MUTHAYAMMAL ENGINEERING COLLEGE

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

Estd. 2000

IQAC

L01

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 09.12.2019**

Topic of Lecture:
Types of Industries and its industrial pollutions

Introduction :

- Industrial waste is the waste produced by industrial activity includes any material that is rendered useless during a manufacturing process (heating, cooling)such as that of;
- Factories, industries, mills mining operations , etc.,

Prerequisite knowledge for Complete understanding and learning of Topic:

- Environmental science and engineering
- Industry processing

Detailed content of the Lecture:

Industry:

- The production side of business activity is refered as industry.
- It is a business activity, which is related to the raising , producing , processing or manufacturing of products
- Types of products are
  - (i) Producer goods
  - (ii) Consumer goods

Types or classification of industries:

(i) Primary industry

- Primary industry is concerned with production of goods with the help of nature.

(a) Genetic Industry

(b) Extractive Industry

(c) Manufacturing Industry

(d) Construction Industry

(e) Service Industry

(ii) Secondary industries

- Involve the manufacture of raw materials, into another product by manual labor or machines.

(iii) Tertiary industries

- Neither produces a raw material nor makes a product.

(iv) Quaternary industries

- Involve the use of high techindustries.

Industrial pollution:

Any form of pollution that can trace its immediate source to industrial practice is known as " Industry Pollution "

Causes of industrial pollutions :

(i) Lack of polices to controls pollutions

- Lack of effective policies and poor enforcement drive allowed many industries to bypass laws made by pollution control board.

(ii) Unplanned industrial growth

- Most industries still rely on old technologies to produce products that generate large amount of waste.

(iii) Use of outdated technologies

(iv) Pressure on large number of small scale industries

- Many small scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations

(v) Inefficient water disposal

- Water pollution and soil pollution are often caused directly due to inefficiency in disposal of waste.

(vi) Leaching of resources from our national world

- Industries do require large amount of raw material to make them into finished products.

Types of pollution from industries:

S.No	Type of the industry	Type of pollution
Caustic Soda	Mercury chlorines	Air, water and land
Distillery	Organic waste	Land and water

Categories of polutions:

(i) Inorganic pollution s

(a) Sugars

(b) Oils and fats

(ii) Organic pollutions

(a) Alkalis

(b) Minerals acids

characteristics of industrial waste:

(c) Physical Characteristics. (Turbidity, Color.)

The principal physical characteristics of waste- water are its solids content, colour, odour and tem- perature. The total solids in a wastewater consist of the insoluble or suspended solids and the soluble com- pounds dissolved in water.

(d) Chemical Characteristics due to Chemical Impurities. Chemical Oxygen Demand (COD) · Total Organic Carbon (TOC)

The principal chemical tests include free ammonia, organic nitrogen, nitrites, nitrates, organic phospho- rus and inorganic phosphorus. Nitrogen and phos- phorus are important because these two nutrients are responsible for the growth of aquatic plants.

(e) Biological Characteristics due to Contaminants. · Biochemical Oxygen Demand (BOD)

Types of pollution from industries

Sl.No	Industry	Wastes Produced	Type of Pollution
1.	Caustic Soda	Mercury, Chlorine gas	Air, water and land
2.	Cement dust, smoke	Particulate matter	-
3.	Distillery	Organic waste	Land and water
4.	Fertilizer	Ammonia, cyanide, oxides of nitrogen, oxides of Sulphur	Air and water
5.	Dye	Inorganic waste pigment	Land and water
6.	Iron and steel	Smoke, gases, coal dust, fly ash, fluorine	Air, water and land

Video Content / Details of website for further learning (if any):
Can be added as link :
https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos 1.0-1.16)

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L02

LECTURE HANDOUTS

CIVIL

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP / Civil

Unit : I –Introduction **Date of Lecture: 10.12.2019**

Topic of Lecture:

- Characteristics of industrial

Introduction :

- Population equivalent or unit per capita loading, (PE), in waste-water treatment is the number expressing the ratio of the sum of the pollution load produced during 24 hours by industrial facilities and services to the individual pollution load in household sewage produced by one person in the same time.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Population forecasting
- Bio- assay laboratory and its testing

Detailed content of the Lecture:

Populations Equivalent

Population equivalents of wastewater from some industries

Type	Activity	BOD PE [inhab/(unit/d)]
Food	Canning (fruit/vegetables)	500
	Pea processing	85-400
	Tomato	50-185
	Carrot	160-390
	Potato	215-545
	Citrus fruit	55
	Chicken meat	70-1600
	Fish	300-2300
	Sweets/candies	40-150
	Sugar cane	50
	Dairy (without cheese)	20-100

Bio assay studies:

Main conclusions

1. A broad range of micro pollutants and their effects were eliminated by more than 80% after the advanced treatments.
2. There was no evidence for a toxicity increase due to a constant formation of stable toxic ozonation by-products.
3. An ozonation should be followed by a final filtration step with biological activity.

4. Quality of treated effluent was significantly improved, leading to improved surface water quality.

Evaluation of Bioassays:

1. The aim of the project "Strategy Micropoll" of the Swiss Federal Office for the Environment (FOEN) was to develop a strategy regarding micro pollutants originating from municipal wastewater.

2. A situation analysis was conducted in order to assess thecontamination of Swiss surface waters with micro pollutants

3. Possibilities for financing measures for advanced wastewater treatment were evaluated.In order to evaluate possible technical treatments to reduce the concentrations and effects oforganic micro pollutants in surface waters, two large-scale pilot studies were conducted.

4. In bothstudies the efficiency of complementary wastewater treatment for the elimination ofmicropollutants from wastewater treatment effluent was assessed, such as ozonation followed bysand filtration (ozonation-SF) and different processes including powdered activated carbon addition (PAC).

5. Technical aspects as well as a performance review regarding the elimination ofmicropollutants using chemical measurements and ecotoxicological test systems were included.

Approach of bio-assay

1. A broad range of biotests for the evaluation of water and wastewater quality is available.

2. Animportant goal of this project was to identify appropriate bioassays sensitive enough to detect theeffects of micro pollutants.

3. The selection of eco toxicological test systems was based on preliminary studies conducted before the first pilot study by measuring specific cellular effects, as well as integrative tests with whole organisms group on ecotoxicology.

4. Bioassays were selected based on one or more of the following selection criteria.

(i) Test sensitivity is Standardized test methods are available.

(ii) Consideration of different trophic levels (bacteria, algae, macrophytes, invertebrates, vertebrates)

5. Application of different types of sample processing and test systems:

(i) Assessment of enriched wastewater samples

(ii)High enough to detect contaminant effects in treated wastewaterin the preliminary studies

 iii)Assessment of wastewater samples without sample enrichment

(iv)Effect measurements with organisms in flow-through systems (channels, microcosms)

6. Two types of bioassays were used:

(i) In vitro bioassays based on specific cellular mechanisms measure cellular effects specificto groups of toxicants with similar modes of action.

Video Content / Details of website for further learning (if any):
Can be added as link :
https://www.youtube.com/watch?v=zVZ9c6EXfTA&list=PL1BFC82F3A63B4172

Important Books/Journals for further learning including the page nos.
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L03

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 11.12.2019**

Topic of Lecture:

Populations Equivalent, Bio assay studies.

Introduction :

- Stream serves people in many ways Drinking, Bathing, Fishing, Irrigation, Navigation, Recreation, Power Generation
- "Biodegradable" has become a popular word. It is assumed that if something is biodegradable, then disposal is not a problem.
- The improper disposal of biodegradable substances in streams became a cause of concern.
- The receiving waters were quickly polluted.
- Fish in the receiving waters died and
- The water had a very offensive odor.
- A stream must therefore be protected, so that it can serve the best interest of people using it.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Stream water
- Rivers water
- Contaminants

Detailed content of the Lecture:

Effects of industrial effluents on streams

Stream Protection

Methods of maintaining a stream

1. Effluent Standards
2. Stream Standards

Effluent Standard: The Quality Standards established by the waste that has been processed from these units.

Stream Standard: The Standard Quality established in accordance with the designation of water bodies

Effluent Standards

Effluent standards pertain to the quality of the discharge water itself. They are based on economics than on absolute protection of the stream

- Easy to control
- Detailed stream analysis are not required
- They do not establish an overall level of pollutant loading for a given water body
- Ratio of wastewater to stream flow are not considered
- Ratio of wastewater to stream flow are not considerer
- Treatment is obligatory irrespective of the size of industry
- For effective protection of an overloaded stream, the effluent standards are required to be upgraded
- Large industries have an edge over small industry

Disposal Standards

- Stream standards refer to the quality of the receiving water downstream from the origin of the wastewater discharge
- They are based on establishing classification of quality for a stream
- The quality of the receiving water is regulated to maintain established stream classification
- Prevention of excessive pollution/ Loading is limited to what the stream can assimilate
- No consideration of type and location of industry
- Allows public to establish goals for present and future water quality

Video Content / Details of website for further learning (if any):
Can be added as link : https://www.youtube.com/watch?v=DAQapF-F4Vw&list=PL9108F6C4E154885A

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L04

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 14.12.2019**

Topic of Lecture:

- Effects of industrial effluents on Streams, sewer

Introduction :

- Part of sewerage, the infrastructure that conveys sewage
- Sanitary sewer, a system of pipes used to transport sewage - several types of sanitary sewers can be distinguished
- Storm drain, a collection and transportation system for storm water
- Combined sewer, one who does sewing
- Keeper of sewer, official overseeing service to King Henry VIII's household
- Sewers (album), by Torture Killer (2009)

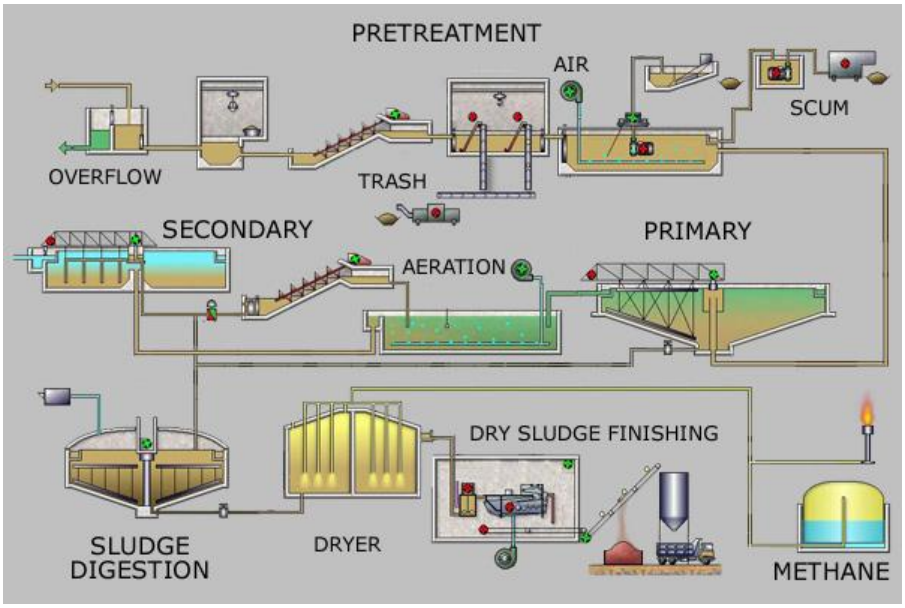
Prerequisite knowledge for Complete understanding and learning of Topic:

- Sewage
- Sewer

Detailed content of the Lecture:

- Sewage treatment is the process of removing contaminants from municipal wastewater, containing mainly household sewage plus some industrial wastewater. Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater (or treated effluent) that is safe enough for release into the environment. A by-product of sewage treatment is a semi-solid waste or slurry, called sewage sludge. The sludge has to undergo further treatment before being suitable for disposal or application to land.
- Sewage treatment may also be referred to as wastewater treatment. However, the latter is a broader term which can also refer to industrial wastewater. For most cities, the sewer system will also carry a proportion of industrial effluent to the sewage treatment plant which has usually received pre-treatment at the factories themselves to reduce the pollutant load. If the sewer system is a combined sewer then it will also carry urban runoff (stormwater) to the sewage treatment plant. Sewage water can travel towards treatment plants via piping and in a flow aided by gravity and pumps. The first part of filtration of sewage typically includes a bar screen to filter solids and large objects which are then collected in dumpsters and disposed of in

landfills. Fat and grease is also removed before the primary treatment of sewage.



Step by Step Wastewater TreatmentProcess

1.Wastewater Collection
2.Odor Control
3.Screening
4.Primary Treatment
5.Secondary Treatment
6.Bio-solids handling
7.Tertiary treatment
8.Disinfection
9.Sludge Treatment

Effect of industrial effluents on sewers.

- Dying
- Paper making
- Brewing , etc

The quantity of the industrial sewage depends largely upon the type of industry and the chemical used in their process of waters.

Some of the following effects are:

- The smooth interior surface of a sewer pipes gets scoured.
- This scouring process reduce the caring capacity of pipes
- Feathers which clog nozzles, Pieces of fat, which clog nozzles.
- Flammable , which cause fires and may lead to explosions

Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.
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L05

LECTURE HANDOUTS

MECH

II / VI

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 16.12.2019**

Topic of Lecture:

- Effects of industrial effluents on land

Introduction :

- In India, land around the cities receiving sewage waters containing both the domestic and the industrial wastes. These wastes are suitable for crop production provided the content of major plant nutrients is high and that of toxic elements is low. Its long-term application would affect the physical, chemical and biological properties of soils.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Soil conditions
- Proper land filling process

Detailed content of the Lecture:

- Several investigators have reported positive effect of sewage irrigation on crop yield. Mahida (1981) obtained higher yields of vegetable crops irrigated with untreated sewage water compared to irrigation with canal water.
- Experiments conducted at National Environmental Engineering Research Institute, Nagpur revealed that the continuous use of untreated sewage for irrigation significantly reduced the yield of wheat, cotton and paddy. However, the use of primary treated sewage proved to be beneficial for both wheat and cotton Application of sewage water resulted remarkable increase on the mean plant height (3.4%), number of tiller/plant (31.8%), length of ear (18.8%) in wheat crop. As a result, straw as well as grain yields also were increased significantly by 43.1 and 34.3%, respectively due to application of sewage water
- Kharche et al. (2011) reported higher concentration of heavy metals in the cabbage plant grown on the sewage-irrigated soils The mean concentration of Fe, Mn, Zn, Cu, Cd, Cr and Ni in cabbage grown on sewage-irrigated soils was about 1.11, 7.51, 1.72, 7.66, 4.36, 1.26 and 1.91 times than their content in well-irrigated soils, respectively. The concentration of heavy metals in cabbage is higher as compared to the suggested permissible tolerance levels (Table 17) as suggested by Council for Agricultural

Science and Technology (1976)

Effects of industrial effluents on land

Industrial effluents

- With the industrialization of the country a large volume of liquid and solid wastes are generated daily. The quality of these wastes depends upon the nature of the industry and type of treatments given to these waters before their release from factory premises. The use of agricultural for the disposal of industrial effluents is becoming a widespread practice. Such materials may contain various toxic metals that could accumulate in excessive quantities in soils. Also, soil pollution by heavy metals is one of the major environmental problems associated with the application of effluents from industries involved in metal processing

Effects of discharging high BOD / COD

- High levels of BOD and COD can cause harm to aquatic life, especially fish. Low levels of BOD and COD in river systems indicate good water quality, while high levels indicate polluted water. There is an inverse relationship between the BOD/COD levels and DO concentrations.

Effects of suspended matters

- This material is called particulate matter and can often be a cause of water pollution. The suspended particles eventually settle and cause a thick silt at the bottom. This is harmful to marine life that lives on the floor of rivers or lakes.

Effects of high salt content

- If the level of salts in the soil water is too high, water may flow from the plant roots back into the soil. This results in dehydration of the plant, causing yield decline or even death of the plant. Crop yield losses may occur even though the effects of salinity may not be obvious

Effects of acids

- When acidand dry acidic particles fall to earth, the nitric and sulfuric acid that make the particles acidic can land on statues, buildings, and other manmade structures, and damage their surfaces. The acidic particles corrode metal and cause paint and stone to deteriorate more quickly

Video Content / Details of website for further learning (if any):

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https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp

Important Books/Journals for further learning including the page nos.

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 17.12.2019**

Topic of Lecture:

- Effects of Industrial Effluents on Effluent Treatment Plants

Introduction :

- In India, land around the cities receiving sewage waters containing both the domestic and the industrial wastes. These wastes are suitable for crop production provided the content of major plant nutrients is high and that of toxic elements is low. Its long-term application would affect the physical, chemical and biological properties of soils.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Effluents
- Treatment plants

Detailed content of the Lecture:

Bio chemical oxygen demand (BoD)

- Wastewater from sewage treatment plants often contains organic materials that are decomposed by microorganisms, which use oxygen in the process.
- (The amount of oxygen consumed by these organisms in breaking down the waste is known as the biochemical oxygen demand or BOD
- It is usually exerted by Dissolved and Colloidal Organic Matter and imposes a load on the Biological units of the Treatment Plant.
- Oxygen must be provided so that Bacteria can grow and oxidise the organic matter. An Added B.O.D load, caused by an increase in Organic Waste, requires more Bacterial Activity, more oxygen, and greater Biological Unit capacity for its Treatment, which (makes) increases the capital cost and operating cost.

Suspended solids

- Suspended solids refers to small solid particles which remain in suspension in water as a colloid or due to the motion of the water, suspended solids can be removed by the sedimentation because of their comparatively large size. It is used as one indicator of water quality.
- Suspended Solids are found in considerable quantity in many Industrial Wastes, such

as Paper& Pulp Effluents. Solids removed by settling and separated from the flowing Sewage are called Sludge, which may then undergo an Anaerobic Decomposition known as Digestion and pumped to drying beds or vacuum filters for extraction of additional water.

- Suspended Solids in Industrial Waste may settle more rapidly or slowly than Sewage Suspended Matter.
- If Industrial Solids settle faster than those of Municipal Sewage, Sludge should be removed at shorter intervals to prevent excessive build up: a Slow Settling one will require a longer detention period and larger basins and increases the likelihood of sludge Decomposition with accompanying nuisances, during Sewage-Flow Periods.
- Any Increased demands on the System usually require larger Sludge handling devices and may ultimately necessitates an increase in the Plants capacity, with resulting Higher Capital and Operating Expenses.

Floating and colored materials

The floating and colored materials such as;

- Oil
- Grease
- Dyes

From the textile finishing mills are disagreeable and visible business

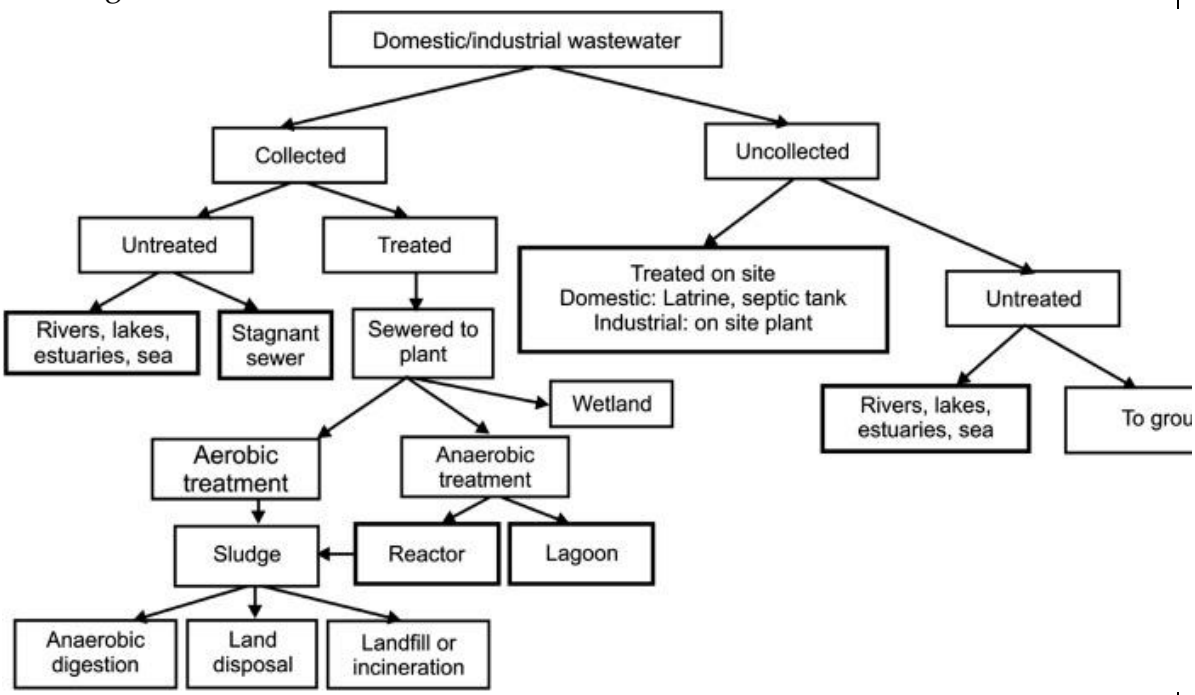
Visible pollution retards the development of a community or area

- Camping
- Boating
- Swimming
- Fishing

Color removal by the treatment units of sewage plants is a knotty problem, and too little effort has been made

The secondary treatment units such as;

- Activated sludge process
- Trickling filter



Volume

- A sewage treatment plant can handle any volume of flow if it's units are sufficiently large
- Unfortunately, most of the sewerage plants are already in operation where a request comes to accept the flow of waste from some new industrial concern.
- The hydraulic loading capacity of all units must then be analyzed.
- Sewer line must be examined for caring capacity
- Bar screens for horizontal flow velocity
- Setting basins for detention periods and surface and weir overflow rates.
- Trickling filters for excessive hydraulic loading etc.

