Nature of Invention: Process design

**Applicant:** NCL

**Inventors:** Prince Yadav

**Chemical Formula:** C2H3ClO2

**Chemical Name:** Monochloroacetic acid

**Process Title:**

**Process Description:**

1. Give the block diagram for the feasible process (as determined in market analysis report). List all unit operations and process conditions.

**Unit operations and process conditions.**

1. **Chlorination Reaction:**

- **Unit Operation:** Reactor operation (liquid-phase reactor)

- **Operating Conditions:**

- **Temperature**: Not explicitly provided, but typically within the range suitable for liquid-phase reactions.

- **Pressure**: 3-5 bar

- Chlorine gas saturation in the liquid phase, under waterless conditions.

- **Type of Reactor**: Liquid-phase reactor

2. **Stripping**:

- **Unit Operation:** Stripping tower operation

- **Operating Conditions:**

- Temperature: Not explicitly provided, but typically between 120 and 180°C.

- Pressure: Between 1 and 7 bar

- **Type of Reactor:** Stripping tower

3. **Cooling**:

- **Unit Operation:** Cooling process

- **Operating Conditions:**

- Temperature: Cooling to a temperature between 10 and 60°C (preferably around 35°C)

- **Type of Equipment**: Cooling system or heat exchanger

4. **Absorption**:

- **Unit Operation**: Absorption tower operation

- **Operating Conditions:**

- Temperature: Operating at the cooled temperature of the gaseous HCl stream.

- **Type of Reactor:** Absorption tower

5. **Crystallization**:

- **Unit Operation**: Crystallization process

- **Operating Conditions:**

- Temperature: Dynamic behaviour analysis indicates a temperature of 273 K (0°C) as the optimal condition.

- **Type of Equipment:** Crystallization vessel or crystallizer

**Specific Operating Conditions:**

- The chlorination reaction takes place in a liquid-phase reactor under pressure, with chlorine gas saturation in the liquid phase, typically at temperatures suitable for liquid-phase reactions.

- Stripping of the liquid phase occurs at elevated temperatures and pressures to separate MCAA and DCAA.

- Cooling of the gaseous HCl stream occurs to a temperature between 10 and 60°C before absorption.

- Absorption of HCl gas is conducted at the cooled temperature of the gaseous HCl stream.

- Crystallization is carried out at a temperature of 273 K (0°C) for optimal separation of MCAA from the mother liquor.

1. Give the material balance for a scaled-up process plant with capacity of 1000 kg/day. (If needed, simplify the calculations by stating assumptions)
2. List the capacity of reactors needed and evaluate the cost. Use Glass lined Carbon steel (GS lined CS) as the material of construction (MOC). Use the pressure according to reaction conditions. You will use only 70% of the total volume. If you design a 1000 L reactor, you can only fill 700 L reaction mixture.

**Capital cost (only for the reactor):**

**example:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Equipment** | **Design Capacity (L)** | **No. of units** | **Cost/unit ($ for year 2014)** | **Total Cost ($ for year 2014)** |
| Reactor 1  (Jacketed reactor, agitated, Carbon steel, atm. pressure) | 2000 | 1 | 33,500 | 33,500 |
|  |  |  |  |  |

**References:** Provide reference for a research paper or an actual patent.

1. <http://www.matche.com/equipcost/Reactor.html>

**List the contributions of each author:**

* Prince Yadav finds out about unit operation and process condition information.
* Authors 2 and 3 found necessary separation steps to achieve desired product purity.

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| CEO Name |  |  |
| Prince Yadav | 200725 | Prince Yadav |
| Second author Name (if any) |  |  |
| Third author Name (if any) |  |  |
| Fourth author Name (if any) |  |  |
| Fifth author Name, Roll No & signature (if any) |  |  |
| Sixth author Name (if any) |  |  |