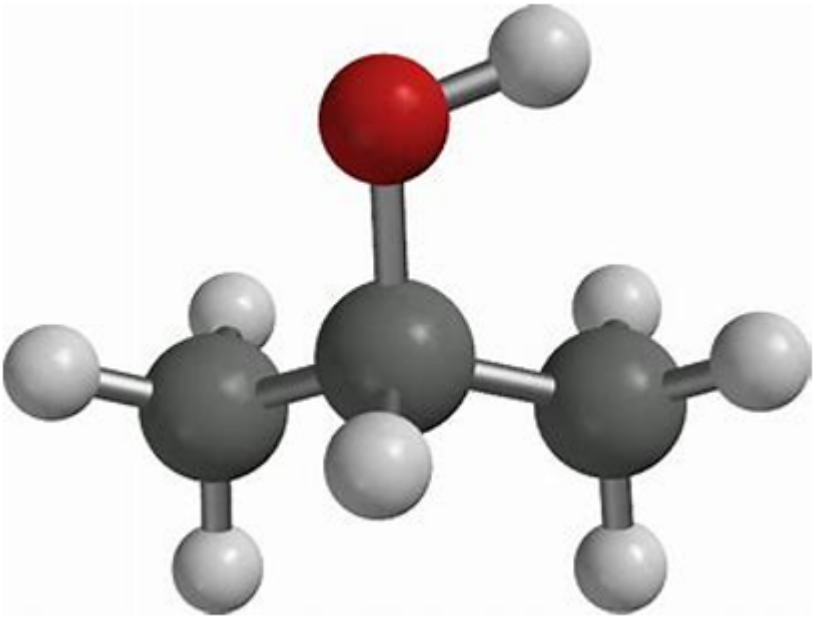
- Akansha Ratnakar
- Lovedeep Sharma
- Kishor Brahmane

Chemical Product Formula: $(CH_3)_2CHOH)$

Chemical Product Name: propan-2-ol/ (Isopropyl alcohol)

Process Title: Hydration Reaction

Chemical Structure:



EHS(Environmental Summary:

A. Safety concerns regarding preparation of Isopropanol.

1. Ventilation:

Isopropanol should be prepared in a well-ventilated area with adequate airflow to prevent the accumulation of vapors. Poor ventilation can lead to the buildup of potentially harmful concentrations of isopropanol vapors in the air.

· Ventilation systems, such as fume hoods or exhaust fans, should be used to remove vapors from the work area.

2. Avoiding Heat Sources:

· Isopropanol is flammable and can ignite at relatively low temperatures. Therefore, it is crucial to keep it away from heat sources, open flames, sparks, and hot surfaces during preparation. It is ensured that all equipment used for heating or mixing is properly grounded and does not produce sparks.

B. Waste generation in preparation of Isopropyl alcohol:

1). Raw Material Processing Waste:

> Propylene: Propylene is not considered a significant environmental pollutant due to its short atmospheric lifetime and low reactivity. However, its production, use, and disposal can release toxic chemicals that can adversely affect human health and the environment. These toxic chemicals include formaldehyde, benzene, and carbon monoxide

2) Reaction By-Products:

> Hydration Reaction: The most common method for isopropanol synthesis involves the hydration of propylene. This reaction typically involves the use of a strong acid catalyst, such as sulfuric acid or phosphoric acid, and water. While the main

product is isopropanol, by-products may include small amounts of other alcohols, ethers, and water.

3) Wastewater:

- Wastewater from Reactor: During the reaction, water is often used as a reactant or a solvent. This water may become contaminated with unreacted starting materials, catalyst residues, by-products, and impurities. Proper treatment of this wastewater is necessary to remove contaminants before disposal to prevent environmental pollution.
- Neutralisation and pH Adjustment: Acidic or alkaline conditions may be present due to the use of acid catalysts or the need for pH adjustment during various stages of the process. Neutralisation of acidic or basic waste streams may generate salts or precipitates that need proper disposal.