Other harmful constitutions

- Pollutants generated include BOD, SS, coliform bacteria, oil and grease, organic nitrogen and ammonia. Processing food for sale produces wastes generated from cooking which are often rich in plant organic material and may also contain salt, flavourings, colouring material and acids or alkali.
- Toxic Metals, Acids, or Alkalis, Pieces of Fat, Flammable Substances, Detergents and Phenols etc. cause nuisance in Treatment Plants.

Video Content / Details of website for further learning (if any):
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https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp

Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture: 18.12.2019**

Topic of Lecture:

- Effects of industrial effluents on human health

Introduction :

- Industrial effluents are characterized by their abnormal turbidity, conductivity, chemical oxygen demand (COD), total suspended solids (TSS), biological oxygen demand (BOD), and total hardness. Waste effluents rich in decomposable organic matter, is the primary cause of organic pollution

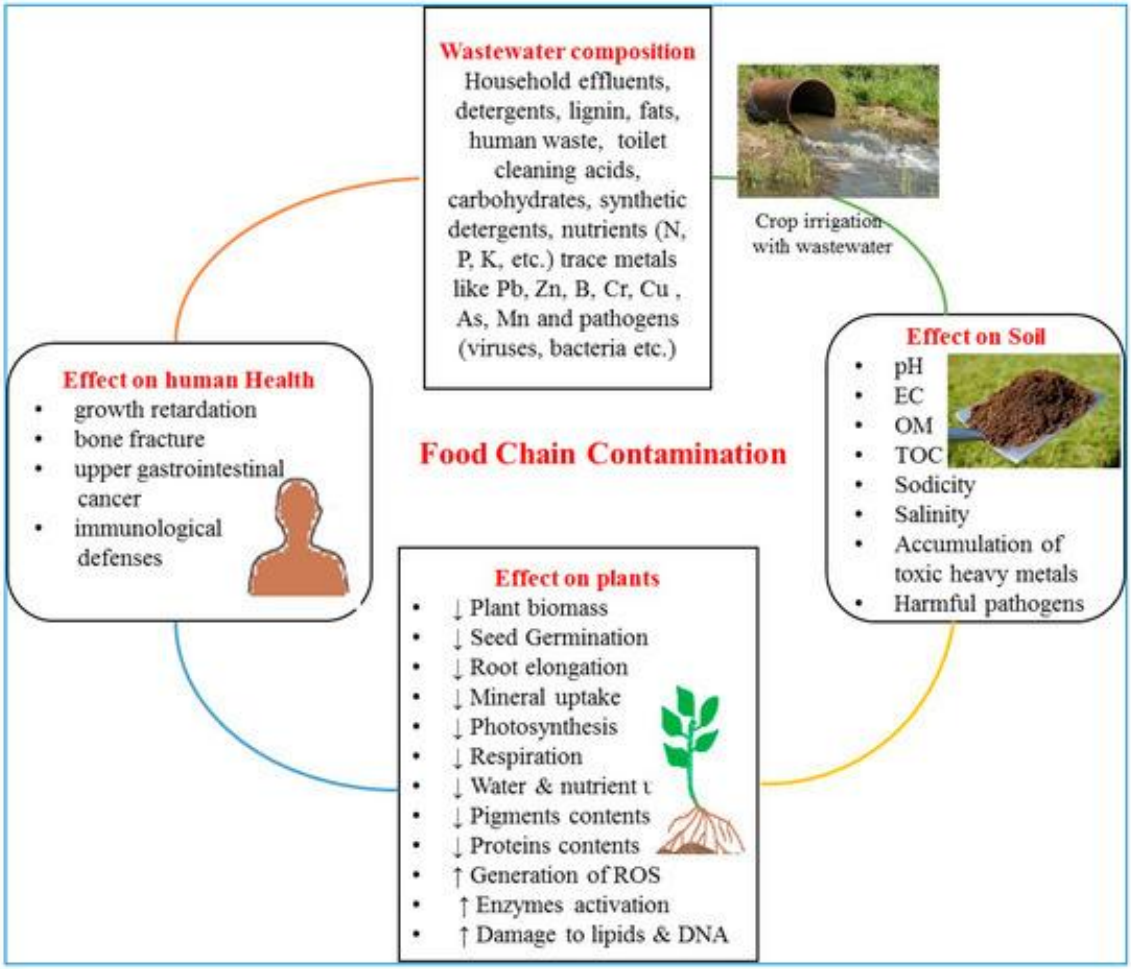
Prerequisite knowledge for Complete understanding and learning of Topic:

- Industrial effluents and its properties

Detailed content of the Lecture:

- Diseases caused by bacteria, viruses and protozoa are the most common health hazards associated with untreated drinking and recreational waters. The main sources of these microbial contaminants in wastewater are human and animal wastes (WHO, 1997; Environmental Canada, 1998, 2003; EPA, 2000; WHO, 2006). These contain a wide variety of viruses, bacteria, and protozoa that may get washed into drinking water supplies or receiving water bodies (Kris, 2007).
- Microbial pathogens are considered to be critical factors contributing to numerous water-borne disease outbreaks. Many microbial pathogens in wastewater can cause chronic diseases with costly long-term effects, such as degenerative heart disease and stomach ulcer. The density and diversity of these pollutants can vary depending on the intensity and prevalence of infection.
- The detection, isolation and identification of the different types of microbial pollutants in wastewater are always difficult, expensive and time consuming. To avoid this, indicator organisms are always used to determine the relative risk of the possible presence of a particular pathogen in wastewater (Paillard et al., 2005). Viruses are among the most important and potentially most hazardous pollutants in wastewater.

- They are generally more resistant to treatment, more infectious, more difficult to detect and require smaller doses to cause infections (Toze, 1997; Okoh, et al., 2007). Because of the difficulty in detecting viruses, due to their low numbers, bacterial viruses (bacteriophages) have been examined for use in faecal pollution and the effectiveness of treatment processes to remove enteric viruses (Okoh, et al., 2007). Bacteria are the most common microbial pollutants in wastewater.
- cause a wide range of infections, such as diarrhea, dysentery, skin and tissue infections, etc. Disease- causing bacteria found in water include different types of bacteria, such as E. coli O157:H7; Listeria, Salmonella, Leptosporosis, Vibrio, Campylobacter, etc (CDC, 1997; Absar, 2005).
- Wastewater consists of vast quantities of bacteria, most of which are harmless to man. However, pathogenic forms that cause diseases, such as typhoid, dysentery, and other intestinal disorders may be present in wastewater.
- The tests for total coliform and faecal coliform nonpathogenic bacteria are used to indicate the presence of pathogenic bacteria (EPA, 1996; APHA, 2001). Because it is easier to test for coliforms, faecal coliform testing has been accepted as the best indicator of faecal contamination.
- Faecal coliform counts of 100 million per 100 milliliters may be found in raw domestic sewage. Detectable health effects have been found at levels of 2300 to 2400 total coliforms per 100 milliliters in recreational waters. Disinfection, usually chlorination, is generally used to reduce these pathogens (EPA, 1996; Absar, 2005).
- Water-borne gastroenteritis of unknown cause is frequently reported, with the susceptible agent being bacterial.
- Some potential sources of this disease are E. coli and certain strains of Pseudomonas, which may affect the newborn and have also been implicated in gastrointestinal disease outbreaks (Metcalf & Eddy, 2003). Also, highly adaptable protozoa are widely distributed in natural waters, although only a few aquatic protozoa are pathogenic.
- Protozoal infections are usually characterized by gastrointestinal disorders of a milder order than those from bacterial infections (Ingraham & Ingraham, 1995). Of the disease-causing organisms, the protozoans Cryptosporidium parvum, Cyclospora, and Giardia lamblia are of great concern because of their significant impact on individuals with compromised immune systems, including young children and the elderly.
- Numerous Crptospridium and Giardia oocysts are present in raw sewage, although not all are viable in terms of their ability to cause disease (Ingraham & Ingraham, 1995; Metcalf & Eddy, 2003).
- Crptosporidium parvum and Giardia lamblia oocysts are the most resistant oocysts form in wastewater. They are of particular concern because they are found in almost all wastewaters, and because conventional disinfection techniques using chlorine have not proved to be effective in their inactivation or destruction. In recent years however, UV disinfection has been known to be effective in the inactivation of C. parvum



Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.
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L08

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture:04.01.2020**

Topic of Lecture:

- Environmental legislations related to prevention and control of industrial effluents

Introduction :

- Environmental legislation is the collection of laws and regulations pertaining to air quality, water quality, the wilderness, endangered wildlife and other environmental factors. ... The act ensures that matters important to the environment are thoroughly considered in any decisions made by federal agencies.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Collections of laws and regulations.

Detailed content of the Lecture:

- **Indian Environmental Legislation.**

Air Pollution legislation

- The Air (Prevention and Control of Pollution) Act, 1981, as amended by Amendment Act, 1987
- The Air (Prevention and Control of Pollution) Rules, 1982
- This law defined an air pollutant as any solid, liquid or gaseous substance present in the atmosphere in such concentration as may be or tend to be injurious to human

beings or other living creatures or plants or property or environment.

- This Act requires approval prior to operating any industrial plant. Government may suggest "control equipment" prior to giving its consent to any industry for its operation. It may include chimney etc.
- In case there is any new technology for emission control, then the Board may insist on this to being installed. Standards specific to industries have been specified.

