Module -5: Applications

Applications of EMS, Waste Audits and Pollution Prevention opportunities in

- **Textile industry,**
- **Sugar, Pulp & Paper industry,**
- **Electroplating,**
- **Tanning industry,**
- **Dairy industry,**
- **Cement industry,**
- **Chemical industries, etc.**

Trans boundary movement, disposal, procedures, of hazardous wastes.

Textile Industry

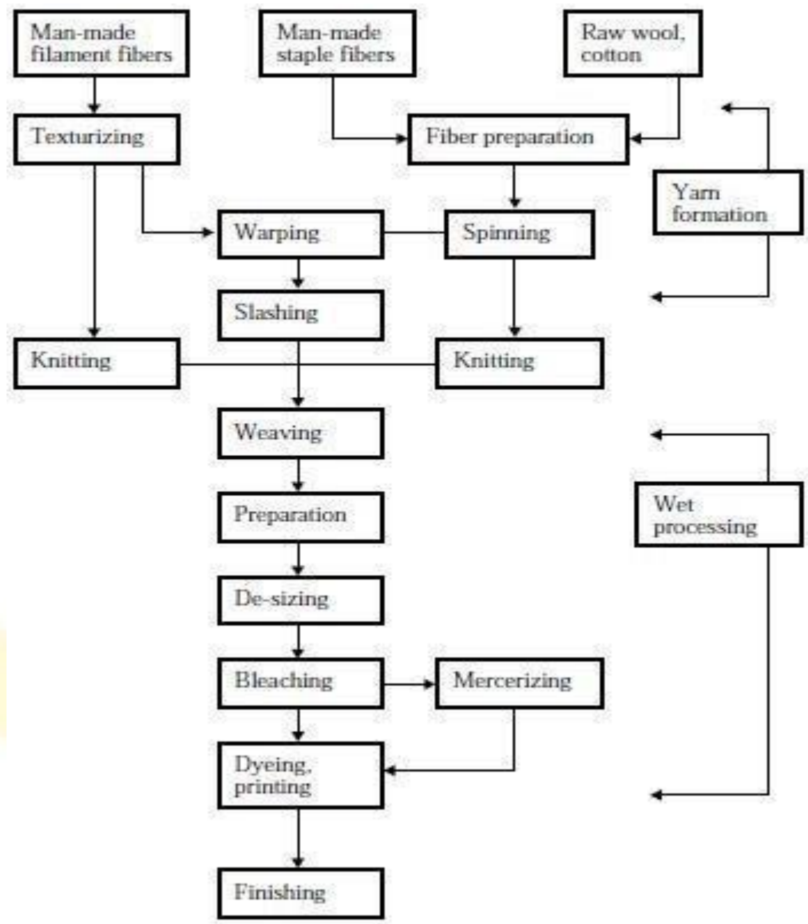
Manufacturing process

An integrated cotton textile mill produces its own yarn from the raw cotton. Production of yarn from raw cotton includes steps like opening & cleaning picking, carding, and drawing spinning, winding & warping. All these sequences are dry operations and as such do not contribute to the liquid waste of the mill. The entire liquid waste from the textile mills comes from the following operation of slashing (sizing), scouring, desizing, bleaching, mercerizing, dyeing & finishing.

In slashing the yarn is strengthen by loading it with starch or other substances wastes originates from the sections due to spills & floor washings. The substitution of low BOD sizes (such as carboxy methylcellulose) for the high BOD of the mill effluent by 40 to 90%. After slashing, the yarn goes for weaving. The prepared cloth now requires scouring & desizing to remove natural impurities and the slashing compounds. Enzymes are usually used in India to hydrolyze the starch; acids may also be used for this purpose. Caustic soda, soda ash, detergents etc. are also used in this section.

Bleaching operations use oxidizing chemicals like peroxides & hyper chloride to remove natural coloring material. The section contributes about 10% of the total pollution load.

Mercerizing consists of passing the sloth through 20% caustic soda solution. This process includes the strength elasticity luster & dye affinity. Waste from this section is recycled after sodium hydroxide recovery. Negligible waste which may come out of this section contributes little BOD but a high degree of alkalinity.



Textile Industry Process

Dyeing may be done in various ways, using different types of dyes and chemical classes of dyes include Vat dyes, developing dyes etc. color from the dyes vary widely and although these are not usually toxic, they are treated separately. Thickened dyes are used for probing and subsequent fixation. After fixation of the prints, the fabric is given a thorough wash to remove the unfixed dyes. The finishing section of the mill imparts various types of chemicals are used for various objectives. These include starches, dextrines, natural & synthetic waxes, synthetics etc. Therefore a composite waste from an integrates cotton textile mill may include the following organic & inorganic substances starch, carboxyl methyl cellulose, sodium hydroxide, detergents, peroxides , hyperchloride dyes & pigments, sodium gums, dextrines, waxes, sulphides, soap etc. Depending on the process & predominant dye used, the characteristics of the mill waste varies widely.

