Unit-III

POLLUTION FROM MAJOR INDUSTRIES

SYLLABUS

Sources, characteristics, waste treatment flow from industries such as Textiles, pulp and paper mill wastes breweries and distilleries waste, Tanneries, Pharmaceuticals, Dairy, sugar mill wastes, steel plants, oil Refineries, fertilizer plant waste, petrochemical complex waste, corn starch industry waste – odour and its removal-removal color from waste waters – waste minimization and clean technologies

SOURCES, CHARACTERISTICS, WASTE TREATMENT FLOW FROM TEXTILES

TEXTILES MILLS WASTE

- The Fibers used in the Textile Industry may be broadly classified into four groups:
- **cotton, wool, regenerated and synthetics.**

Cotton textile mill waste

- **Carding:-** It is a process in the manufacture of spun yarns whereby the staple is opened, cleaned, aligned and formed into a continuous untwisted strand called sliver.
- **Drawing:-** It is the process of increasing the length per unit weight of sliver.
- **Combing:-** A method to remove short fibers, foreign matter from cotton stock by pressing it through a series of needles or combs
- **Spinning**:- It is a process by which a long strand of fibers is drawn out to a short strand and converted into a yarn. After drawing out, it is subjected to twisting and the resulting yarn is wound into a bobbin.

- **Winding**:- It is the process of transfer of a yarn or thread from one type of package to another.
- **Weaving:-** It is the process of interlocking two yarns of similar materials so that they cross each other at right angles to produce a woven fabric The entire liquid waste from the textile mills comes from the following operation of slashing (or sizing), scouring and resizing, bleaching, mercerizing, dyeing and finishing.

Table 3.1 Composition of composite cotton textile mill waste

pH	9.8 - 11.8
Total alkalinity	17.35 mg/l as $CaCO_3$
BOD	760 mg/l
COD	1418 mg/l
Total solids	6170 mg/l
Total Chromium	12.5 mg/l

WOOLEN TEXTILE MILLS WASTE

- Wool wastes originate from **scouring, carbonizing, bleaching, dyeing, oiling, fuelling and finishing operations.**

Table 3.2 Characteristics of a typical wool waste:

pH	9-10.5
Total alkalinity	600 mg/l
BOD	900 mg/l
Colour	Brown
Total solids	3000 mg/l
Suspended solids	100 mg/l
Total Chromium	4 mg/l

Effects of the cotton textile and woolen textile mill wastes on receiving streams / sewers

- The alkalinity and the toxic substances like **sulphides and chromium affect the aquatic life;** and also interfere with the biological treatment process; some of the dyes are also found toxic.

Treatment of Cotton and Woolen Textile Mill Waste

- The pollution load of the waste is dealt with in the operations like ***segregation, equalization, neutralization, chemical precipitation, chemical oxidation and biological oxidation***.
- Several chemicals are used to reduce the BOD by chemical coagulation.
- These are **alum, ferrous sulfate, ferric sulfate, ferric chloride etc., lime or sulfuric acid is used to adjust the pH in this process.**
- Calcium chloride is found to be effective in treating wool-scouring waste.
- The dye wastes may be treated economically by biological methods, with prior equalization, **neutralization and chemical oxidation for certain wastes.**

Synthetic Textile Mill Waste

- The most prominent man made synthetic fibers are **Rayon, nylon and polyester.**
- These fabrics require no processing for the removal of natural impurities as they are manmade.
- **Manufacture of synthetic fabrics involves two steps**

(i) Manufacture of the synthetic fiber

(ii) Preparation of the cloth

PULP AND PAPER MILL WASTE

- The paper mills use the 'pulp' as the raw material , which is again produced utilizing different cellulosic materials like ***wood , bamboo, jute, straw mainly of rice and wheat, waste paper, bagasse*** etc. in the pulp mills.

Manufacturing Process

- The Process of manufacturing of paper may be divided into two phases - Pulp making and then making of final product of paper.
- The major portion of the pollution from papermaking originates in the pulping processes.
- Raw materials are reduced to a fibrous pulp by either mechanical or chemical means.
- The bark is mechanically or hydraulically removed from wood before it is reduced to chips for cooking.