Penalty:

- Penalties are minimum of six months imprisonment to a maximum of seven years and fine up to Rs. 5,000 for every day during which violation continues after conviction
- This law makes it clear that when offences are committed by a company, its director, manager, secretary or other officers could be held guilty and punished accordingly.
- As the industries are running on age-old processes, outdated technology, fuel, coal as their source of energy where there are no proper installations for measurement and treatment of emissions like SO2, oxides of nitrogen, suspended particulate, etc it becomes harder and impossible to fulfill the norms of the legislative standards.

Noise Pollution

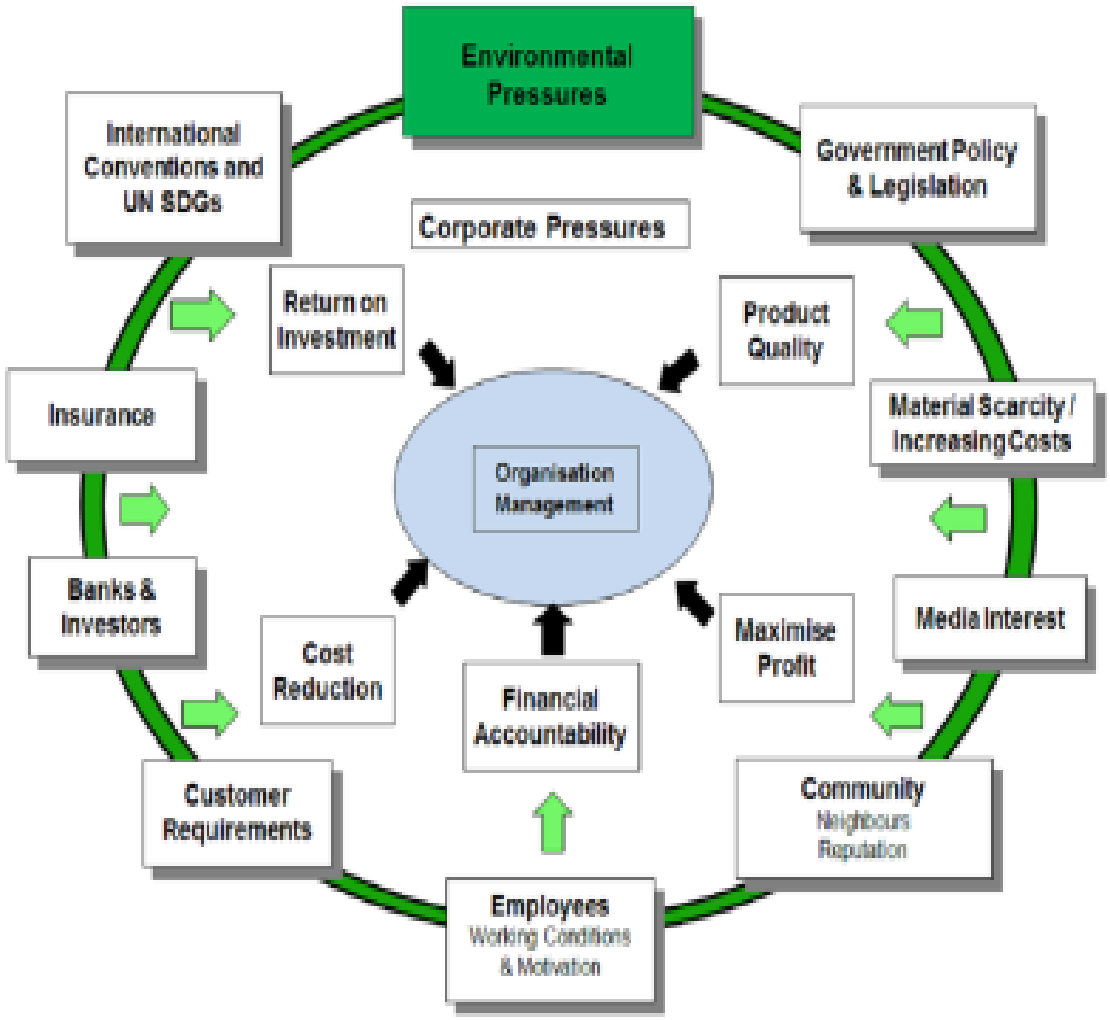
- Commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.
- The state government shall take measures to control noise including noise emanating from vehicular movements and ensure that the specified noise levels do not exceed.
- A person may, if the noise level exceeds the ambient noise standards by 10 dB or more given in standards against any area/zone, can make a complaint to the authority.
- The authority shall act on the complaint and take action against the violator in accordance with the provisions of these rules and any other law in force.

Norms for noise pollution

- Silence zone is defined as an area comprising not less than 100 metres around hospitals, educational institutions and courts. The silence zones are declared as such by the competent authority.

Ozone Depletion

- The legislation refers to the:
- Ozone Depletion Substances (Regulation) Rules, 2000
- Ozone (O3) is a form of oxygen in the atmosphere about 20 kms. above the earth's surface that efficiently screens out almost all the harmful ultraviolet rays of the sun. This radiation has the potential to cause skin cancer, eye damage; suppress body's immune system; decrease crop yield; cause damage to forests and affect ocean life.
- In accordance with the National Strategy for Ozone depletion substances (ODS) phase out
- the GoI - MoEF, have framed comprehensive draft rules, covering various aspects of production, sale, consumption, Export and import of ODS.
- Some of the important provisions of the proposed draft ODS rules, are as follows:



- Important provisions of the proposed draft ODS rules
- Compulsory to register with MoEF Restriction on production levels

Environment Protection Act

- Act and rules related to environment protection
- The Environment (Protection) Act, 1986
- The Environment (Protection) Rules, 1986

Video Content / Details of website for further learning (if any):

Can be added as link :

https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp

Important Books/Journals for further learning including the page nos.

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L09

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : I –Introduction **Date of Lecture:06.01.2020**

Topic of Lecture:

- Hazardous wastes.

Introduction :

- Resource Conservation and Recovery Act (RCRA) Hazardous wastes are wastes with properties that make them dangerous or potentially harmful to human health or the environment. Hazardous wastes can be liquids, solids, contained gases, or sledges

Prerequisite knowledge for Complete understanding and learning of Topic:

- Toxic wastes and its properties

Detailed content of the Lecture:

Toxicity Parameters

1. Biological parameters measured in bioassays, such as mortality, number of offspring, cell number, weight, and cellular receptor activity, are commonly referred to as 'endpoints'.

2. The term 'toxicity parameter' refers to effect values, which are calculated using statistical or mathematical methods.

3. The calculation is done by regression analysis and gives, additionally to the respective derived toxicity parameter, a confidence interval

4. NOEC The no observed effect concentration (NOEC) is the highest tested concentration that does not yet because a statistically significant effect compared to the control.

5. LOEC The lowest observed effect concentration (LOEC) is the lowest tested concentration that elicits a statistically significant effect compared to the control.

6. TEQ The toxic equivalent concentration (TEQ) is defined as the concentration of reference substance, which would have the same effect as the environmental sample.

Hazardous wastes.

- A waste that has a hazardous component and a radioactive component is called a mixed waste and is regulated under both the Resource Conservation and Recovery Act (RCRA) and the Atomic Energy Act.

List of Hazardous waste

- A waste is determined to be a hazardous waste if it is specifically listed on one of

four lists (the F, K, P and U lists) found in title 40 of the Code of Federal Regulations (CFR) in section 261.

The F and K Lists

- The F-list, found at 40 CFR sections 261.31, identifies wastes from common manufacturing and industrial processes as hazardous. Because the processes generating these wastes can occur in different sectors of industry,
- Spent solvent wastes,
- Electroplating and other metal finishing wastes,
- Dioxin-bearing wastes,
- Chlorinated aliphatic hydrocarbons production,
- Wood preserving wastes,

The K-list identifies hazardous wastes from specific sectors of industry and manufacturing and is considered source-specific wastes.

- Wood preservation,
- Organic chemicals manufacturing,
- Pesticides manufacturing,
- Petroleum refining,

To indicate its reason for listing a waste, EPA assigns a hazard code to each waste listed on the F and K list. An explanation of each of the codes is below:

(T) - Toxic Waste
(H) - Acute Hazardous Waste
(I) - Ignitable Waste
(C) - Corrosive Waste
(R) - Reactive Waste
(E) - Toxicity Characteristic Waste

The P and U Lists

The P and U lists designate as hazardous waste pure and commercial grade formulations of certain unused chemicals that are being disposed. For a waste to be considered a P- or U-listed waste it must meeting the following three criteria:

- The waste must contain one of the chemicals listed on the P or U list;
- The chemical in the waste must be unused; and
- The chemical in the waste must be in the form of a commercial chemical product.

Characteristic Wastes

- Ignitability, Corrosively
- Reactivity, Toxicity
- Mixed Radiological and Hazardous Waste

Video Content / Details of website for further learning (if any):
Can be added as link : https://www.youtube.com/watch?v=x8ViYoqjEhc

Important Books/Journals for further learning including the page nos.
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L10

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:07.01.2020**

Topic of Lecture:

- Waste management approach

Introduction :

- The integrated waste management strategy relies on handling waste in a four pronged approach: waste minimization, recycling (including composting), Energy Recovery, and finally as a last resort, landfill

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Waste management approach

Dealing with waste in India;

1. Waste is an issue that affects us all.
2. We all produce waste on average, each of the highly populated people living in the India throws away around half a ton of household rubbish every year.
3. This is on top of huge amounts of waste generated from activities such as manufacturing (360 million tons) and construction (900 million tons), while water supply and energy production generate another 95 million tons.
4. Altogether, India produces up to 3 billiontons of waste every year.
5. All this waste has a huge impact on the environment, causing pollution and greenhouse gas emissions that contribute to climate change, as well as significant losses of materials a particular problem for the India which is highly dependent on exported raw materials.
6. The amount of waste we are creating is increasing and the nature of waste itself is changing, partly due to the dramatic rise in the use of hi-tech products.
7. This means waste now contains an increasingly complex mix of materials, including plastics, precious metals and hazardous materials that are difficult to deal with safely.
8. Indian waste management policies aim to reduce the environmental and health impacts of waste and improve India's resource efficiency.

9. The long-term goal is to turn our country into a recycling society, avoiding waste and using unavoidable waste as a resource wherever possible.

10. The aim is to achieve much higher levels of recycling and to minimize the extraction of additional natural resources.

11. Proper waste management is a key element in ensuring resource efficiency and the sustainable growth of Indian economies.

12. Working to minimize the negative impacts of waste while maximizing the benefits of good waste management, and the role individuals, households, businesses and local and national governments have to play.