The characteristics of a typical Indian cotton textile mill waste is given below

Characteristics	Value
pH	9.8-11.8
Total alkalinity	17.35 mg/lt
BOD	760 mg/lt
COD	1418 mg/lt
Total solids	6170 mg/lt
Total Chromium	12.5 mg/lt

Effect of textile mill waste on receiving streams/sewers

If the mill waste water is discharged into streams, it causes depletion of DO of the stream. This is due to the settlement of the suspended substances and subsequent decomposition of the same in anaerobic condition. The alkalinity and toxic substances like sulphides & chromium affects the aquatic life and also interferes with the biological treatment processes. Some of the dyes are also found to be toxic. The color often renders the water unfit for use for side. The presence of sulphides makes the waste corrosive particularly to concrete structures. All treatment plants should be planned giving serious consideration for the reduction of waste volume & strength, through process of chemical substitution, chemical recovery & recycling of water. The pollution load from a textile, mill is dealt with operations like segregation, neutralization, equalization, chemical ppt, chemical oxidation & biological oxidation. Several chemicals are used to reduce the BOD by chemical coagulation such as alum, ferric sulphate, ferrous sulphate & ferric chloride, lime or H2So4 is used to adjust pH in this process. The dye waste may be economically treated by biological methods prior equalization, neutralization & chemical oxidation.

A Composite waste, when free from toxic substances may be treated as efficiently as domestic sewage, as most of the textile mill wastes contain sufficient nutrients like nitrogen & phosphorous. Trickling filters, activated sludge process & stabilization ponds have been effective in treating textile mill wastes. Extended aeration is found to be very effective in treating strong wastes even without equalization & pretreatment.

Sugar Industry

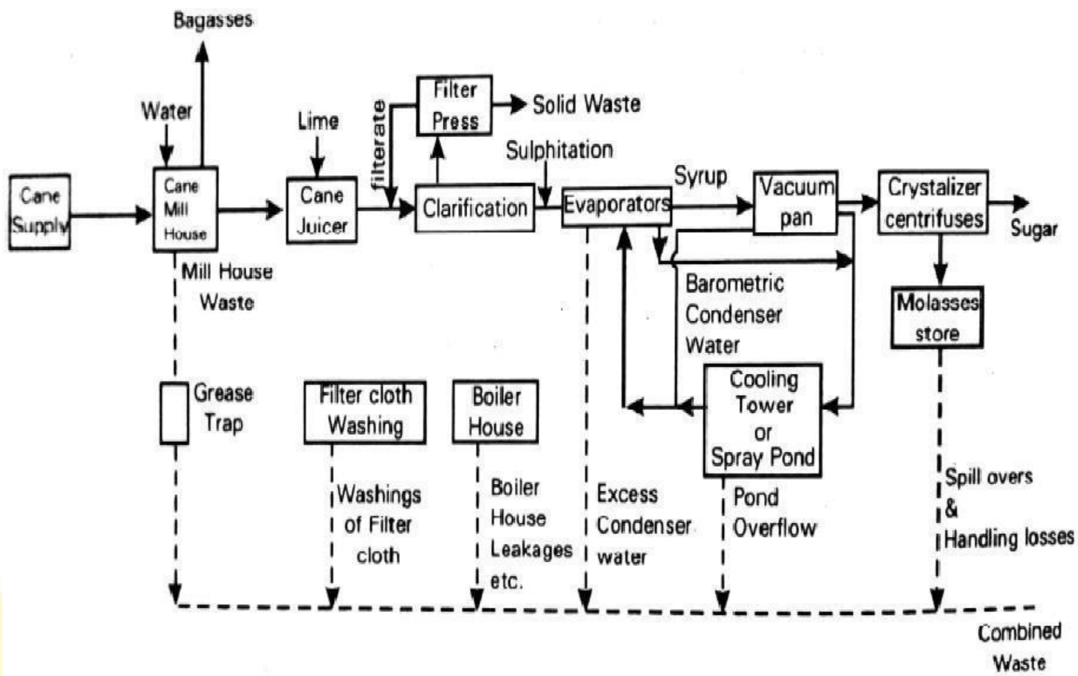
In countries like India, Cuba & Jamaica the sugar is produced from sugar canes, while in many other but roots are used as raw material for the sugar production. In India, most of the sugar mills are situated in the country side & operate for about 4-8 months just after the harvesting of the sugar canes. A large volume of waste of organic nature is produced during the period of production & normally they are discharged on to land or onto the nearby water source usually small streams practically without treatment.

Manufacturing process

The sugar cane is normally harvested manually in India, which eliminates the carriage of soil & trashes to the factory along with the sugar canes. The sugarcanes are cut into pieces & crushed in a series of rollers to extract the juice in the mill. Then for sugar canes of Lime is then added to the juice & heated where in all the colloidal & suspended impurities are coagulated. Much of the color is also removed during lime treatment. The coagulated juice is then clarified to remove the sludge. The clarifier sludge is further filtered through filter process & then disposed off as solution waste. The filtrate is recycled to the process and the entire quantity of clarified juice is treated by passing sulfur dioxide gas through it. The process is known as sulphitate process. Here color of the juice is completely bleached out due to this process.

The clarified juice is then pre- heated & concentrated in evaporators & vacuum pans. The partially crystallized syrup from the vacuum pan is known as Massecuite is then transferred to the crystallizers, where complete crystallization of sugar occurs. The massecuite is then centrifuged, to separate the sugar crystals from the mother liquor. The spent liquor is discarded as black strap molasses. The sugar is then dried & bagged for transport.

The fibrous residue of the mill house known as bagasses may be burnt in the boilers or may be used as raw materials for the production of paper product. The black strap molasses may be used in the distilleries.



Sources and characteristics of wastes

Waste from the mill house include the water used as splashes to extract maximum amount of juice & those used to cool the roller bearings. As such, the mill house waste contains high BOD due to the presence of sugar & oil from the machineries. The filter cloths used for filtering the juice needs occasional cleaning. The wash waster thus produced through small in volume, contains high BOD & suspended solids.