Characteristics of pulp and paper mill wastes

- The volume depends mainly on the manufacturing procedure, and the water economy adopted in the plant.
- It has been observed that a well operated and well managed integrated pulp and paper mill employing Kraft process for pulping, produces a waste volume in the range of 225 to 320 m3 per ton of paper manufactured.
- The mills manufacturing special quality of paper produce larger amount of water for washing and bleaching.

Table 3.3 Characteristics of Pulp and Paper Mill Wastes

	Small Mill - (<20 t of paper/day)	Large Mill - (2000 t of paper/day)
pH	8.2 - 8.5	8.5 - 9.5
Total solids, mg/l	----	4410
Suspended solids, mg/l	900-2000	3300
COD , mg/l	3400-5780	716
BOD, mg/l	680-1250	155
Colour	Dark Brown	Dark Brown
COD/BOD	3.9-5	4.6

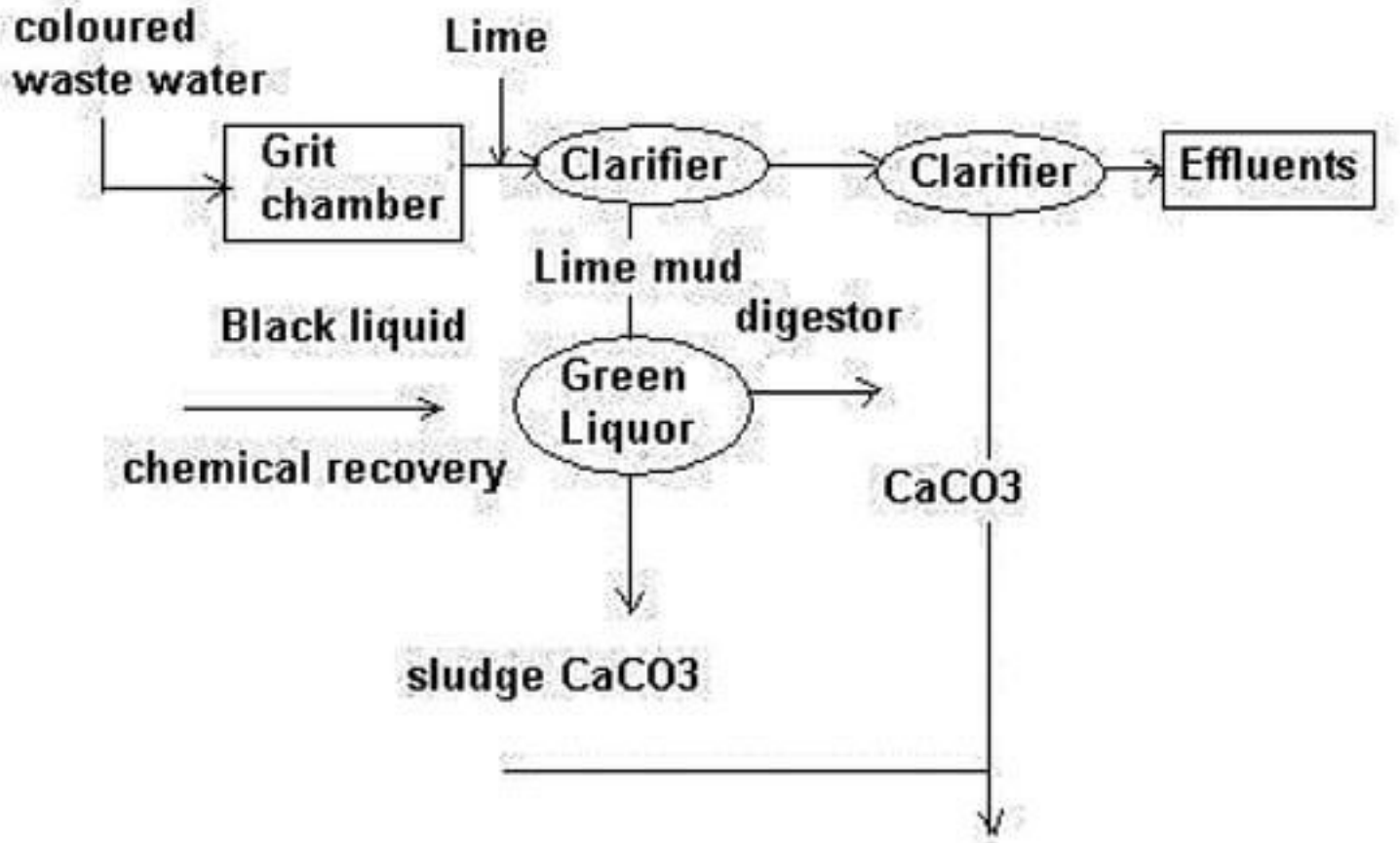
The effect of wastes on receiving water courses or sewers

