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Internal Assesment Test –II

Sub:	INDUSTRIAL WASTEWATER TREATMENT							Code:	10CV835
Date:	10 / 05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	VIII	Branch:	CIVIL

Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1(a)	Explain the orgin of wastewater from cane sugar mill with the help of flow diagram.	[07]	CIV809.4	L2
(b)	List the characteristics of wastewaterfrom cane sugar mill.	[03]	CIV809.4	L1
2	Explain Volume Reduction method for treatment of industrial waste water	[10]	CIV809.3	L2
3	Explainthe different methods forNeutralization of industrial wastewater	[10]	CIV809.3	L2
4	Explain different kinds of wastewater from a typical diary industry.	[10]	CIV809.4	L2
5	Explain the cotton textile mill wastes orgin with process flow diagram.	[10]	CIV809.4	L2
6 (a)	Explain the different methods of cement manufacturing.	[05]	CIV809.4	L2
(b)	Discuss the sources of wastewater and treatment options for cement industry.	[05]	CIV809.4	L2

IAT-II SOLUTION

INDUSTRIAL WASTEWATER TREATMENT (10CV835)

1.a.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. The milk of lime is then added to the juice and heated, when all the colloidal and suspended impurities are coagulated; much of the colour is also removed during this lime treatment. Lime is added to the extracted juice to raise its pH and to prevent the inversion of the sucrose molecule to glucose and fructose. 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.Thefilterate 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"; colour 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" 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 mollases". The sugar is then dried and bagged for transport. The black strap mollases may be used in the distilleries.

Sources of Waste Water and the Characteristics of the Waste

Wastes from the mill house include the water used as splashes to extract maximum amount of juice, and those used to cool the bearings. As such the mill house waste contains high B.O.D due to the presence of sugar, and oil from the machineries.

The filter clothes, used for filtering the juice, need occasional cleaning. The wastewater thus produced through small in volume, contains high B.O.D and suspended solids. A large volume of water is required in the barometric condensers of the multiple effect evaporators and vacuum pans. The water is usually partially or fully recirculated, 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 evaporators and vacuum pans.

The water from spray pond when overflows, becomes a part of the wastewater, and usually of low B.O.D in a properly operated sugar mill. Additional waste originates due to the leakages and

spillages of juice, syrup and molasses in different sections, and also due to the handling of molasses.