A large volume of water is required in the Barometric condensers of the evaporators & vacuum pan. The water is usually partially or fully circulated after cooling through a spray pond. This cooling water gets polluted as it picks up some organic substances from the vapour of boiling syrup in evaporation & vacuum pans. This polluted water, instead of recirculated is discarded as excess condenser water. These discharges contribute substantially to the waste volume & modulated to BOD in many sugar mills.

Additional waste originates due to the leakages & spillages of juice, syrup & molasses in different sections. The periodical washings of the floor through small in volume have got very high BOD.

The periodic blow off of the boilers produces another intermittence waste discharge. This waste is high in suspended solids, low in BOD & usually alkaline.

The characteristics of a sugar industry waste is given below

Characteristics	Value
pH	4.6-7.1
Total solids	870-3500 mg/lt
BOD	300-200 mg/lt
COD	600-4380 mg/lt
Total suspended solids	220-800 mg/lt
Total Nitrogen	10-40 mg/lt

Effects of wastes on receiving water

The fresh effluent from the sugar mill decomposes rapidly after few hours of stagnation. It has been found to cause considerable difficulties when this effluent gets an access to the water course particularly the small & non perennial streams in the rural areas. The rapid depletion of oxygen due to biological oxidation followed by anaerobic stabilization of the waste causes secondary pollution of offensive odor, black color & fish mortality.

Treatment of the wastewater

Like any other industry the pollution low in sugar mills can also be reduced with a better water and material economy practiced in the plant. Judicious use of water in various plant practices &it recycle, wherever practicable, will reduced by recycling cleaning of floors or floor washings using controlled quantity of water will also reduce the volume of waste to certain extent.

The organic load of the waste cam only be reduced by a proper control of the operations. Over loading of the evaporates & the vacuum pans and the extensive boiling of the syrup leads to a loss of sugar through condenser water & this in turn increases both volume & strength of the waste effluent. Disposal of the effluent on land as irrigation water is practiced in many sugar mills, but it is associated with odor problems.

Anaerobic treatment of the effluent using both digesters and lagoons has been found to be very effective & economical. A BOD reduction of both 70-88% was observed in pilot plant study with an anaerobic digester, where BOD loading was 0.65-1.79 kg/m3/day with a detention time of 2-2.4 days at a controlled temperature of 37^{o}C.

The effluents of the anaerobic treatment units are found to contain sufficient nutrients (nitrogen & phosphorous) as such further reduction of BOD can be accomplished in aerobic waste stabilization ponds.

Paper and Pulp Industry

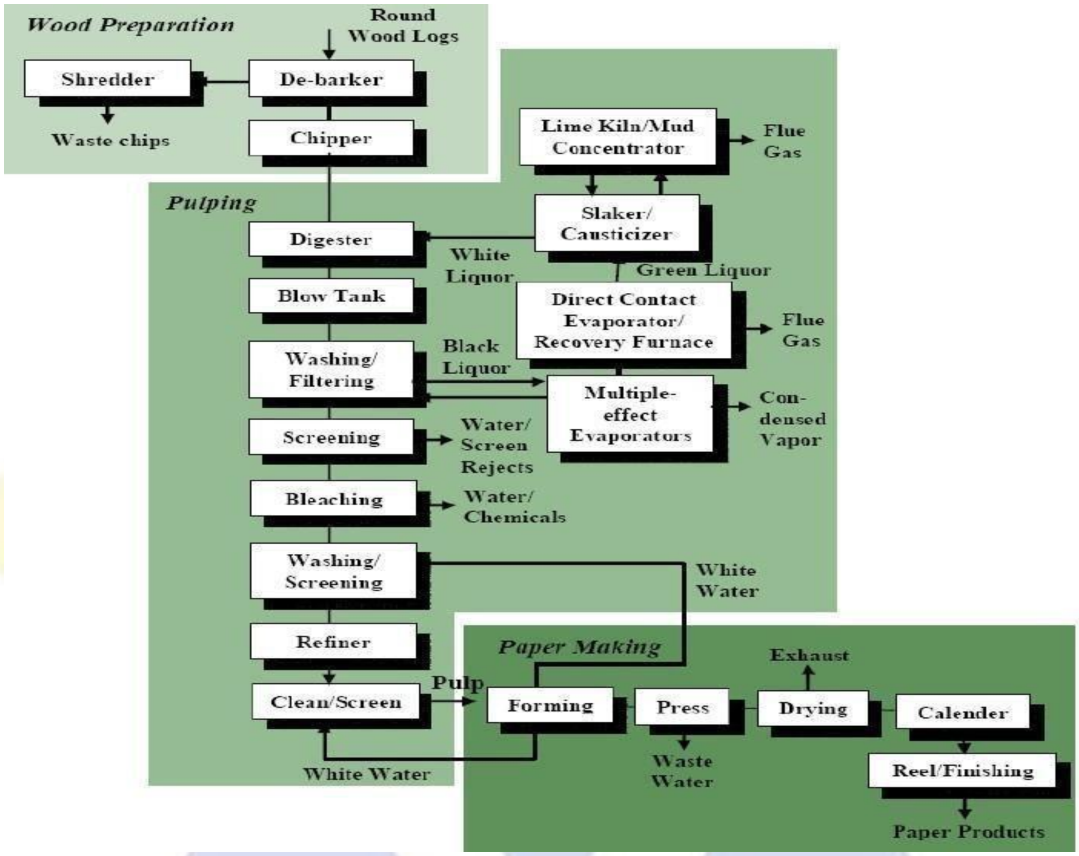
The paper mills use the Pulp as the raw materials which is again produced utilizing different cellulosic materials like wood, bamboo etc., in the pulp mills . The pulp & paper mill wastes characteristically contain vey high COD & color. The presence of lignin in the waste, which is not easily biodegradable, makes the COD/BOD ratio of the waste very high. It may be noted that, the pollution potential of the paper mills are negligible compare to that of the pulp mills. As such, it is the pulp making process, which is responsible for the pollution problem associated with the integrated pulp & paper mills.