- Crude pulp and paper mill wastes, or insufficiently treated wastes cause very serious pollution problems, when discharged into the streams
- The fine fibers often clog the water intake screens in the downstream side.
- A toxic effect may also be induced upon the **flora (all plant life) and fauna (all animal life) of the stream due to sulfites and phenols in the waste.**
- The bottom deposit of Lignin - Cellulosic materials near the point of the discharge of the waste in a stream undergo slow decomposition and may lead to the dissolved oxygen depletion followed by the creation of anaerobic condition and **destruction of the aquatic life**.

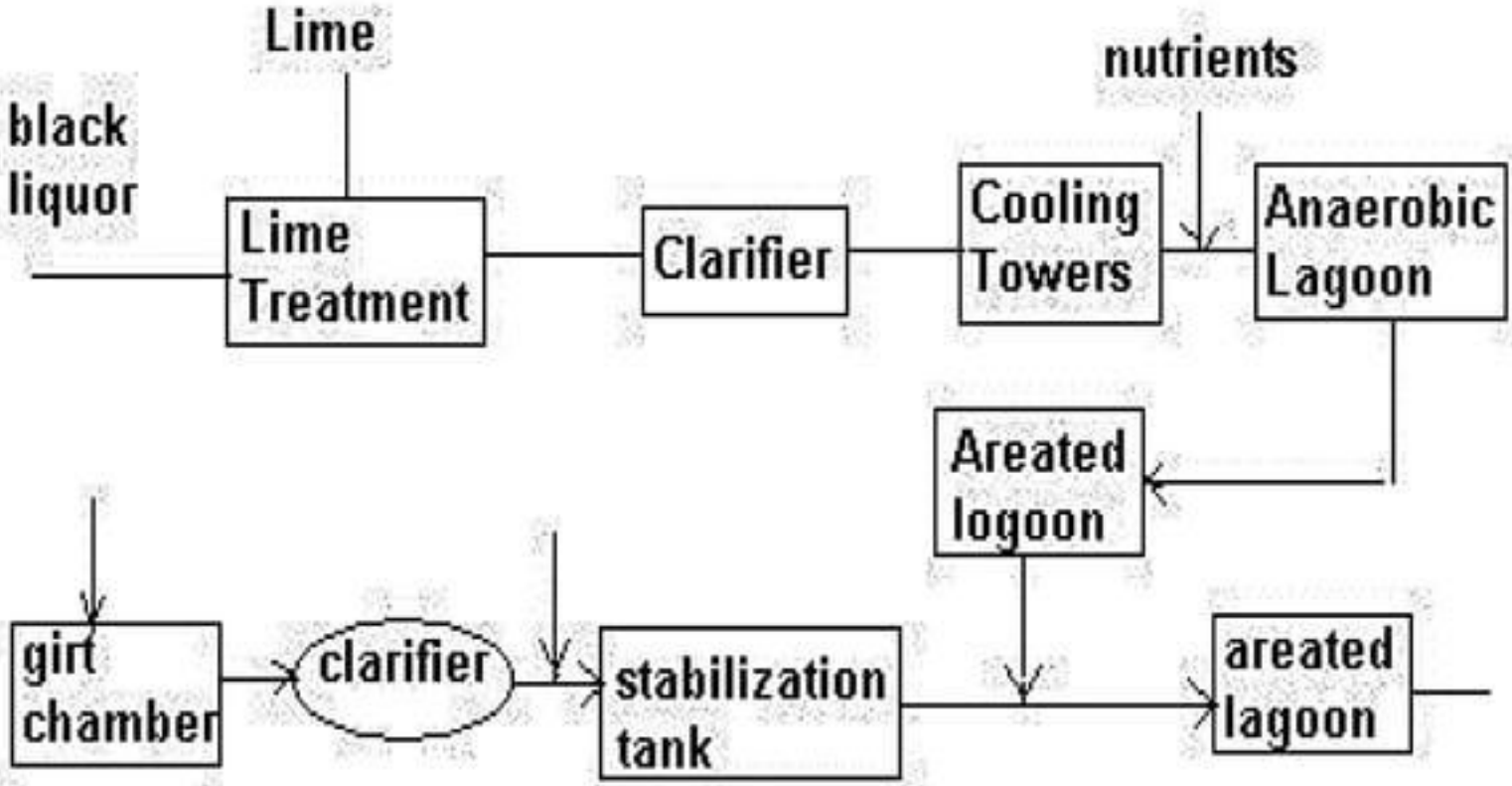
The treatment of the waste may consist of all or a combination of some of the following processes