The Challenges of Waste

1. Whether it is re-used, recycled, incinerated or put into landfill sites, the management of household and industrial waste comes at a financial and environmental cost.

2. First, waste must be collected, sorted and transported before being treated which can prove expensive and result in greenhouse gas emissions and pollution of air, soils and water.

3. One major challenge is the fact that a large amount of the waste generated each year some 100 million tonsis hazardous, containing heavy metals and other toxin

4. These substances make the waste particularly difficult to treat as special processes are needed to deal with the hazardous components.

5. Our country is working to reduce the hazardous materials used in products which then end up in our waste, as well as ensuring that hazardous waste is dealt with in the safest way possible.

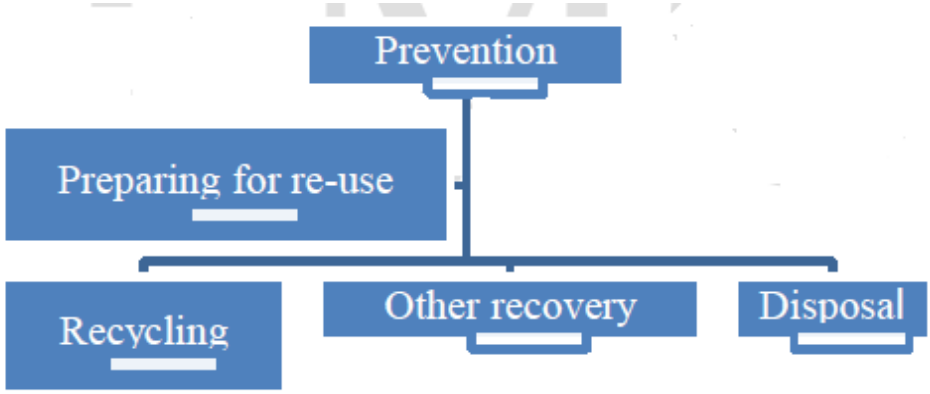
6. Several types of chemicals have been banned and the use of other materials has been significantly restricted.

The India's Approach to Waste Management

1. Waste management approach has evolved over the last 30 years through a series of

environmental action plans and a framework of legislation that aims to reduce negative environmental and health impacts and create an energy and resource efficient economy.
2. This led to the development of a long-term strategy on waste.
3. The 2015 Thematic Strategy on Waste Prevention and Recycling resulted in the revision of the Waste Framework Directive, the cornerstone of India's approach to waste management
4. It includes targets for IndianState Members to recycle 50% of their municipal waste and 70% of construction waste by 2020.
5. The Directive introduces a five-step waste hierarchy where prevention is the best option, followed by re-use, recycling and other forms of recovery, with disposal such as landfill as the last resort.

Moving Up the Waste Hierarchy:



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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:08.01.2020**

Topic of Lecture:

- Waste audit

Introduction :

- A waste audit is a process used to calculate the type and amount of waste generated by an organization. Any size organization can perform this type of audit. The data collected from the audit will identify the type of waste produced by the organization and how the organization manages this waste.
- The audit can also make the organization more effective at reducing waste management costs by educating staff about proper waste disposal and making better use of natural resources

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste auditing techniques

Detailed content of the Lecture:

WASTE AUDIT

Purpose

1. The purpose of a waste audit is to gain a detailed understanding of the types and weights of material being generated.
2. Audit results are used to improve the economic and environmental performance of waste management efforts.
3. There are three major components to the waste audit:
   - Preparation
   - Sorting, recording, and cleanup
   - Analysis and reporting.
4. When undertaking an audit, one person should be designated as the audit coordinator.
5. This person is responsible for preparing and leading the audit.

Preparation

1. Identify which material streams will be audited.
2. Use the materials stream categorization guide to help.

3. Ensure that the waste is sorted into separate piles based on waste stream, day collected, or source location if auditing specific areas or buildings.

4. Choose an adequate sample size for the audit.

5. The % of waste audited will depend on total waste generation of the organization larger numbers yield more accurate results.

Procedures

1. There are significant differences between auditing methods.

2. There is also some flexibility in how the audits are performed.

3. The audit coordinator can adjust the procedures as required to best suit the needs of the firm.

Types of auditing

- Differences between auditing methods
- Bulk auditing (large audits)
- Individual bag contamination rate auditing

Individual bag & sub-categorization auditing

Roles Explained

Audit Coordinator:

1. This person is responsible for preparing and leading the audit.

2. They must ensure that all preparations are carried out before participants begin auditing and measuring waste.

3. If possible, the audit coordinator should play a role in forming or overseeing the waste

management plan for the organization.

Data Recorders

1. This position involves weighing the sorted contents of the audit.
2. They will be responsible for weighing the bins and the sorted waste, recording data, and taking notes during the audit.
3. They may also be tasked with taking pictures.

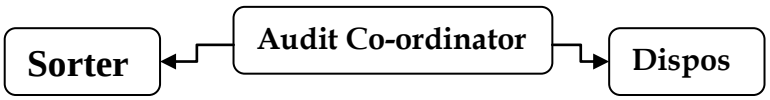
Sorters

1. These people are responsible for opening the bags and sorting the waste according to the categorization chosen by the audit coordinator.
2. In audits with no diversion team, the sorters will dispose of their own waste according to the proper materials stream in a designated diversion area.

Diversion team

1. These people are responsible for diverting material into proper large bins/bags after they have been sorted.
2. This ensures the highest level of diversion is achieved at the end of the audit.

Team structures



Cleanup

1. All waste should be disposed of properly according to local area sorting requirements.
2. This will need to be done on an ongoing basis throughout the audit.
3. For bulk auditing no additional sorting step is required for disposal.

Analysis and Reporting

1. Enter the data values into the excel spreadsheet auditing tool.
2. The tool will only allow manipulation of cells which require data entry and these cells are highlighted in yellow.
3. If you wish to alter the tool, you must first unprotect the sheet

Video Content / Details of website for further learning (if any):
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:11.01.2020**

Topic of Lecture:

- ISO 14000 volume reduction

Introduction :

- The information presented is a pathway to effective and sustainable water and wastewater management from start to finish. This information is organized into five sections:
- Segment Profile
- Data Management
- Best Practices
- Onsite Wastewater Treatment
- Case Studies

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste characteristics

Detailed content of the Lecture:

Volume reduction:

Segment Profile

- A discussion of water usage and wastewater effluent trends, where to find information on regulatory drivers, examples of non-regulatory drivers, and risks and opportunities for cost savings.

Data Management

- A guide to identifying the components of water and wastewater information, establishing key performance indicators and goals, managing water and wastewater data, and benchmarking progress toward goals.

Best Practices

- Guidance on best practices to reduce water usage and wastewater generation focusing on opportunities in the brewing process, including packaging, warehousing, utilities, and food service/events.

Onsite Wastewater Treatment

- An overview of drivers for onsite wastewater treatment and example technologies

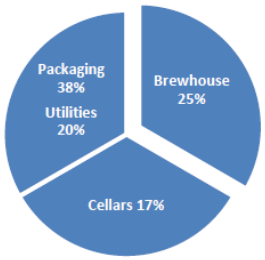
Case Studies

- Selected brewery examples which provide more detail of water and wastewater reduction programs.

Water Usage &Wastewater Generated By Craft Brewers

1. Beer is about 95% water in composition; however, the amount of water used to produce a container of beer is far greater than the amount of water contained in the beer that is actually packaged and shipped out.
2. Although water usage varies widely among breweries and is dependent upon specific processes and location.
3. Most craft brewers receive their water from municipal suppliers, while a few use well water as an alternative source.
4. In addition to the water used in production, wastewater generation and disposal presents another improvement opportunity for brewers.
5. Most breweries discharge 70% of their incoming water as effluent.
6. Effluent is defined as wastewater that is generated and flows to the sewer system.
7. In most cases, brewery effluent disposal costs are much higher than water supply costs.
8. In many communities, breweries may be the largest consumer of water and the largest source of organic effluent that must be treated by the municipal treatment plant.
9. This presents unique supply and cost concerns.

Typical Brewery Water Use per Area



Environmental Drivers

- Stress on water supplies
- Risk of (local) water shortage

Effective Data Management System

- 1. Data management is more than just a component of a successful program
- 2. It is a necessity for a successful business strategy.
- 3. There are both risks and opportunities in water and wastewater management.

Video Content / Details of website for further learning (if any):
Can be added as link : https://www.youtube.com/watch?v=cY2G4-JEo8Y

Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture: 13.01.2020**

Topic of Lecture:

- ISO 14000 strength reduction

Introduction :

- Waste strength reduction (i.e. reducing the concentration of contaminants) is the second major objective for an industrial plant concerned with waste treatment. Any effort to find means of reducing the total amount of pollutants in industrial wastes will be well rewarded by the savings due to the reduced requirements for waste treatment. The strength of waste may be reduced by

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste characteristics

Detailed content of the Lecture:

Strength reduction:

1. Process changes and equipment modification
2. Segregation of wastes
3. Equalization of wastes
4. By-product recovery
5. Proportioning wastes
6. Monitoring waste streams.

Process changes and equipment modification

- A reduction in strength of the waste stream can be achieved either by changing the manufacturing process, or with slight modification of the present equipment.

Segregation of wastes

- Segregation of wastes reduces the strength and/or the difficulty of treating the final waste from an industrial plant. Waste segregation usually results in two wastes: one high strength and low in volume, and the other low strength and with almost the same volume as the original unsegregated wastes. Another type of segregation is the removal of one particular process-waste from the other wastes of an industry

Equalization

- Equalization of wastes Plants that produce many products from a diversity of

processes prefer to equalise their wastes.

- This requires holding wastes for a certain period of time, depending on the time taken for the repetitive processes in the plant.
- The effluent from an equalisation basin is much more consistent in its characteristics than is each separate influent to the basin. Stabilisation of pH and settling of solids and heavy metals are among the objectives of equalisation.

By-product recovery

- This important aspect of industrial waste treatment is the one phase of the entire problem that may lead to economic gain.
- Any use of waste materials obviously eliminates at least some of the waste that must eventually be disposed of, and the search for by-products should be encouraged, because it also provides management with a clearer insight into processing and waste problems.

Proportioning wastes

- By proportioning its discharge of concentrated wastes into the main sewer a plant can often reduce the strength of its total waste to a point where it will need a minimum of final treatment, or will cause the least damage to the stream or treatment plant.

Monitoring waste streams

- In practice, accidental spills are often the sole cause of stream pollution or malfunctioning of treatment plants, and these can be controlled, and often completely eliminated, if all significant sources of wastes are monitored.