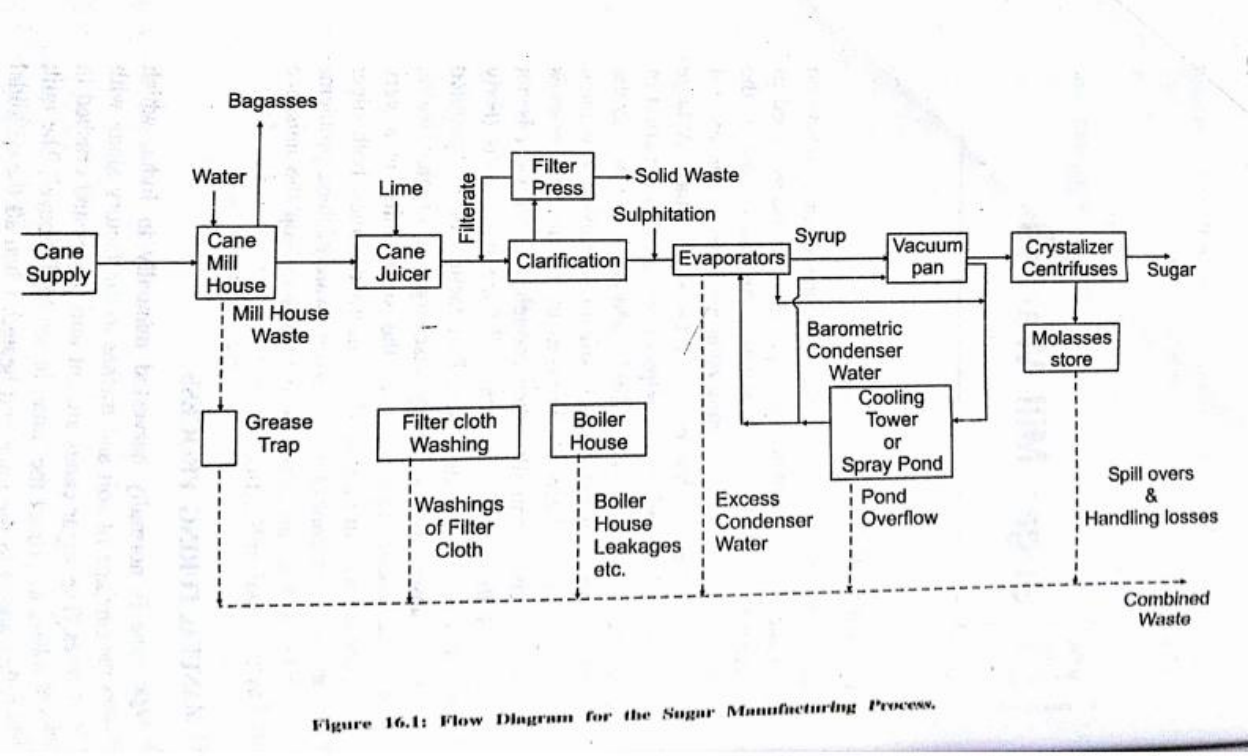

Figure 16.1: Flow Diagram for the Sugar Manufacturing Process.

1.b.Characteristics of wastewater from cane sugar mill

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

2. In general, the first step in minimizing the effects of Industrial Wastes on receiving Streams and Treatment Plants is to reduce the Volume of such Wastes.
This may be accomplished by:
1.Classification of wastes
2.Conservation of waste water
3.Changing production to decrease wastes

4.Re-using both industrial and municipal effluents as raw water supplies
5.Elimination of batch or slug discharges of process wastes.

Classification of Wastes:

If wastes are classified, so that manufacturing-process waters are separated from cooling waters, the volume of water requiring intensive treatment may be reduced considerably. Sometimes it is possible to classify and separate the process waters themselves, so that only the most polluted ones are treated and the relatively uncontaminated ones are discharged without Treatment.

The Three main classes of waste are:

1. Wastes from manufacturing processes

2. Waters used as cooling agents in industrial processes

3. Wastes from sanitary uses.

Conservation of wastewater:

Water conserved is waste saved. Conservation begins when an industry changes from open to a closed system. Introduction of conservation practices requires a complete engineering survey of existing water use and an inventory of all plant operations using water and producing wastes, so as to develop an accurate balance for peak and average operating conditions.

Changing Production to Decrease Wastes: This is an effective method of controlling the volume of wastes but is difficult to put into practice. It is hard to persuade production men to change their operations just to eliminate wastes. Normally, the operational phase of engineering is planned by the chemical, mechanical or industrial engineer, whose primary objective is cost savings, several measures that can be used to reduce wastes, improved process control, improved equipment design, use of different or better quality raw materials, good house keeping and preventive maintenance.

Re-Using Both Industrial and Municipal Effluents for Raw Water supplies:

Practiced mainly in areas where water is scarce and/or expensive, this is proving a popular and economical method of conservation of all the sources of water available to industry. Sewage plant effluent is the most reliable at all seasons of the year and the only one that is actually increasing in quantity and improving in quality. Many industries and cities hesitate to reuse effluents for raw water supply. Certain technical problems such as hardness, colour and an esthetic reluctance to accept effluents as a potential source of water for any purpose. Also treatment plants are subject to shutdown and sudden discharges, both of which may make the supply undependable or of variable quality. Waste- treatment plant effluents to increase the present water supply by replenishing the ground water. The ever-available treatment plant effluent can produce a low cost steady water source through ground water recharge. Re-use of sewage effluent will reduce the quantity of pollution discharged by the municipality.

Elimination of Batch or Slug Discharge of Process Wastes

If the waste is discharged in a short period of time, it is usually referred to as a slug discharge. This type of waste, because of its concentrated contaminants and/or surge in volume, can be troublesome to both treatment plants and receiving streams.

There are atleast two methods of reducing the effects of these discharges:

1. The-manufacturing firm alters its practice so as to increase the frequency and lessen the magnitude of Batch discharges.

2. Slug Wastes are retained in holding basins from which they are allowed to flow continuously and uniformly over an extended (usually 24-hour) period.

3. Excessively acidic or alkaline wastes should not be discharged without treatment into a receiving stream. A stream is adversely affected by low or high pH values. This adverse condition is even more critical when sudden sludge of acids or alkalis are imposed upon the stream.

Acceptable Methods of Neutralization:

1. Mixing wastes so that the net effect is a neutral pH.
2. Passing acid wastes through beds of limestone.
3. Mixing acid wastes with lime slurries.
4. Adding the proper proportions of concentrated solutions of caustic soda(NaOH) or soda ash (Na_2CO_3)to acid wastes.
5. Adding compressed CO_2 to alkaline wastes.
6. Adding sulfuric acid to alkaline wastes.