1. *Chemical treatment for color removal*
2. *Activated carbon for color removal*
3. *Physical treatment for clarification*
4. *Biological treatment of the waste*

The treatment of the pulp and paper mill waste



Flow Chart of Lagooning



FERMENTATION

- The Fermentation industries include **breweries and distillery manufactures** of alcohol and certain organic chemicals and some parts of the pharmaceutical industry such as producers of antibiotics.
- The transformation of **grape juice into wine**, the **manufacture of alcohol from molasses**, and the use of **yeast in dough to make bread** are familiar examples of fermentation.

TANNING INDUSTRY

Tanning Process

The tanning process consists of three basic stages

1. Preparation of the hides for tanning.
2. Tanning proper.
3. Finishing.

- Tannery wastes originate from the beam house and the tan yard.
- In the beam house curing, **fleshing, washing, soaking, remove haring, lime splitting, bating, pickling** and degreasing operations are carried out.
- In the tan yard, **the final leather** is prepared by several processes.
- These include vegetable or chrome tanning, shaving and finishing.
- The finishing operation includes **bleaching, stiffing and fat liquoring and coloring.**

PHARMACEUTICAL INDUSTRY

- Pharmaceutical waste can result from many activities and locations in a healthcare facility.
- If you have a compounding pharmacy on site, it generates drug waste.
- Anywhere medicines are employed can be the site of spills, half-used bottles, and IV equipment with residual medicine on it.

Sources of Pharmaceutical Waste

- • Wastewater Treatment Plants (WWTPs) These WWTPs focus on stopping waste from reaching the water or sources of water.
- • **Humans and Animals**
- • Pharmaceutical Waste Treatment Plants
- • **Unused Drugs**
- • Healthcare Institutions.
- • **Homes and Farms Where Food is Grown**
- • Personal Care Products.

Characteristics of pharmaceutical waste

In general, the composition of pharmaceutical wastewater is complex, which has

- ✓ High concentration of organic matter,
- ✓ **Microbial toxicity,**
- ✓ High salt, and
- ✓ **It's hard to biodegrade**

DAIRY WASTES

Units Operation in a Dairy

- **Receiving Stations**

The receiving station serves as a collection point for raw milk from the farmers. When milk is delivered to the dairy in cans and these cans are emptied, rinsed and washed and in some cases sterilized before returning.

- **Bottling**

Raw milk received is weighed and classified (generally based on the fat content), it is preheated, pasteurized, cooled and then filled into bottles, polythene bags, cardboard packets etc.

Product Making

- Dry milk, milk powder, cheese, butter and other products as ice cream, condensed milk are prepared out of milk.

Sources of wastes

- Waste producing operations are washing of bottles, cases, cans, tanks, cooling equipment, Processing equipment and floors
- Dripping, leaks, spillages and overflows due to improper equipment or inefficient operation.
- Discharges from evaporators
- Wasted buttermilk and whey (watery liquid left when milk forms curds).
- Spoiled raw or treated products

Characteristics of diary wastes

Parameter	Value
pH	7.2
B.O.D mg/l	1240 mg/l
Alkalinity	600 mg/l as $CaCO_3$
Total Dissolved Solids	1060 mg/l
Chlorides	105 mg/l
Nitrogen	80 mg/l
Phosphates	10 mg/l
Organic Grease	290 mg/l
Suspended Solids	760 mg/l

Treatment of Waste

- As evident from the high BOD/COD ratio, the dairy wastes can be treated efficiently by biological processes.