Full Cost of Water

The full cost of water is equal to

1.The "price on the water bill" 2. Costs Associated with water use 3. Price of incoming water 4. Sewer Service Charge 5. Cost of energy and chemicals needed to process water 6.Labor and other costs associated with water processing and treatment

Typical Reductions in Water Use

Water saving measure possible application typical reduction in process use (%)

Closed loop recycle	Fermented cooling	>90
Cleaning-in-place	(CIP) New CIP	set 60
Re-use of wash water	Cask washer	50
Countercurrent rinsing	CIP	set 40
Good housekeeping	Hose pipes	30
Cleaning-in-place	Optimization of CIP	set 30
Spray/jet upgrades	Cask Washer	20
Brushes/squeegees	Fermenter cleaning	20

Video Content / Details of website for further learning (if any):

Can be added as link : https://www.youtube.com/watch?v=cY2G4-JEo8Y

Important Books/Journals for further learning including the page nos.

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:14.01.2020**

Topic of Lecture:

- Material modifications

Introduction :

- **MaterialsModifications**, the series of operations that transforms industrial materials from a raw-material state into finished parts or products. Industrial materials are defined as those used in the manufacture of "hard" goods, such as more or less durable machines and equipment produced for industry and consumers, as contrasted with disposable "soft" goods, such as chemicals, foodstuffs, pharmaceuticals, and apparel.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Raw materials used in specific industry
- Updating technology

Detailed content of the Lecture:

- How society uses materials fundamentally affects our economic and environmental future. Inefficient and wasteful use of materials now challenges the capacity of the Earth – air, water and land.
- We can fulfill our needs and prosper while using less material, reducing toxics, and recovering more of the material we consume.
- By acting less wastefully and considering systemwide impacts in the design, marketing, reuse, recycling, and disposal of products, life-cycle materials assessment represents an important change in how we think about waste and chemicals management

Material modification of thermal power plant industry:

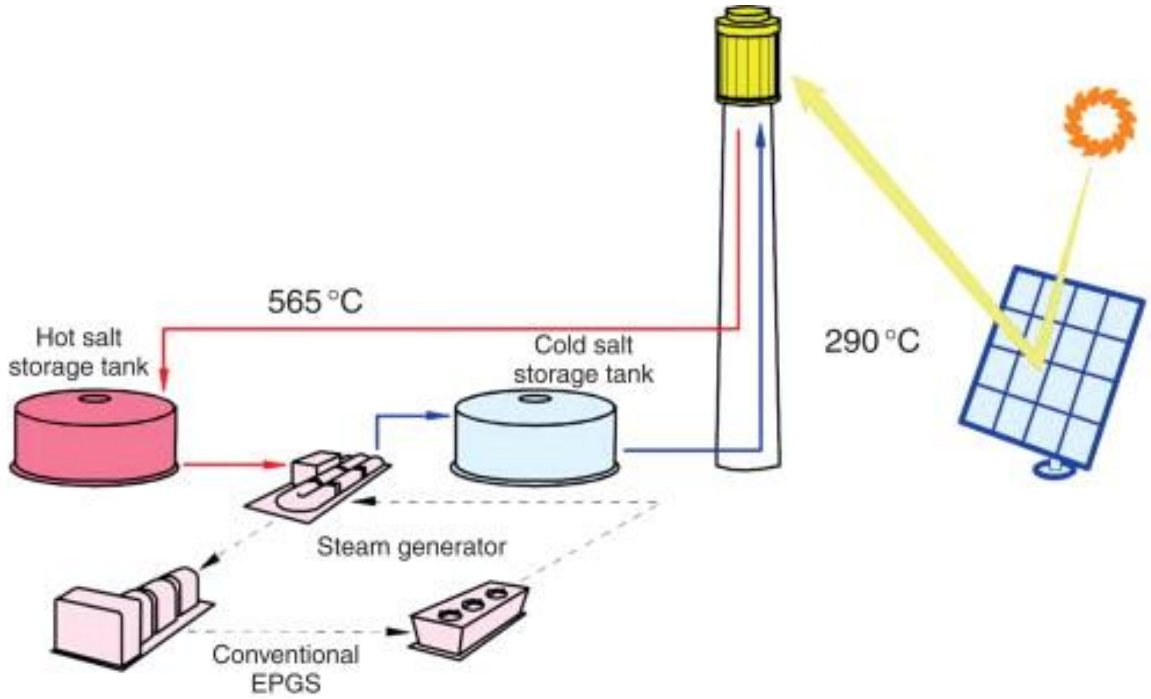
- Coal-based thermal power plants are the main source from which sulfur dioxide (SO2) is released.
- Since the beginning of the 21st century, there has been a steady rise in the SO2 emissions from nearly 118,000 Gg in 1970 to about 125,000 Gg in 2008 (Fig. 2.4). In fact, the emission level in USA has dropped down gradually since 1970, while that for China have increased. In South Asia, the rise in emissions has been slow and

gradual.

- The country-wise distribution of SO2 emissions in South Asia shows a gradual rise in India and Pakistan, while other South Asian nations show negligible increase, and remaining below 100 Gg since 1970 Sulfur dioxide emissions have substantial impacts on human health, as well as terrestrial and aquatic ecosystems, and have come under increasing regulation worldwide (Klimont et al., 2013).

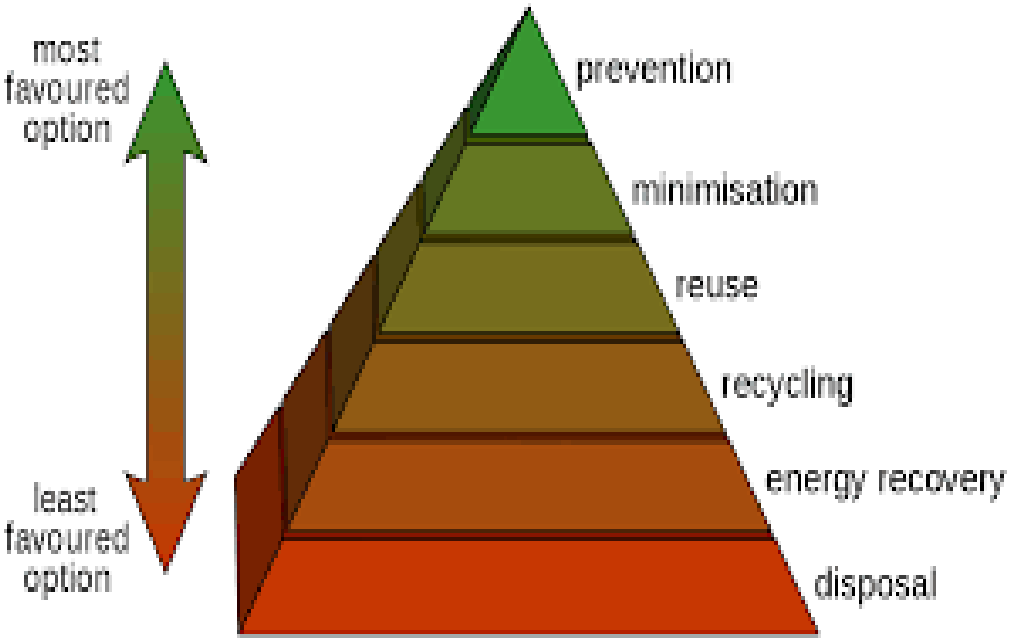
Alternate Energy Sources

"A Solar Updraft Tower"



- Above figure shows a low-tech solar thermal power plant where air passes under a very large agricultural glass house (between 2 and 30 km in diameter) that is heated by the sun and channeled upwards toward a convection tower.
- It then rises naturally and is used to drive turbines, which generate electricity. An energy tower (see Fig. 7.4) is an alternative proposal for the solar updraft tower and is driven by spraying water at the top of the tower.
- Evaporation of water causes a downdraft by cooling the air, thereby increasing its density, driving wind turbines at the bottom of the tower. It requires a hot, arid climate and large quantities of water (sea water may be used for this purpose) but does not require the large glass house of the solar updraft tower.
- A solar pond is a low-cost approach to harvesting solar energy. The pond has three layers of water: the top layer with a low salt content; an intermediate layer with a salt gradient, which sets up a density gradient that prevents heat exchange by natural convection in the water; and a bottom layer that has a high salt content, which can reach a temperature of 90°C.
- The different densities of the layers prevent convection currents. The heat trapped in the salty bottom layer can be used for different purposes, such as heating of buildings, industrial processes, or generating electricity.
- Solar chemical refers to a number of possible processes that harness solar energy by

absorbing sunlight in a chemical reaction in a way similar to photosynthesis in plants but without using living organisms. Metals, such as zinc, have been shown to drive photoelectrolysis of water.



Video Content / Details of website for further learning (if any):
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:20.01.2020**

Topic of Lecture:

- Process modifications

Introduction :

- Equipment or Process Modification deals with **how** you make whatever it is you make or **do** whatever it is you do, whether it be manufacturing chemicals or simply running a household. It involves using new equipment or processes, or altering existing equipment or processes to:
  - improve efficiency
  - reduce or eliminate pollution
  - reduce material, water or energy use
- This pollution prevention technique can help reduce your energy and water bills, save you money on disposal costs, save you money by having to buy less material, and more.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Raw materials used in specific industry
- Updating technology

Detailed content of the Lecture:

- Process modifications or changes mean:

(1) The use of alternative low-waste process pathways to obtain the same product

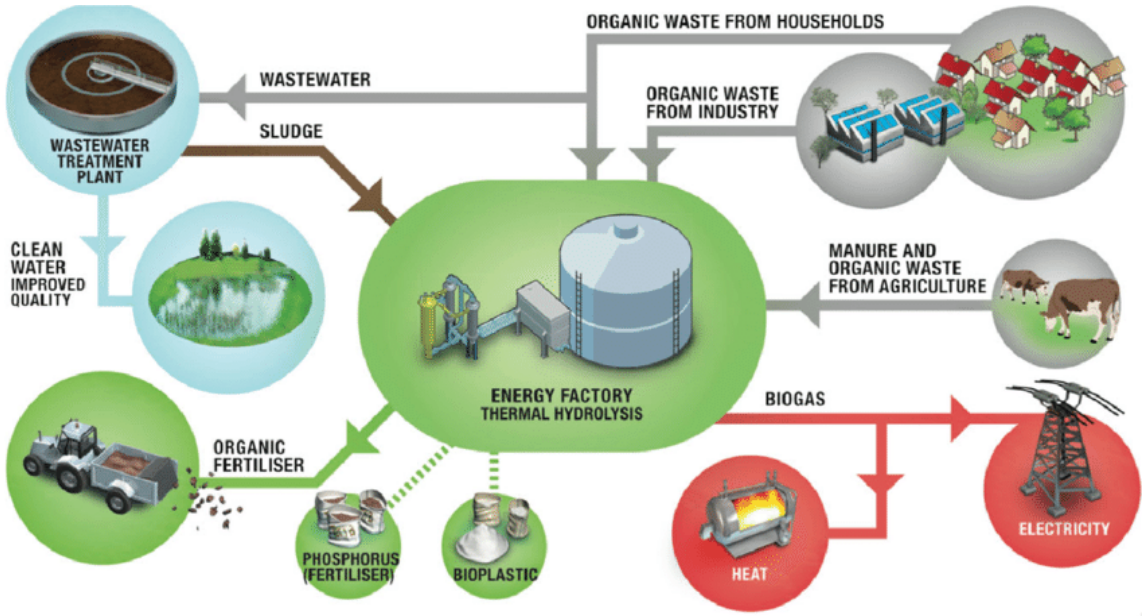
(2) Modification of reaction or separation parameters. Multiple chemical reactions can be classified into three general reaction types

(1) Series, (2) parallel and (3) combinations of series and parallel reactions.