Manufacturing process & the sources of the waste

The volume & characteristics of the waste depends on the type & manufacturing process adopted & the extent of reuse of water employee in the plant. The process of manufacturing of paper & pulp making & then making the final product of paper.

In the pulp-making phase, the chipped cellulose raw materials are digested with different chemicals in one tank under high temperature & pressure. The process thus loosens the cellulose fibers & dissolves the lignin & resin & other non-cellulosic materials in the raw material. The kraft process or sulphate process of pulp making uses sodium, sulphate, sodium hydroxide & sodium sulphide as the above mentioned digestive chemicals. Another process of pulp making known as sulphide process uses magnesium or calcium bisulphate & sulphurous acid as the digestive chemicals. The alkali process uses sodium hydroxide or lime for pulp making.

The spent liquor produced by the above process of digestion is known as “Black Liquor”. This is not only very rich in lignin content, but also contains a large amount of utilized chemicals. Therefore, this black liquor is treated separately for the recovery. So while the entire quantity of the liquor is up hide process makes the colored waste from the section, in the kraft process, the same is produced due to the leakages, spillages or overflow only from the digester. The cellulosic fiber after being separated from the black liquor is washed & then partially dewatered.



Characteristics of pulp and paper mill wastes

The chemical composition of the wastes depends on the size of the plant, manufacturing process and largely on the material economy practiced (by way of recovery of chemicals and fibers) in the plant. In most of the small paper mills in India, the chemical recovery is not practiced due to economic reasons. As such, the pollution potential of the waste of smaller mills is higher than that of the larger mills. Generally, very strong color, high BOD, high-suspended solids, and a high COD/BOD ratio characterize the pulp and paper mills wastes.

It may be noticed that too much difference is percent-suspended solids contribution from different sections b/w the large and small mills arises due to following reasons.

Large mills produces large amount of lime mud and without being calcined, it is discharged as a waste. This lime mud in the large mills contributes 86.5% of the total suspended solids in the effluent. As such, the percent suspended solids from the digester section; bleaching paper mill section etc. assumes a very low value. On the other hand, no question of lime mud rises in small mill, as it does not have the chemical recovery plant. The waste volume percentage from the digester section is also higher in the case of small mill as the entire quantity of black liquor is wasted in such mills.

Treatment of pulp and paper mill wastes Recovery

The recovery of the process chemicals and fibers reduces the pollution load largely, where the economy permits; the color bearing "black liquor" is treated for the chemical recovery. The process of recovery is described earlier. However, in this process the lignin is destroyed. The same may also be recovered from the black liquor, by precipitation by acidulation with either CO2 or sulphuric acid. These recovered lignin have got various uses in other industries. The alkaline lignin of kraft process may be used as a dispersing agent in various suspensions. Lignins may be used as raw materials for various other substances like dimethyl sulphide, which is used as spinning solvent for polyacrylonitarite fibers. Activated carbons may also be manufactured from the lignins, recovered from the black liquors. The fibers in the white water, from the paper mills are recovered either by sedimentation or by flotation using forced air in the tank.

Chemical treatment for the color removal

The chemical coagulation for the removal of color is found to be uneconomical. Attempts have been made to remove color from the waste suing the lime sludge. The results are not encouraging. Massive lime treatment process developed in USA is said to be capable of removing 90% of color & 40- 60% of BOD from the waste. In this process, entire quantity of lime normally required for the recaustisation of green liquor into white liquor, is taken & allowed to react first with the colored waste effluent. The color is absorbed by the lime and sludge after setting is used in recausting the green liquor. The treatment of the green liquor with colored lime sludge results in the formation of dark brown liquor containing both desired cooking (digesting) chemicals and color producing component like lignin. This lignin bearing liquor is used as digester liquor and then destroyed along with the fresh lignins, in the subsequent operation of concentration and incineration in the process of chemical recovery.