Reduction of volume and strength of the wastes by

a. Prevention of spills, leakages and dropping of milk from cans.

b. By reducing the amount of water for washes

c. By segregating the uncontaminated cooling water and recycling the same.

SUGAR MILL WASTES

CHARACTERISTICS AND COMPOSITION OF WASTE WATER MANUFACTURING PROCESS SUGAR MILL WASTES

Introduction

- In Countries like India, Cuba and Jamaica, the sugar is produced from **sugar canes**, while in many other places **beetroots** are used as the raw materials for the sugar production.
- In India most of the sugar mills operate for about **4 to 8 months just after the harvesting of the sugar canes**

Manufacturing Process

- The sugar canes are cut into pieces and crushed in a series of rollers to extract the juice, in the mill house.
- Juice is extracted from the sugar cane, leaving a fibrous residue called **bagasse**, which can be used as a **fuel** for the **boilers** or can be **disposed of as solid waste**.

1. The milk of lime is then added to the juice and heated, when all the colloidal and suspended impurities are **coagulated**; much of the color is also removed during this **lime treatment**.
2. Lime is added to the extracted juice to raise its pH and to prevent the inversion of the **sucrose molecule to glucose and fructose**.
3. The **coagulated juice** is then clarified to **remove the sludge**.

- The clarifier is further filtered through filter presses, and then disposed off as solid waste.
- The filterate is recycled to the process, and the entire quantity of clarified juice is treated by passing **sulphur dioxide gas** through it.
- The process is known as "**sulphitation process**"; color of the juice is completely bleached out due to this process.

- The clarified juice is then preheated and concentrated in evaporators and vacuum pans. The partially crystallized syrup from the vacuum pan, known as "**massecuite**"(massecuite (countable and uncountable, plural massecuites) **A suspension of sugar crystals in a mother liquor, after boiling of syrup**; produced in a sugar factory.) is then transferred to the crystallizers, where complete crystallization of sugar occurs.

Characteristics of Sugar Mill Waste

Parameter	Value
pH	4.6- 7.1
C.O.D mg/l	600 – 4380
B.O.D mg/l	300 – 2000
Total Solids	870 – 3500
Total Volatile Solids	400 – 2200
Total Suspended Solids	220 – 800
Total Nitrogen	10 – 40
C.O.D /B.O.D ratio	1.3 - 2.0

STEEL PLANT WASTES

- Integrated steel plants usually consist of five main units, Viz; Coal washer, Coke oven blast furnace, steel melting shop and rolling mills.
- In addition to the above the plants may have auxiliary units like oxygen plant and power plant for their own uses.

Characteristics of Coal Washeries

Parameter	Value
Total Solids	1000-25000 mg/l
Suspended Solids	800 - 24700 mg/l
Dissolved Solids	200 - 300 mg/l
Hardness	230 mg/l as $CaCo_3$
Alkalinity	86 mg/l as $Ca\ Co_3$
pH	7.4 - 7.8

METAL PLATING WASTE

- Plating is the application of a plate, or coat, of metal to a surface for decoration, reflection of light, protection against corrosion, or increased wearing quality.
- Electroplating is the most common method because it permits the control of the thickness of the plating. We offer: **Gold, Nickel, Copper, and Chrome plating.**

OIL REFINERIES WASTE

Sources of Waste Water & Manufacturing Process

- Crude oils are complex mixtures of hydrocarbons of varying molecular weight and structure.
- These hydrocarbons range from simply highly volatile substances to complex waxes and asphaltic compounds.
- The final petroleum products are obtained from the crude oil through a series of operations viz. **topping, thermal cracking, catalytic cracking, catalytic reforming etc**.