- It is the many possible reactions which generate many of our waste products.

Generally, we have desirable products and undesirable products.

- The undesirable products may become waste streams.
- The ratio of the desirable products to the undesirable products is generally defined as the selectivity of the reaction.
- This selectivity can be influenced by the choice of the reaction parameters or by modification of these reaction parameters.
- Waste minimization by modification of reaction parameters is defined as changing the selectivity of the reaction so that undesirable reactions which produce waste products are minimized, while at the same time producing the desirable products. This selectivity may be affected by all of the reaction conditions.
- These reaction conditions include: temperature, pressure, catalyst, mixing conditions, ratio of feed concentrations and conditions, reaction



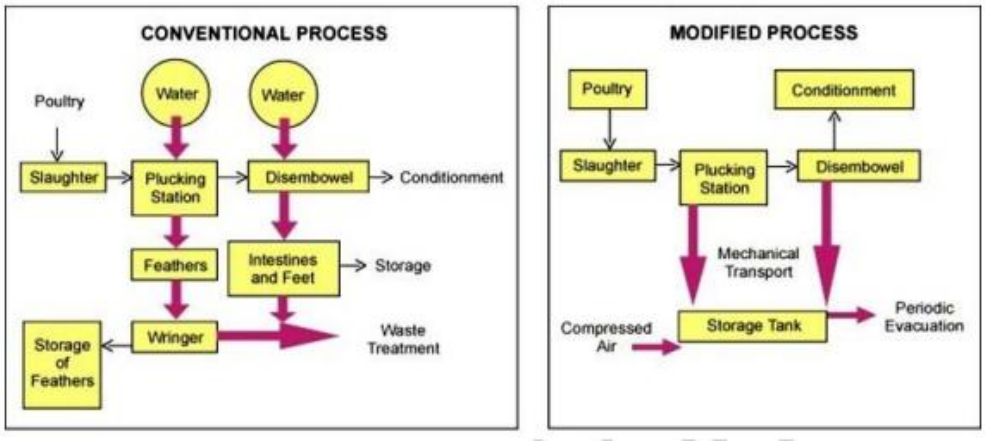
Examples of process modifications

- Switching to more energy-efficient lighting
- Improving the design of your rinse equipment to increase its efficiency and effectiveness
- Using more efficient spray-paint systems
- Using mechanical stripping/cleaning devices instead of solvents
- If you do not use harmful chemicals, they do not get out in the environment
- Selecting appropriately sized motors
- This saves energy and prolongs the life of the motor
- For more information, examples and guidance, please see the Pollution Prevention

Planning Handbook.

Alteration in Washing/Cleaning Procedure

- Using counter-current washing;
- Recycling used solvent;
- Reducing the cleaning frequency.



Video Content / Details of website for further learning (if any):
Can be added as link : https://www.youtube.com/watch?v=8ETBAdEQr7M

Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:21.01.2020**

Topic of Lecture:

- Recycling of waste and its applications

Introduction :

- Recycling is the process of converting waste materials into new materials and objects.
- Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution (from incineration), and water pollution (from land filling)

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industry and its waste generation
- Recycling process of industrial waste

Detailed content of the Lecture:

- 3Rs offer an environmentally friendly alternative to deal with growing generation of wastes and its related impact on human health, economy and natural ecosystem
- Recycling your industrial waste -- be it hazardous or non-hazardous -- offers many benefits to organization. Recycling reduces the costs you would otherwise incur disposing of unused materials and byproducts. Recycling can provide you with a steady, dependable stream. Recycling can help your company reach its environmental goals and improve company's standing with local governments and the community at large.

Stages in product life cycle

1. Extraction of natural resources Processing of resources
2. Design of products and selection of inputs
3. Production of goods and services

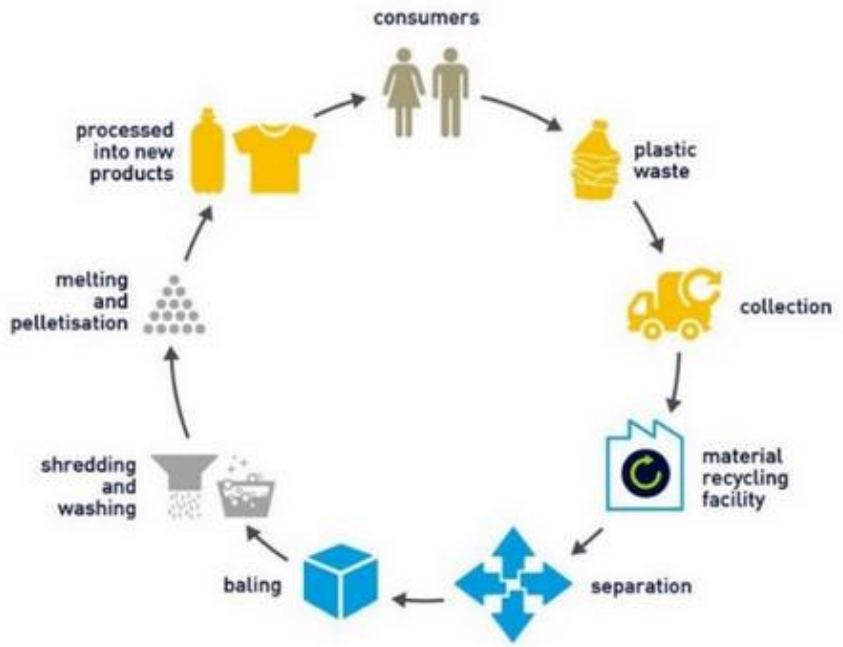
4. Distribution

5. Consumption

6. Reuse of wastes from production or consumption

7. Recycling of wastes from consumption or production

8. Disposal of residual wastes



Application of Recycling

- Reduce material intensity , Reduce energy intensity
- Reduce dispersion of toxic substances , Enhance the ability to recycle , Maximize use of renewable resources , Extend product durability , Increase service intensity
- Reduces the amount of waste sent to landfills and incinerators
- Conserves natural resources such as timber, water and minerals
- Increases economic security by tapping a domestic source of materials
- Prevents pollution by reducing the need to collect new raw materials
- Saves energy, Supports American manufacturing and conserves valuable resources
- Helps create jobs in the recycling and manufacturing industries in the United States

Video Content / Details of website for further learning (if any):
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture:22.01.2020**

Topic of Lecture:

- Reuse of waste and its applications

Introduction :

- Reuse is a means to prevent solid waste from entering the landfill, improve our communities, and increase the material, educational and occupational wellbeing of our citizens by taking useful products discarded by those who no longer want them and providing them to those who do.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industry and its waste generation
- Reuse process of industrial waste

Detailed content of the Lecture:

- Reuse is the action or practice of using an item, whether for its original purpose (conventional reuse) or to fulfil a different function (creative reuse or repurposing). It should be distinguished from recycling, which is the breaking down of used items to make raw materials for the manufacture of new products. Reuse – by taking, but not reprocessing, previously used items – helps save time, money, energy and resources. In broader economic terms, it can make quality products available to people and organizations with limited means, while generating jobs and business activity that contribute to the economy
- Historically, financial motivation was one of the main drivers of reuse. In the developing world this driver can lead to very high levels of reuse, however rising wages and consequent consumer demand for the convenience of disposable products has made the reuse of low value items such as packaging uneconomic in richer countries, leading to the demise of many reuse programs. Current environmental awareness is gradually changing attitudes and regulations, such as the new packaging regulations, are gradually beginning to reverse the situation.

Advantages

Reuse has certain potential advantages:

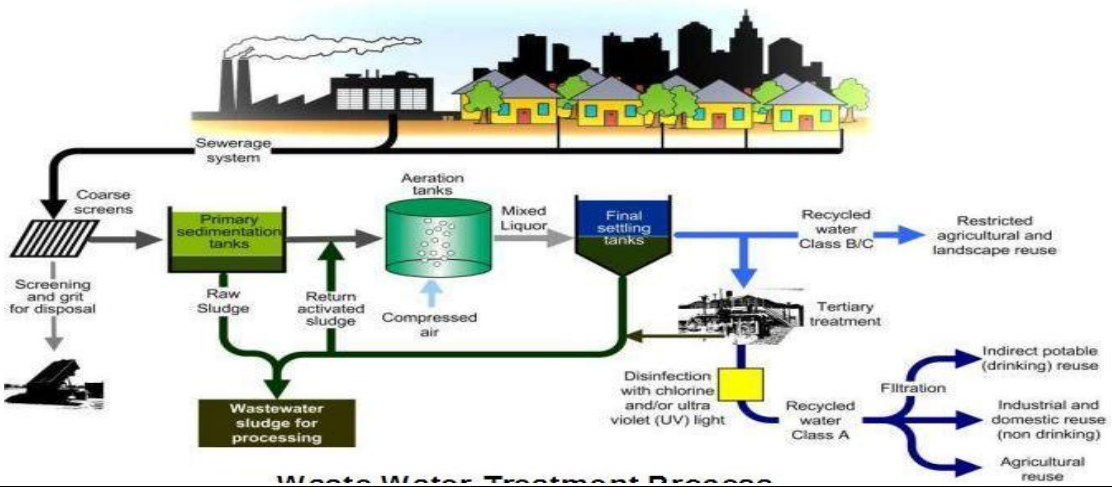
- Energy and raw materials savings as replacing many single use products with one

reusable one reduces the number that need to be manufactured.