The material and method used should be selected on the basis of the overall cost, since material costs vary widely and equipment for utilizing various agents will differ with the method selected. The volume, kind and quality of acid or alkali to be neutralized are also factors in deciding which neutralizing agent to use.

4. Diary industry

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 such 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).

Classification of Waste:

Spent waters: Water used for condensing and free from milk solids. These are easily disposed off.

Waste waters produced during handling and manufacturing of dairy products are :

(i) Spoiled products of skim milk, whey and buttermilk.

(ii) Drips, leaks, first rinses and alkaline wash waters. Whey and buttermilk have high BOD.

5. **Cotton textile mill waste:**

An integrated cotton textile mill produces its own yarn from the raw cotton. Production of yarn from raw cotton includes steps like opening and cleaning, picking, carding, drawing, spinning,

winding and warping. All these sequences are dry operations and as such do not contribute to the liquid waste of the mill.

Carding : It is a process in the manufacture of 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 fibres 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 threadfrom 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 desizing, bleaching, mercerizing, dyeing and finishing.

In slashing,(to give it the tensile strength and smoothness necessary for subsequent weaving) the yarn is strengthened by loading it with starch or other sizing substances. Waste originates from this section due to spills and the floor washings at the weak end.

After slashing the yarn goes for weaving .The prepared cloth now requires scouring and desizing to remove natural impurities and the slashing compounds.

To remove the natural impurities such as greases, waxes, fats and other impurities, the desized cloth is subjected to kier boiling i.e they are boiled with the aid of steam in an alkaline solution containing caustic soda. After boiling the spent liquor is discharged as waste. This is a strong waste, dark brown in colour, and highly alkaline. Temperature of the effulent is high. BOD of the liquor is also high, contributing 35% of the total waste. Bleaching operations use oxidizing chemicals like peroxides and hypochlorites to remove natural colouring materials and to render the clothes white.The bleaching process is necessary where fabrics are to be given a full white or where they are to be dyed in specific shades. In this process the natural colouring matter in the textile material is removed by the use of oxidising chemicals like peroxides and hypochlorites.

Mercerizing consists of passing the cloth through 20% caustic soda solution. The process improves the strength, elasticity, lustre and dye affinity. Waste from this section is recycled after sodium hydroxide recovery. Dyeing may be done in various ways, using different types of dyes and auxiliary chemicals.

Colour from the dyes vary widely and although those are not usually toxic, they are aesthetically objectional when they impart colour in the drinking water supplies. Thickened dyes, along with printing gums and necessary auxiliaries, are used for printing and subsequent fixation. After fixation of the prints, the fabric is given a thorough wash to remove unfixed dyes. The finishing section of the mill imparts various finishes to the fabrics. Various types of chemicals are used for various objectives.

