

## **POLLUTION CONTROL AND SAFETY**

Generally, in plant of acetic acid various problems are encountered during the usage of plant regarding pollution and safety purposes. They are as follows.

### **1.) CONCENTRATION AND PURIFICATION:**

- This means total removal of impurity. Generally, aqueous solutions of acetic acid are to produce as byproducts of industrial processes. Recovery of the acid from these aqueous streams can be accomplished by column distillation, azeotropic distillation, solvent extraction and extractive distillation.
- Direct Distillation: A significant number of plates and a high reflux ratio in column is required.
- Extractive Distillation: The vapor streams of acetic acid and water are to scrub with a high boiling solvent that preferentially dissolves one of the components.

### **2.) WASTE WATER AND OFF GAS PROBLEMS :**

- The acetic acid contained in wastewater is to dilute, neutralize and then degrade biologically. In Federal Republic of Germany, acetic acid belongs to class 2 materials (TA-LUFT) as an off-gas problem. Under this class, a limit of  $150\text{mg/m}^3$  acid is permissible for emissions  $\geq 3$  kg/h of off-gas.
- Acetic acid can be removable from the off-gas by cooling or by washing with water.
- Some other acetate compounds which belongs to class 2, (TA-LUFT) are ethyl acetate, butyl acetate and phenyl acetate.
- Off-gas emissions containing esters in class 3 may contain a maximum of  $300\text{mg/m}^3$
- for emissions  $\geq 6\text{kg/h}$  of off-gas.
- So, these esters removal from gas emissions can be achieved by thermal condensation, washing with nonvolatile organic solvents, physical adsorption or burning.
- In US, emissions are governed by US Clean Air Act, with each state having enforcement responsibilities. In various status there, the acetic

acid and volatile organic compounds (like acetic acid esters) are limited to emission of less than  $22.675 \times 10^3$  kg/a (<2.6 kg/h).

3.) QUALITY CHECK:

- As per only one commercial grade of acetic acid sold in US, one of the most requirements is "*permanganate time*". For this test, a solution of 5 ml of acetic acid, 10 ml of water and 0.25 ml of 5 ml of 0.1N potassium permanganate must retain its color for up to 2 hours.

4.) CORROSIVE ATTACKS ON METALS:

- The selection of materials of construction, heat treatments, welding techniques and other technical aspects of each acetic acid process should be properly taken care of. Corrosive attacks on metals by liquid streams increase with acetic acid, halide or formic acid concentrations and with many temperatures.
- In absence of reducing agents and halides, AISI 316 stainless steel is widely used (Cr: 16-18 wt%, Ni: 10-14%). If halides are present, Hastelloy B [12605-84-4]
- or C [12605-85-5] or other exotic materials of construction are necessary.
- At ambient temperature, and high concentration, Al [7429-90-5] and AISI 304 stainless steel (Cr 18-20 wt%, Ni: 8-10.5 wt %) are used in storage tanks, pumps, and piping.

5.) METHOD TO DETERMINE ACETIC ACID CONTENT OF A VOLATILE MIXTURE:

- For determination of acetic acid content of a volatile mixture, gas chromatography is the most usual technique. Packed columns can be used for this, but capillary columns can be used for this, but capillary columns are equally effective.
- The substrates used here are Carbowax 20M and terephthalic acid terminated (41479-14-5).

6.) STORAGE AND TRANSPORTATION PROBLEMS :

- Acetic acid can be stored and transported in containers lined with stainless steel, glass or polyethylene. Aluminium is also resistant to glacial acetic acid around 99.7%.

- Aluminium in contact with acetic acid is slowly attacked to form a layer of Aluminium oxide. This prevents further corrosion but some of oxides can be suspended in acid which gives cloudy appearance. Storage containers, tank cars, tank trucks and pipes for concentrated acid should be equipped with a heating coil that can be connected to a steam line and steam trap.
- Also, all storage tank, vents must be steam traps to prevent plugging by acetic acid crystals.

#### 7.) VINEGAR LAW:

- Vinegars containing more than 11 wt% acetic acid should be marketed commercially in closed containers made from materials resistant to acetic acid.
- The containers must be labeled clearly with warning, "HANDLE WITH CARE, DO NOT SWALLOW UNDILUTED". Acetic acid concentrations > 25 wt. % can be handled only by dealers who are not consumers.
- The law says, the vinegar tax is recalculated each time the price of vinegar changes. And acetic acid which is suitable only for commercial purposes or for human consumption is exempted from the tax.

#### 8.) TOXICOLOGY AND OCCUPATIONAL HEALTH :

- For persons more than 2 years old, estimated daily acetic acid intakes up to 2.1 g is possible. As vinegar contains 3-6% acetic acid, solutions of acetic acid in 5% range can cause "*human mucous membrane irritation*" that can lead to "*weight loss*".
- Diluted acetic acid can act more strongly on the skin than some diluted mineral acids because diluted acetic acid is readily miscible with the liquids.
- Acetic acid can lead to eye irritation, nose and throat at 10 ppm. At 10 ppm, possible damage to these organs can occur.
- Also, repeated inhalation leads to habituation with daily concentrations up to 60 ppm can be tolerated. A TLV of 10 ppm is recommendable with no skin exposure.

- Oral acetic acid poisoning leads to severe mouth and digestive tract pain. In extreme cases, this may lead to vomiting, respiratory and circulatory distress, and sometimes death may follow.