Activated carbon for color removal

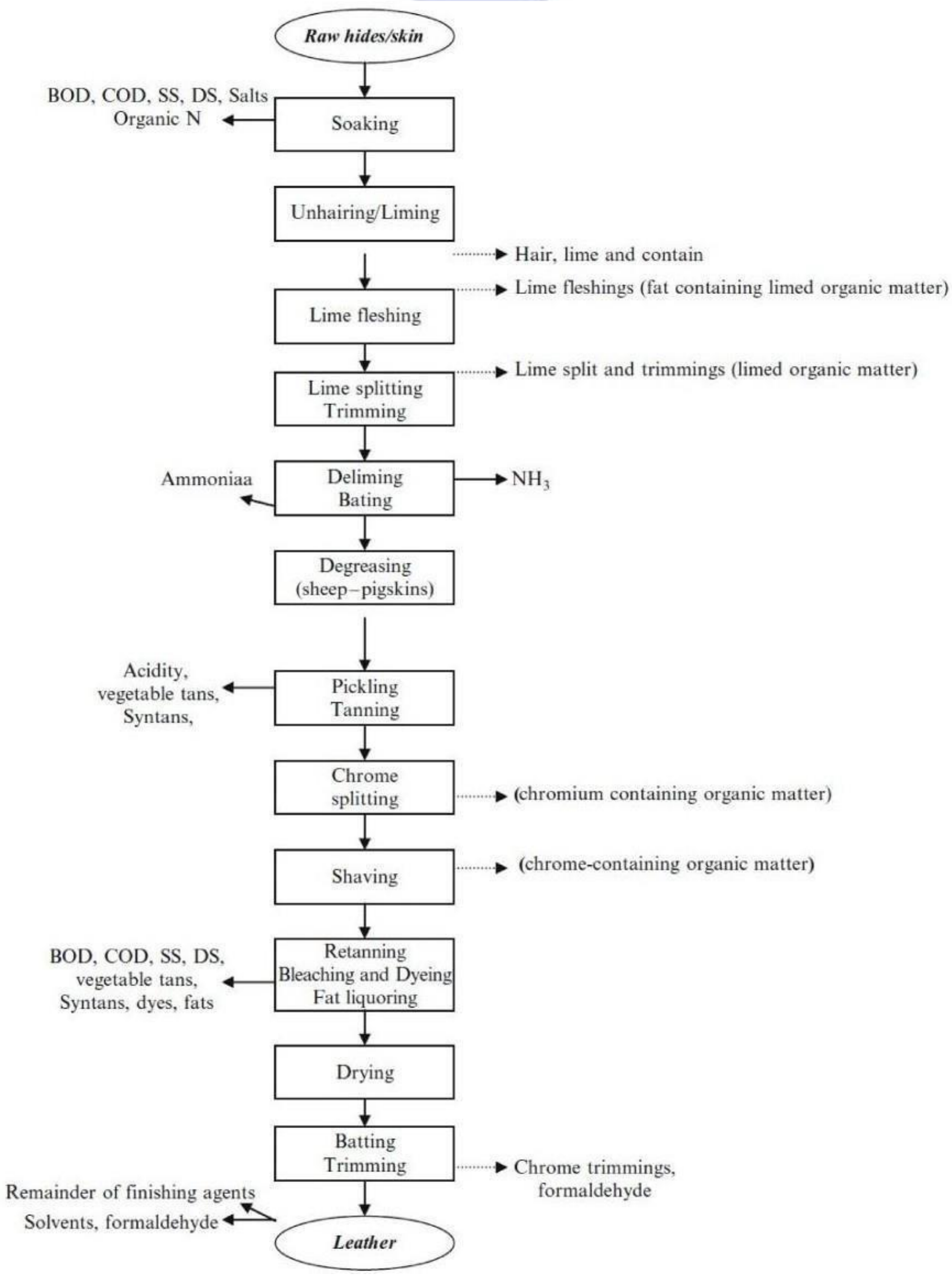
a. Physical treatment for clarification: Mechanically cleaned circular clarifiers along are found to be capable of 70- 80% of the suspended solids from the combined mill effluent. About 95% - 99% removal of settle able solids can be accomplished in the clarifiers. However the BOD reduction is comparatively small and of the order of 25- 40% only.

b. Biological treatment of the waste: Considerable reduction of BOD from the waste can be accomplished in both conventional and low cost biological treatment processes. Some are also effective in the reduction of color from the waste. If sufficient area is available, the waste stabilization ponds offer the cheapest means for treatment. Depth of these ponds vary from 0.9m- 1.5m, the detention period may vary from 12- 30 days. A minimum of 85% removal of BOD is found to be achievable.

c. Lagooning: In small mills where the black liquor is not treated separately for the chemical recovery, the strong black liquor must be segregated from the other wastes and stored in a lagoon. The content of the lagoon may be discharged into the stream under favorable conditions in the monsoon.

Tanning Industry

The tanning industry is one of the old industries in India. Usually the tannery wastes are characterized by strong color high BOD, high pH & high dissolved salts. The concentrated growth of this industry in certain localities has shown how the waste from this industry can issue severe damage to the water environment in the vicinity. In view of this peculiar pollution potential and the increasing demand for good quality water, it has become essential to treated it waste to a certain degree prior to its disposal.



Sources and characteristics of wastewater

The wastewater originates from the all operations in the tanning process. The waste may be classified as continues flow water, and intermittent flow waste. Continues flow waste consists of wash water after various processes and comprises of large portions of the total waste and are relatively and less polluted then the other one. Spent liquors belonging to soaking, liming and batting, pickling, tanning and finishing operation are discharged intermittently. Although small in volume, they are highly polluted and contain varieties of solute and organic and inorganic substances.

The spent and soaked liquor contains soluble proteins of the hides, dirt and large amount of common salt where salted hides are process. This spent liquor under goes putrefaction very rapidly as it offers a good amount nutrient and favorable environment of bacterial growth. The growth of pathogenic – anthrax bacteria in this waste is also reported.

The spent lime liquor contains dissolved and suspended lime, colloidal proteins and their degradation products, sulphides emulsified fatty matters and also carrying a sludge composed of unreacted lime, Calcium sulphide and calcium carbonate. As such the spent lime liquor as a high alkalinity and moderate BOD and high ammonia nitrogen content.

The spent bate liquor contains high amount of organic and ammonium nitrogen due to the presence of soluble skin proteins and ammonia salts used in bating.

The vegetable ton exact containing tannins and also non tannins. Tannins are of high COD but relatively low BOD value. While non tannins including inorganic salts, organic acids and salts and sugar are of high BOD and COD. The spent vegetable tanning liquor is the strongest individual waste in the vegetable tannin having the highest BOD and very strong dirty brown color.