4). Energy Consumption:

- Energy Waste: The preparation of isopropanol often requires significant energy inputs, especially during the reaction stages and purification processes. Energy consumption contributes to environmental impacts such as greenhouse gas emissions and resource depletion, although it may not directly generate waste, it's an important aspect to consider in overall environmental impact assessment.

5). Solid Waste: Catalyst and Reactant Contaminated Materials: Used catalysts, spent solvents, and contaminated equipment may require disposal as hazardous waste due to their potential toxicity or reactivity.

C. Treatment procedure for waste produced:

> Propylene: It is recycled, the process involves the thermal depolymerization of plastic waste into valuable products. This method can be improved by using a thermo-catalytic method to convert plastic waste into useful products, such as catalytic pyrolysis, which has several advantages over thermal pyrolysis, including a lower degradation temperature, quicker cracking reaction, improved selectivity, shorter operating time, and enhanced product.

> Waste water: We use several processes for this such as Advanced Oxidation Processing (AOP): AOP is a chemical treatment method that uses strong oxidizing agents to break down organic pollutants in wastewater. Vitrification is a thermal treatment method that converts wastewater into a glass-like material. This method is effective in removing solids, oils, and grease from wastewater.

> Solid waste: Treatment for solid waste, mechanical treatment methods include particle agglomeration, immobilization, filtration, and solidification. These methods focus on altering the size, shape, density, or state of the waste stream from solid to liquid,

D. Permissible Concentration of waste produced in Work Area :

- **Propylene**

  Health and Safety Executive (HSE) - United Kingdom:
  >Workplace Exposure Limit (WEL) Time-Weighted Average (TWA): 1000 parts per million (ppm) for an 8-hour workday.

- **Formaldehyde**

  Occupational Safety and Health Administration (OSHA) - United States:
  >Permissible Exposure Limit (PEL) Time-Weighted Average (TWA): 0.75 parts per million (ppm) for an 8-hour workday.
  >Short-Term Exposure Limit (STEL): 2 ppm for a 15-minute period.

- **Benzene**

  Occupational Safety and Health Administration (OSHA) - United States:
  >Permissible Exposure Limit (PEL) Time-Weighted Average (TWA): 1 part per million (ppm) for an 8-hour workday.
  >Short-Term Exposure Limit (STEL): 5 ppm for a 15-minute period.

- **Carbon Monoxide**

  Occupational Safety and Health Administration (OSHA) - United States:
  >Permissible Exposure Limit (PEL) Time-Weighted Average (TWA): 50 parts per million (ppm) for an 8-hour workday.
  >Short-Term Exposure Limit (STEL): 200 ppm for a 15-minute period.

References:

>https://www.bing.com/ck/a?!&&p=b72f47e026fd6c53JmltdHM9MTcxMjE4ODgwMCZpZ3VpZD0yODRmZDg2Ni01YmM3LTZjMmEtMzMxMy1jYmVkNWEzNTZkNWMmaW5zaWQ9NTIzNA&ptn=3&ver=2&hsh=3&fclid=284fd866-5bc7-6c2a-3313-cbed5a356d5c&psq=propylene+waste+treatment+method&u=a1aHR0cHM6Ly93d3cubmNiaS5ubG0ubmloLmdvdi9wbWMvYXJ0aWNsZXMvUE1DOTM3MDkyNS8&ntb=1

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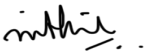
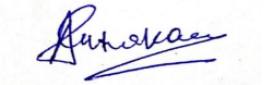
Contribution of each author(For Both chemicals):

- Author 1,2 and 3 carried out the literature search and found the current regulations.
- Author 2 and 3 obtained data for Permissible limits , Author 1 obtained STEL and PEL data.
- Author 1, and 2 carried out the methods for waste disposal techniques.

Signature:

Name	Roll No	Signature
Nikhil Gupta (CEO)	**220708**	
1. Akansha Ratnakar	**220093**	
2. Lovedeep sharma	**220595**	
3. Kishor Brahmane	**220536**