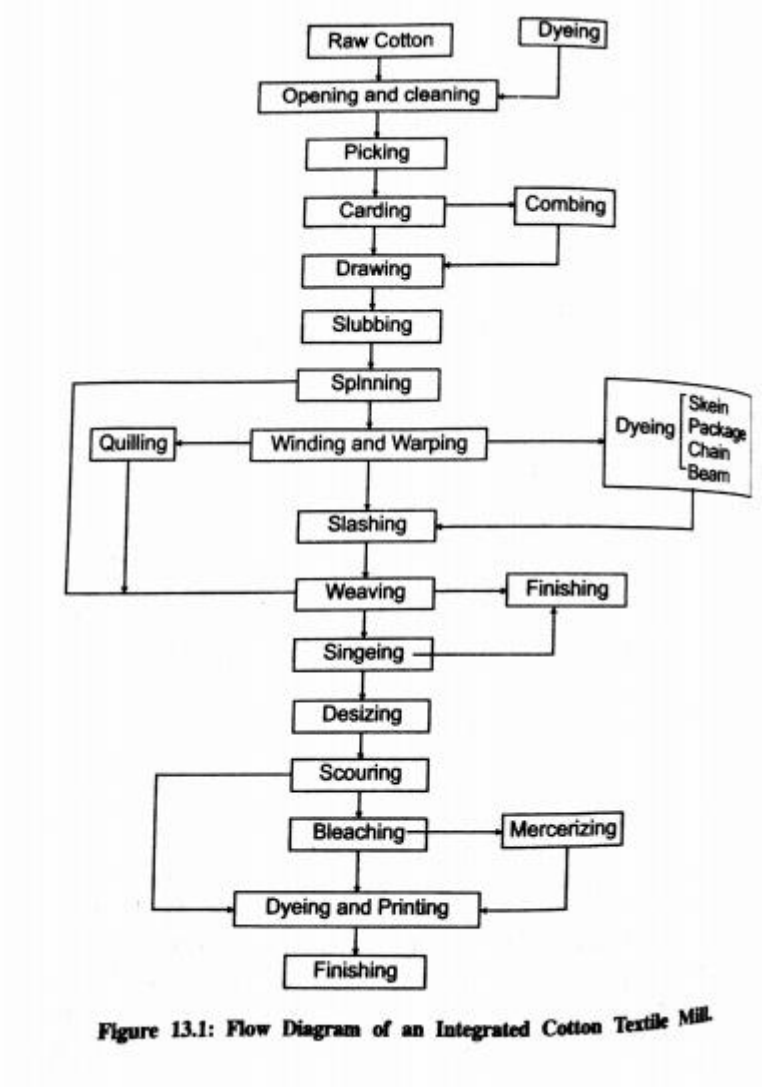

Figure 13.1: Flow Diagram of an Integrated Cotton Textile Mill.

6.a. Cement manufacturing

Raw material extraction

Cement uses raw materials that cover calcium, silicon, iron and aluminium. Such raw materials are limestone, clay and sand. Limestone is for calcium. It is combined with much smaller proportions of sand and clay. Sand & clay fulfill the need of silicon, iron and aluminium.

a) Dry Process

The both calcareous and argillaceous raw materials are firstly crushed in the crushers to get 2-5cm size pieces separately. The crushed materials are again grinded to get fine particles. Each finely grinded material is stored in hopper after screening. Now these powdered minerals are mixed in required proportion to get dry raw mix which is then stored in silos and kept ready to be sent into rotary kiln. Now the raw materials are mixed in specific proportions so that the average composition of the final product is maintained properly.

b) Wet Process

The raw materials are firstly crushed and made into powdered form and stored in silos. The clay is then washed in washing mills to remove adhering organic matters found in clay.

The powdered limestone and water washed clay are sent to flow in the channels and transfer to grinding mills where they are completely mixed and the paste is formed, i.e., known as slurry.

The grinding process can be done in ball or tube mill or even both. Then the slurry is send to collecting basin where composition can be adjusted. The slurry contains around 38-40% water that is stored in storage tanks and kept ready for the rotary kiln.

PROPORTIONING, BLENDING & GRINDING

The raw materials from quarry are now routed in plant laboratory where, they are analyzed and proper proportioning of limestone and clay are made possible before the beginning of grinding. Now cement plant grind the raw mix with the help of heavy wheel type rollers and rotating table. Roller crushes the material to a fine powder and finishes the job.

PRE-HEATING RAW MATERIAL

After final grinding, the material is ready to face the pre-heating chamber. Pre-heater chamber consists of series of vertical cyclone from where the raw material passes before facing the kiln. Pre-heating chamber utilizes the emitting hot gases from kiln. Pre-heating of the material saves the energy and make plant environmental friendly.

KILN PHASE

Kiln is a huge rotating furnace, also called as the heart of cement making process. Here, raw material is heated up to 1450 ^{0}C. At this temperature, a chemical reaction called decarbonationreleases the carbon dioxide. High temperature of kiln makes slurry of the material.

The series of chemical reactions between calcium and silicon dioxide compounds form the primary constituents of cement i.e., calcium silicate. Kiln is heated up from the exit side by the use of natural gas and coal. When material reaches the lower part of the kiln, it forms the shape of clinker.

COOLING AND FINAL GRINDING

After passing out from the kiln, clinkers are cooled by mean of forced air. Clinker released the absorb heat and cool down to lower temperature. Released heat by clinker is reused by recirculating it back to the kiln. This too saves energy.

Final process of this phase is the final grinding. Clinker reach the rotating drum after cooling. Here, steel balls tumble and crush the clinker into a very fine powder. This fine powder is

considered as cement. During grinding gypsum is also added to the mix in small percentage that controls the setting of cement.

PACKING AND SHIPPING

Material is directly conveyed to the silos (silos are the large storage tanks of cement) from the grinding mills. Further, it is packed to about 20-40 kg bags.

6.b.Sources of wastewater: Cooling water: It can be recycled after cooling as it doesnot contain harmful materials.

Wet scrubbing effluent: Wet scrubbing of kiln dust yields an effluent that has high pH value, alkalinity, suspended and dissolved solids

In cement industries water is used only for cooling operation of manufacturing process. Wastewater with high pH and suspended solids may be generated in some operations. Generally water used for cooling purpose is recycled and reused in the process. Suspended solids reduction is done by settling basin and clarifier. Water treated from wastewater treatment plant should be used for green belt development.