- In general, the crude oil is first subjected to **fractional distillation** in the process known as "**topping** ".
- The products obtained are called raw products and include raw gasoline, raw naphtha, raw kerosene, gas oil, fuel oil etc.
- Now these intermediate refinery products are again treated to yield various finished market products as per the requirements.
- The operations practiced include "**catalytic cracking**" or "**thermal cracking**" and further purification processes like "**acid treatment**", "**sweetening treatment**", "**hydrodesulphurization**" etc.

FERTILIZER PLANT WASTE

Fertilizer industry can be divided into three main categories depending upon

1. ***Fertilizer raw materials***
2. ***Fertilizer intermediates***
3. ***Fertilizer products***

Fertilizer Intermediates

- 1. Sulphuric acid
- 2. Phosphoric acid
- 3. Nitric acid

Fertilizer products:

SOLID

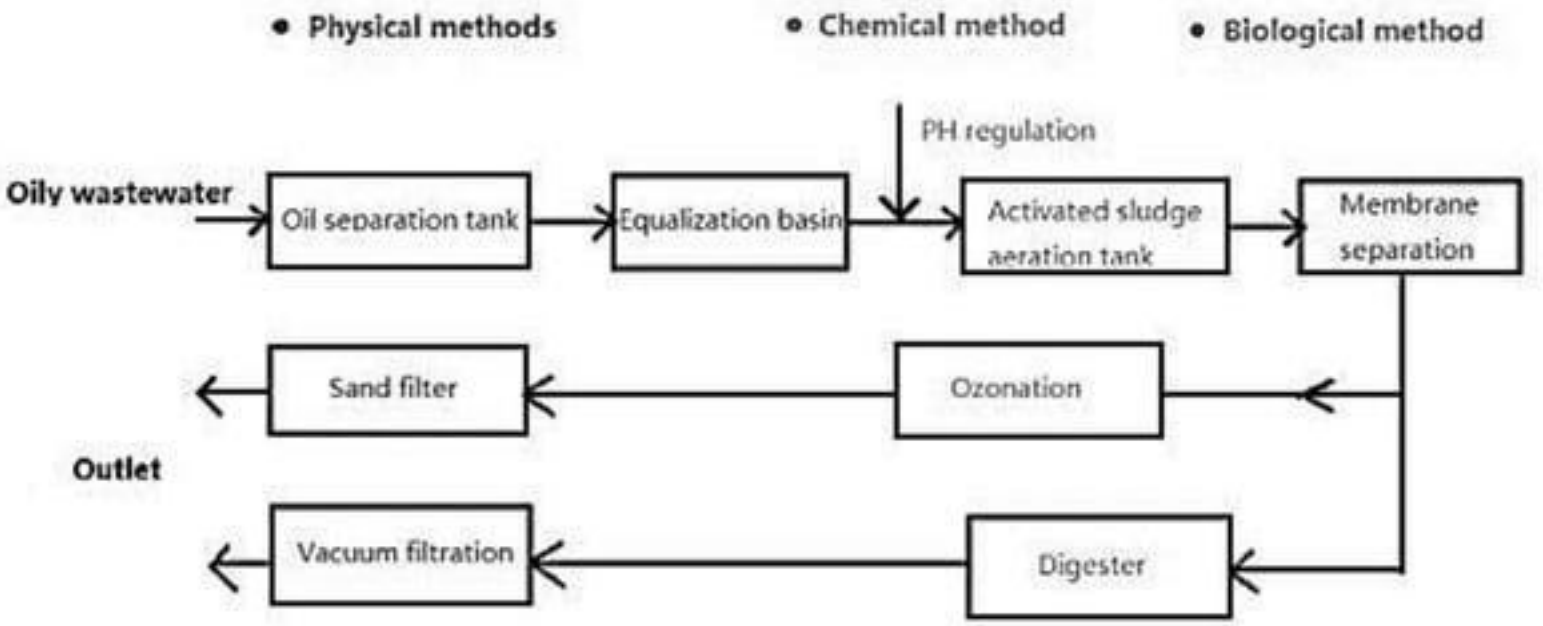
N - Fertilizers

- 1. Ammonium nitrate
- 2. Urea
- 3. Ammonium sulfate P - Fertilizers
- 4. Super phosphates NPK fertilizers

PETROCHEMICAL COMPLEX WASTE

- Petroleum, known as "industrial blood", is important energy and industrial raw material, as well as an important production and daily necessities of human beings.
- With the rapid development of economy and society, oil and its products have been widely used in various fields of the national economy and people's daily life, and their use and demand are gradually increasing.
- In the refining process, petroleum will produce by-products that have an impact on the environment, including petrochemical wastewater.
- As one of the main sources of petroleum pollution, petrochemical wastewater has a serious negative impact on economic development and the ecological environment.