The spent pickling and chrome tanning waste comprises of as small volume, having a low BOD and contains traces of proteins impurities, sodium chloride and minerals acids and chromium salts. Chromium is known to be highly toxic to the living aquatic organisms.

Treatment of wastewater

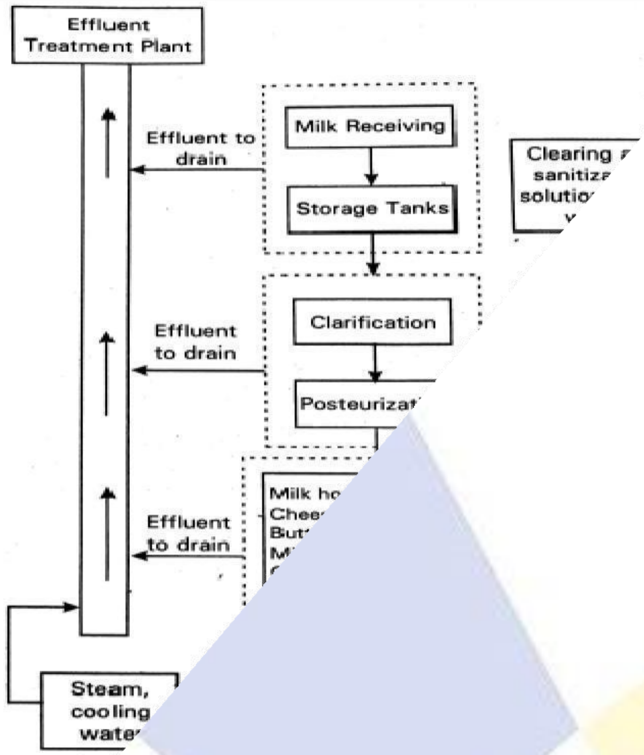
The method of treatment of tannery waste may be classified as physical, chemical and biological. The physical treatment includes mainly screening and primary sedimentation. Screen are required to remove fleshing, hairs and other floating substance. A continuous flow sedimentation tank, designed on maximum hourly flow with 4 hrs of detention, and is found to be effective in 90% removal of suspended solid. About 98% of the chromium is precipitated in the primary sedimentation tank and is removed along with the sludge. The sludge is dried over sand drying beds and can be used as good manure. No appreciable reduction of dissolved solids, BOD, COD, color and chloride can be achieved in the physical treatment processes.

Chemical coagulation with or without neutralization, followed by biological treatment is necessary for better quality of the effluent. Several coagulants like alum, ferric chloride and ferrous sulphate have been tried for chemical coagulations. Chemical coagulation with ferric chloride alone is reported to be quite effective in the removal of tannin and COD.

Biological treatment of the tannery waste, in activated sludge process, after mixing with municipal wastewater in a suitable proportion, and using acclimatized microorganism is capable to reduce the BOD, COD and tannin by about 90%. Trickling filter may also be used for effective removal of BOD, COD and color. The low cost treatment methods may effectively be used for the treatment of tannery wastes. Both oxidation pond and anaerobic lagoons are recommended for small and isolated tanners. Anaerobic lagoons require less land area and nutrient addition compared to those in oxidation ponds.

Dairy Industry

With increase in demand for milk & milk products, many dairies of different sizes have come up in different places. These dairies collect the milk from the producers & then either packed it for marketing or produce different milk foods according to their capacity. Large quantity of waste water originates due to their different operations. The organic substances in the wastes comes either in the form in which they were present in milk or in a degraded form due to their processing. As such the dairy wastes though biodegradable are very strong in nature.



Processing and sources of wastes

The liquid waste from a large dairy originates from the following sections or plants. Receiving station bottling plant, cheese plant, butter plant, casein plant, condensing plant, dried milk plant & ice cream plants. Wastes also come from water softening plant & from bottle and washing plants. At the receiving station, the milk is received from the farmers and is emptied into large containers for transport to bottling of other processing plants. The empty can be rinsed, washed and sterilized before returning to the farmers. At the bottling plants, the raw milk delivered by receiving station is stored. The processing includes cooling, filtration, clarification, pasteurization and bottling.

Effects of the waste on the receiving water and sewage plants

As the dairies are usually situated in rural areas or in small towns, the question of discharging the dairy waste in to the sewers does not arise.

The waste is basically organic in nature. This is also slightly alkaline when fresh. When these wastes are allowed to go into the stream without any treatment, a rapid depletion of DO of the stream occurs along with growth of sewage fungi covering the entire bottom of the stream. The waste is said to carry occasionally, the bacteria responsible for tuberculosis (TB). Though alkaline in fresh condition the milk waste becomes acidic due to the decomposition of lactose into lactic acid under anaerobic condition. The resulting condition precipitates casein from the waste, which decomposes further into a highly odors black sludge. At certain dilution the dairy waste is found to be toxic to fishes also.

Treatment of the dairy waste

Due to low COD, BOD ratio the dairy wastes can be treated efficiently by biological processes. Moreover, these wastes contain sufficient nutrients for bacterial growth. But for economical reasons, attempt should be made to reduce the volume & strength of the waste. This can be accomplished by

1. Prevention of spills, leakages & dropping of milk from the cans.
2. By reducing the amount of water for washes.
3. By segregating the uncontaminated cooling water and recycling the same.
4. By utilizing the buttermilk and whey for the production of dairy bi products of good market value.

Due to the intermittent nature of the waste, it is desirable to provide equalization tank, with or without aeration, before the same is sent for biological treatment. A provision of grease trap is also necessary as a pretreatment to remove fat & other greasy substances from the wastes. Aeration for a day not only prevents the formation of lactic acid, but also reduces the BOD by about 50%.

