

## CHAPTER 3

## METHODS OF WASTEWATERS TREATMENT

3.1 General methods of wastewaters treatment

A classification and summary of methods of wastewaters treatment are following :

- (a) Removal of Suspended Solids
  - (1) Sedimentation
  - (2) Flotation
  - (3) Screening
  
- (b) Removal of Colloidal Solids
  - (1) Chemical coagulation
  - (2) Coagulation by neutralization of the electrical charges.
  - (3) Removal of colloids by adsorption
  
- (c) Removal of Inorganic Dissolved Solids
  - (1) Evaporation
  - (2) Dialysis
  - (3) Ion exchange
  - (4) Algae
  - (5) Reverse osmosis
  - (6) Miscellaneous methods

(d) Removal of Organic Dissolved Solids

- (1) Lagooning
- (2) Activated - sludge treatment
- (3) Modified aeration
- (4) Dispersed - growth aeration
- (5) Contact stabilization
- (6) High - rate aerobic treatment
- (7) Trickling filtration
- (8) Spray irrigation
- (9) Wet combustion
- (10) Anaerobic digestion
- (11) Mechanical aeration system
- (12) Well injection
- (13) Foam phase separation
- (14) Brush aeration
- (15) Subsurface disposal
- (16) The bio - disc system

3.2 Treatment and Disposal of Sludge Solids

- (1) Anaerobic and aerobic digestion
- (2) Vacuum filtration
- (3) Elutriation
- (4) Drying beds
- (5) Sludge lagooning
- (6) The wet combustion process
- (7) Atomized suspension

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- (8) Drying and incineration
- (9) Centrifuging
- (10) Sludge barging
- (11) Sanitary landfill
- (12) Sludge pumping
- (13) Miscellaneous methods

(Nemerow 1971)

### 3.3 Treatment of pulp and paper mill wastes

Pulp and paper - mill wastes are treated in the following manner.

- (1) Recovery
- (2) Sedimentation and flotation
- (3) Chemical precipitation
- (4) Activated sludge
- (5) Lagooning
- (6) High - pressure oxidation

(Nemerow 1971)

Recovery Processes in the paper mill involve the use of "save - alls" in either closed or partly closed systems. These save - alls are installed not only as a waste - treatment measure, but also as a conservation measure to recover fibers and fillers. The main types are based on filtration, sedimentation, or flotation processes. Filtration devices are usually some variation of a revolving, cylindrical, perforated screen or

filter that removes the suspended solids in the form of a mat, which is subsequently scraped off the drum and returned to the paper - making stock system. Conical or other sedimentation tanks are also often used to separate the suspended matter by difference in specific gravity. ( Nemerow 1971 )

#### Sedimentation and flotation

These treatments are achieved through the use of save - alls, which have been described earlier. Although save - alls are used on paper - machine white waters primarily for purposes of clarification (forwhite - water reuse) and fiber recovery, they may still be considered as part of process equipment. Removal of the fiber naturally results in decreased loss of solids to the sewer, and therefore effluents, of lower pollutional strength.

Sedimentation is the usual method of total and final treatment of paper - mill effluents, the save - alls being restricted to usage within the mill. ( Nemerow 1971 )

#### Chemical precipitation

An Indiana mill, using sulfite pulp, treats all wastes with alum. The sludge is dried on beds, and the effluent is recirculated to the process. A Michigan mill uses chemical precipitation and obtains a BOD reduction of 64 percent --- somewhat higher than usual. (Nemerow 1971.)

### Activated - sludge treatment

Aerobic biological processes have been most successful on kraft - mill wastes. Nitrogen and phosphorus nutrients are added as needed. This plant accomplished an 85 percent BOD reduction. (Nemerow 1971)

### Lagooning

The major method of pulp - and paper - mill final waste treatment is lagooning. Ponds, the most widely used form of lagoons, can be used for storage or as effluent - stabilization devices, with storage ranging from 10 days to 10 months.

(Nemerow 1971)

### High - pressure oxidation

The Zimmerman process has been used successfully for treating sulfite - mill waste in Norway, but economic factor must be studied carefully before such a high investment in capital equipment can be made in this country. (Nemerow 1971)

## 3.4 Treatments of paper - mill wastewater

This research work will deal with the wastewater from paper mill only. Since the main sources of contamination are from dirt and other solids involved in the paper making process, removal of these components will certainly improve the wastewater

quality. Therefore, the method of chemical coagulation or chemical precipitation is employed in the study on treatment of paper mill wastewater.

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