The treatment process of oily wastewater



CORN STARCH INDUSTRY

- Corn starch industry contributes almost 12% of starch production.
- Maize starch, produced worldwide, contributes huge amount of acidic effluent (pH 3-5) containing high Chemical oxygen demand (COD) (10000- 30000 mg/L), biological oxygen demand (BOD) (4000-8000 mg/L), nitrogenous pollutant (400-900 mg/L) and other pollutants.

- Conventional methods of **anaerobic digestion and nitrification-denitrification process** are widely being used to treat starch industry effluent.
- The anaerobic digestion requires neutral pH operation thus increases operational cost.
- Similarly, nitrification and denitrification processes are lengthy processes consuming high operational cost and require secondary treatment for generated excess sludge.

- **Starch is widely used in food, pharmaceutical, paper & textile industry in large quantities. Maize is used as a bulk source of starch production in various countries.**
- It is the highest produced cereal crop and widely cultivated throughout the world, counts among major contributors of raw material in bulk industrial scale.

- The main goal of all available technologies are to remove **maximal removal of carbonaceous and nitrogenous contaminant from water and to make the water reusable for irrigation purpose** or to make it potable by applying further advanced technologies like reverse osmosis after biological treatment
- The technologies developed over time for **aerobic and anaerobic treatment** are in consideration to neutral pH waste treatment, while starch effluents are highly acidic in nature.
- Thus there is a compulsory requirement to neutralize the effluent by dilution or chemical addition before introducing it to treatment system

Odour Removal

- Waste water treatment, is the process of removing contaminants from wastewater and household sewage.
- It includes **physical, chemical, and biological processes to remove physical, chemical and biological contaminants.**
- Odors emitted by waste water treatment are typically an indication of anaerobic conditions.
- Early stages of processing will tend to produce toxic gases, like **Hydrogen Sulphide (H S), Sulphur Dioxide (SO), Bromine and Oxides of Nitrogen, Chlorine** etc
- which can be even corrosive in higher concentrations, which makes odor removal a necessary criteria.

Chemical Oxidation System

- Chemical oxidation process involves oxidizing agents reacting with organic pollutants in the air and oxidizing them.
- Essentially, these pollutants undergo a chemical reaction that transforms them into non-toxic substances and traps odor efficiently.
- These advanced technology filters not only remove odors but also destroys other harmful organic matters.

- Chemical oxidation effectively oxidizes 99% organic pollutants to less dangerous or harmless substances
- Removes other types of odor causing substances like amines compounds.
- Helps to achieve immediate odor control.

Biological Oxidation System

- The knowledge and experience of Aqoza has made it possible to adapt to the most eco-friendly technologies for the changing times and changing needs.
- Our emerging odour control units use biological oxidation for the destruction and removal of VOCs, organic matters, odors and hydrocarbons.

WASTE MINIMIZATION AND RESOURCE CONSERVATION

- Waste is also the inefficient use of utilities such as electricity, water, and fuel, which are often considered unavoidable overheads.
- The costs of these wastes are generally underestimated by managers.
- It is important to realize that the cost of waste is not only the cost of waste disposal, but also other costs such as:

✓ **▪ Disposal cost**

✓ **▪ Inefficient energy use cost**

✓ **▪ Purchase cost of wasted raw material**

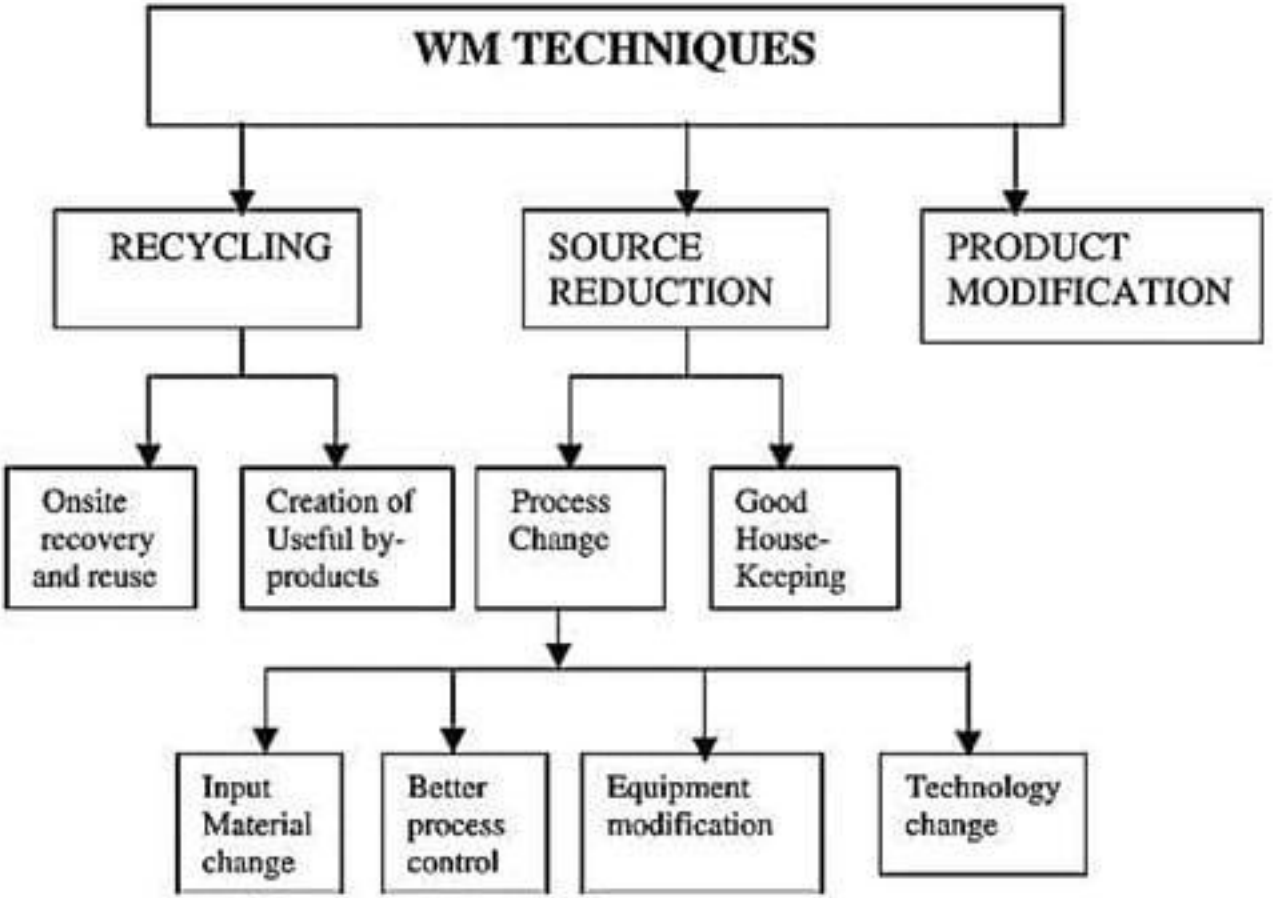
✓ **▪ Production cost for the waste material**

✓ **▪ Management time spent on waste material**

✓ **▪ Lost revenue for what could have been a product instead of waste**

✓ **▪ Potential liabilities due to waste.**

Classification of Waste Minimization (WM) Techniques



Source Reduction

Under this category, four techniques of WM are briefly discussed below:

a) Good Housekeeping

b) Process Change

- (i) Input Material Change
- (ii) Better Process Control
- (iii) Equipment Modification
- (iv) Technology change

c) Recycling

- i) On-site Recovery and Reuse
- ii) Production of Useful by-product

d) Product Modification

UNIT – 3
COMPLETED

THANK YOU