Both high rates trickling filters & activated sludge plants can be employed very effectively for a complete treatment of the dairy waste. However, these convention methods involve much maintenance, skilled methods like oxidation ditch, aerated lagoon, waste stabilization pond etc., can be employed with simpler type of equipment's & less maintenance.

Use of the dairy waste for irrigation after primary treatment in an aerated lagoon may be a good answer for the disposal of dairy wastes.

Cement Industry

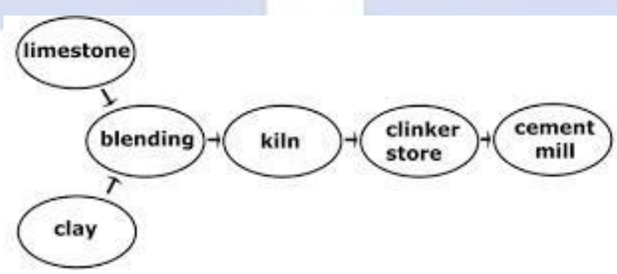
Cement industry contributes much to air pollution & liquid effluents are not problem Raw materials

It is a compound made up of calcium oxide & silicon di oxide along with aluminium oxide, ferric oxide & magnesium oxide. Raw materials required for the manufacture of cement are lime, sand clay, shale, iron –ore & blast furnace slag.

<u>Cement Manufacturing Process Phases</u>

Production of cement completes after passing of raw materials from the following six phases. These are;

1. Raw material extraction/Quarry
2. Grinding, Proportioning and Blending
3. Pre-heater Phase
4. Kiln Phase
5. Cooling and Final Grinding
6. Packing & Shipping



Sources of effluent

Cooling water- It can be recycled after cooling as it does not contain harmful materials

Wet scrubbing effluent – Wet scrubbing of kiln dust yields an effluent that has a high pH value, alkalinity, suspended & dissolved solids like sulfate & potassium predominates.

Wastewater and Industrial Process Wastewater Treatment

In cement industries, water is used only for cooling operation of manufacturing process. Process wastewater with high pH and suspended solids may be generated in some operations. Generally, waster used for cooling purpose is recycled and reused in the process. Screening and for suspended solid reduction is done by using settling basin and clarifier. Water treated from wastewater treatment plant should use for green belt development. This green belt also helps in minimizing noise pollution.

At lime mining site and cement plant contaminated streams of rainwater should be directed to the wastewater treatment plant and should use for industrial process. Storm-water flowing through pet–coke, coal, and waste material stockpiles exposed to the open air may become contaminated. Rainwater should be protected from contacting from coal depot clinker and lime and fly ash storage area to prevent contamination by covering the storage area and should collect at some tank for further use in dust suppression system at plant. If storm-water does contact storage yard than it may indicate presence of high value of sulphate in soil and toxic metals like Zinc, Lead and Chromium in the dust and high TDS value in ground water.

Pharmaceutical industry (Chemical Industry)

Pharmaceutical industry produces varied type of products. They range from vitamins, synthetic drugs to antibiotics. The raw materials used are includes both organic and inorganic compounds. Some of the pharmaceutical plants do not generate any liquid effluents, while some others discharge little quantities of strong waste & others let out larger volumes.

Due to these wide variations a generalization cannot be drawn on the effluents of pharmaceutical industry. Most of the antibiotics such as penicillin. Streptomycin, lysine, sulfaquinazoline, nicarbazine & vitamins such as B1, B2, B12 and many steroids are prepared in the fermentation. The most waste produced in the fermentation process is the spent beer liquor. The spent beer liquor is the fermented broth remaining after the recovery of antibiotics and other valuables. It contains large amounts of organic materials, proteins and other nutrients and consequently the BOD of these effluents is abnormally high

Five main pharmaceutical wastes and their characteristics are as follows

1. Strong fermentation beers (small in volume but having 4000 to 8000 mg/LBOD)
2. Inorganic solids (waste slurry with little BOD)
3. Washings of floor and equipment (large percentage of total volume and BOD from 600 to 2500ppm)
4. Chemical waste – solution or solvents which exert a substantial BOD when diluted with other wastes
5. Barometric condenser wastewater – resulting from solids and volatile gases being mixed with condenser wastewater causing 60 to 120 ppm BOD

The antibiotic wastes impart objectionable odors to stream and inhibit biological population and action. If they are discharged into sewer, they must be properly diluted; otherwise they affect the sewage treatment.

The volume and composition vary from unit to unit. Approximately 1000 to 3000 liters of waste will be discharged per 100 kg of products manufactured. No specific conclusion on the characteristics of the effluents can be drawn. In general, they are either highly acidic or highly alkaline and possess a high BOD and COD. Some of the effluents contain toxic substances like cyanides.

If the wastes are discharged into stream, they deplete the dissolved oxygen immediately.

These are corrosive due to their high acidity/alkalinity. Further, some of the substances present in them are toxic to aquatic life.

Effects of the waste on receiving water sewer

If a crude waste from an antibiotic waste is discharged into a stream, it not only imparts an objectionable odour to the stream but also adversely affects the biological process in it. This waste should not be allowed to discharge into a municipal sewer unless the sewage treatment plant is properly designed to handle a widely varying and concentrated waste from such a plant.

Treatment of wastewater Antibiotic wastes

Equalization, neutralization and clarification are the essential steps involved in the primary treatment of these waste. Anaerobic digestion and controlled aeration are proved to be the effective secondary treatments. Activated sludge and oxidation ditch are also employed in some pharmaceutical manufacturing units. The effluent from secondary treatments may be passed on to sand filters to produce effluent of better quality

Sometimes, the antibiotics wastes are evaporated and incinerated. Residues from penicillin and other antibiotics are dried and used in stock food. It is reported that a vacuum dried mycelium from the manufacture of penicillin can be digested to produce methane while reducing the organic matter content by about 55%.

Synthetic drug wastes

The type of treatment largely depends on the products manufactured. Due to the varied characteristics of wastes from different sections of the plant, a careful pilot plant study is essential. Segregation of different waste streams is a preliminary step in the treatment. Acidic wastes are neutralized with lime. Odor producing wastes are chlorinated. Cyanide bearing effluents are subjected to alkaline chlorination. Secondary treatments include biological oxidation with acclimatized microorganisms.

Hazardous Wastes and their Disposal

Wastes have been understood globally to mean substances or objects that are :-

- disposed of, intended to be disposed of,
- or required to be disposed of under provisions of national law.

Hazardous wastes are a subset of waste that can cause harm to human health and/or damage to the environment.

Hazardous substances include by products that are explosive; flammable, radioactive; liable to spontaneous combustion, emit flammable gases upon contact with water, poisonous , infectious, corrosive, toxic and those that are capable of yielding another harmful substance after disposal.

They include waste containing harmful compounds such as arsenic, cadmium, mercury, lead, acidic solutions, organic phosphorus, halogenated organic solvents phenols.

The wastes originate from a variety of sources including a wide range of production processes medical care in hospitals and domestic garbage.

As the world becomes more developed and societies larger with affluent consumption patterns, a range of industrial, commercial, construction, agricultural, medical and even domestic activities increase and increase waste including hazardous as well.

Eg. A report recorded that the EU generate some1.3 billion tonnes of waste every year of which over 36milllion tonnes are Hazard-wastes.

Other concerns of Hazardous wastes include:-

- The amount of waste generated, the adverse health and environmental impacts of hazardous substances & their by products;
- Increase of improper handling and unsafe disposal methods and practices;
- Industry and other sectors are in dire need of alternative disposal sites/facilities**;**
- Although there is no scientific certainty about the hazards of all wastes, studies have confirmed &revealed the danger of many wastes their toxicity, carcinogenicity, mutagenicity, corrosivity and other characteristics harmful to human health and environment.
- The revelations were a basis for international action, they stimulated tightening of regulations, the cost of hazardous waste disposal rose, and search for cheaper ways of disposing waste within and abroad, including in the high seas began.
- The practice of manufacturers of concealing information about the nature of waste generated in their production processes in the name of trade and business secrets.
- Another problem is traders in toxic wastes conceal the nature of waste they handle especially waste exports.
- This affects the ability of recipient countries to take appropriate measures.

International response to hazardous waste

Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal:

- The Basel Convention was adopted in 1989,it came into force in 1992;
- The Convention has Parties;
- It is a most comprehensive global environmental agreement on hazardous and other wastes adopted for the purpose of protecting human health and the environment against the

adverse effects resulting from the generation, management, transboundary movement and disposal of hazardous and other wastes.

The Main goal of the Convention

- To protect, by strict control, human health and the environment against the adverse effects which may result from the generation and management of hazardous waste and other wastes;

Examples of wastes:

- Obsolete stocks of pesticides
- Biomedical/healthcare wastes
- Used oils; Used lead acid batteries; POPs waste; Electronic Waste (e-waste); Mobile phones; Ships destined to be dismantled

Objective

The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics, as well as two types of wastes defined as “other wastes” - household waste and incinerator ash.

Aims and provisions

The provisions of the Convention center around the following principal aims:

- the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and

- a regulatory system applying to cases where transboundary movements are permissible.

The first aim is addressed through a number of general provisions requiring States to observe the fundamental principles of environmentally sound waste management (article 4). A number of prohibitions are designed to attain the second aim: hazardous wastes may not be exported to Antarctica, to a State not party to the Basel Convention, or to a party having banned the import of hazardous wastes (article 4). Parties may, however, enter into bilateral or multilateral agreements on hazardous waste management with other parties or with non-parties, provided that such agreements are "no less environmentally sound" than the Basel Convention (article 11). In all cases where transboundary movement is not, in principle, prohibited, it may take place only if it represents an environmentally sound solution, if the principles of environmentally sound management and non-discrimination are observed and if it is carried out in accordance with the Convention's regulatory system.

The regulatory system is the cornerstone of the Basel Convention as originally adopted. Based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if and when all States concerned have given their written consent (articles 6 and 7). The Basel Convention also provides for cooperation between parties, ranging from exchange of information on issues relevant to the implementation of the Convention to technical assistance, particularly to developing countries (articles 10 and 13). The Secretariat is required to facilitate and support this cooperation, acting as a clearing-house (article 16). In the event of a transboundary movement of hazardous wastes having been carried out illegally, i.e. in contravention of the provisions of articles 6 and 7, or cannot be completed as foreseen, the Convention attributes responsibility to one or more of the States involved, and imposes the duty to ensure safe disposal, either by re-import into the State of generation or otherwise (articles 8 and 9).

The Convention also provides for the establishment of regional or sub-regional centres for training and technology transfers regarding the management of hazardous wastes and other wastes and the minimization of their generation to cater to the specific needs of different regions and subregions (article 14). Fourteen such centres have been established. They carry out training and capacity building activities in the regions.