- Reduced disposal needs and costs.
- Refurbishment can bring sophisticated, sustainable, well paid jobs to underdeveloped economies.
- Cost savings for business and consumers as a reusable product is often cheaper than the many single use products it replaces.
- Some older items were better handcrafted and appreciate in value.

Disadvantages are also apparent:

- Reuse often requires cleaning or transport, which have environmental costs.
- Some items, such as freon appliances, infant auto seats, older tube TVs and secondhand automobiles could be hazardous or less energy efficient as they continue to be used.
- Reusable products need to be more durable than single-use products, and hence require more material per item. This is particularly significant if only a small proportion of the reusable products are in fact reused.
- Sorting and preparing items for reuse takes time, which is inconvenient for consumers and costs money for businesses.
- Special skills are required to tweak the functional throughout of items when devoting them to new uses outside of their original purpose.
- Knowing the standards that legacy products conform to is required for knowing what adapters to buy for newer products to be compatible with them, even though the cost of adapters for such applications is a minor disadvantage.
- Being a rather minor disadvantage, metal that is repurposed later on can sometimes contain rust, seeing as it sometimes ages before reuse.



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Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : II - Cleaner Production **Date of Lecture: 27.01.2020**

Topic of Lecture:

- By product recovery of waste and its applications

Introduction :

- From the environmental point of view, by-product/waste recovery is an efficient method of waste reduction. There are many examples on by-product/waste recovery. In pulp and paper industry, as conventional treatment, an evaporator is used to recover lignosulphonates of all molecular weights together.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industry and its waste generation
- By product process of industrial waste

Detailed content of the Lecture:

- Every year the Chemical and Allied industries generate and safely dispose of billions of tons of industrial processing waste. While the industry has made significant progress in recycling and reuse, these wastes illustrate a measure of lost productivity.
- Technologies and practices to reduce processing wastes result in improved energy efficiency, greater resource conservation, reduced environmental impact and reduced operating costs (lower raw material and disposal costs).
- Waste reduction also provides more freedom to operate by easing legal barriers and resistance to plant expansions and new plant construction. Additionally, the products produced by the chemical and Allied industries create even greater quantities of downstream waste. Downstream waste can serve as potential raw materials and fuels; recovering this waste from downstream customers can provide low-cost domestic sources of raw materials and fuels for the Chemical and Allied industries and create new businesses and jobs in the collection and processing of these materials.

By product recovery from tannery:

- Degreasing waste produced in the beam house, if subjected to suitable chemical treatment may yield valuable fatty acids which can be used as chicken fodder.
- Glue and gelatin can be made from various tannery byproducts.
- Foam generating substances can be made from limited fleshings, trimmings and shavings.

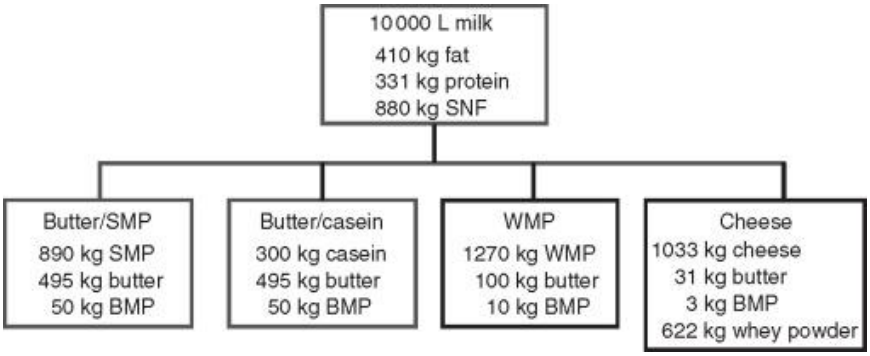
- The fleshings are also useful for generation of manure, animal feed, amino acids, grease etc.
- Lime liquors when mixed with sodium silicate offers itself as good cement.
- Lime sludge can be made into briquettes for heating purposes

By product recovery from distillery:

- The yeast sludge from the distilleries contains the degradation product of the dead yeasts and organic debris from the malts like proteins, fats, vitamins and carbohydrates.
- On the other hand the spent wash contains all the above nutrients plus unfermented sugars, amino acids, ammonium phosphates etc.
- So two types of byproducts the nutrient rich animal feed, and the potassium rich fertilizers may be recovered in a distillery.
- The segregation of yeast sludge for processing for animal feed is practiced in some distilleries, which in turn reduces the insoluble BOD load of the waste.

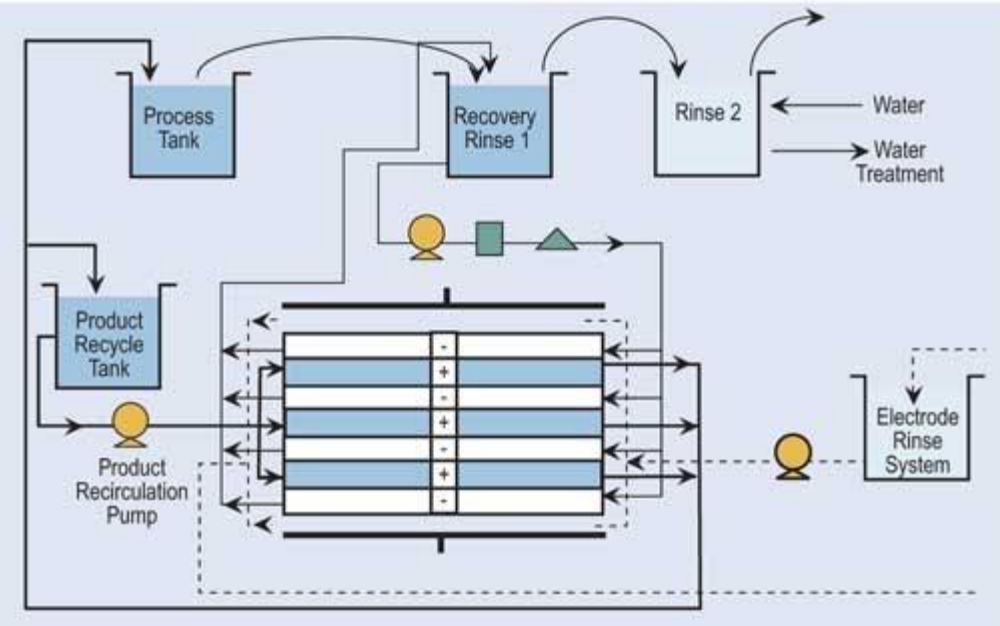
By product recovery from dairy:

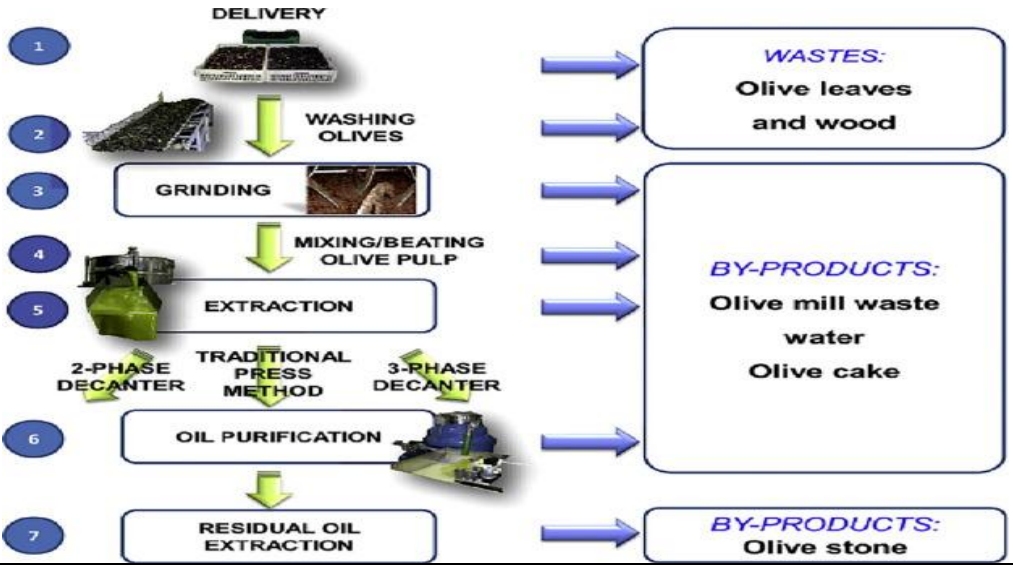
- The byproduct recovery from dairy industry can be done with the help of following method:
    - Treatment of cheese waste by cross flow ultrafiltration.
    - Use of CFUF in fermentation of lactose.
    - Use of cross flow microfiltration in the treatment of whey waste



By product recovery from electroplating:

- Materials used in electroplating industries can be effectively recovered using following available technologies:
    - Evaporation
    - Reverse osmosis
    - Ion exchange
    - Electrodialysis
    - Electrolytic recovery





Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Pollutionfrom Major Industries **Date of Lecture:28.01.2020**

Topic of Lecture:

- Sources, characteristics, of textiles industries

Introduction :

- Textile wastewater contains a large variety of dyes and chemical that make the environmental hazardous for textile industry not only as liquid waste but also in its chemical composition. Dyeing and finishing industry are mainly responsible to produce a large amount of waste water.
- This processes done by the input of a wide range of chemicals and dyestuffs or pigments, which generally are organic or inorganic compounds in nature. Water is applied as the medium to apply dyes and various chemicals for finishes.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Sources of textile industries

Most of the pollutants in textile waste waters from textile industry are high suspended solids, chemical oxygen demand, heat, color, acidity, and other soluble substances. Materials which need to be eliminated from textile wastewater are mainly COD, BOD, nitrogen, heavy metals and dyestuffs or colorants.

The wastes water from the textile mills comes from the following operation of:

1. Sizing (caboxymethyl cellulose (CMC), polyvinyl alcohol (PVA).
2. Desizing (mineral acid)
3. Scouring (Caustic soda, soda ash, detergent)
4. Bleaching(sodium hypochlorite (NaOCl) or hydrogen peroxide (H202))
5. Mercerizing (caustic soda solution)
6. Dyeing (vat dyes, developing dyes, naphthol dyes, sulfur dyes, basic dye, direct dyes etc.)
7. Finishing (starches, dextrines,natural and synthetic waxes, synthetic resins)

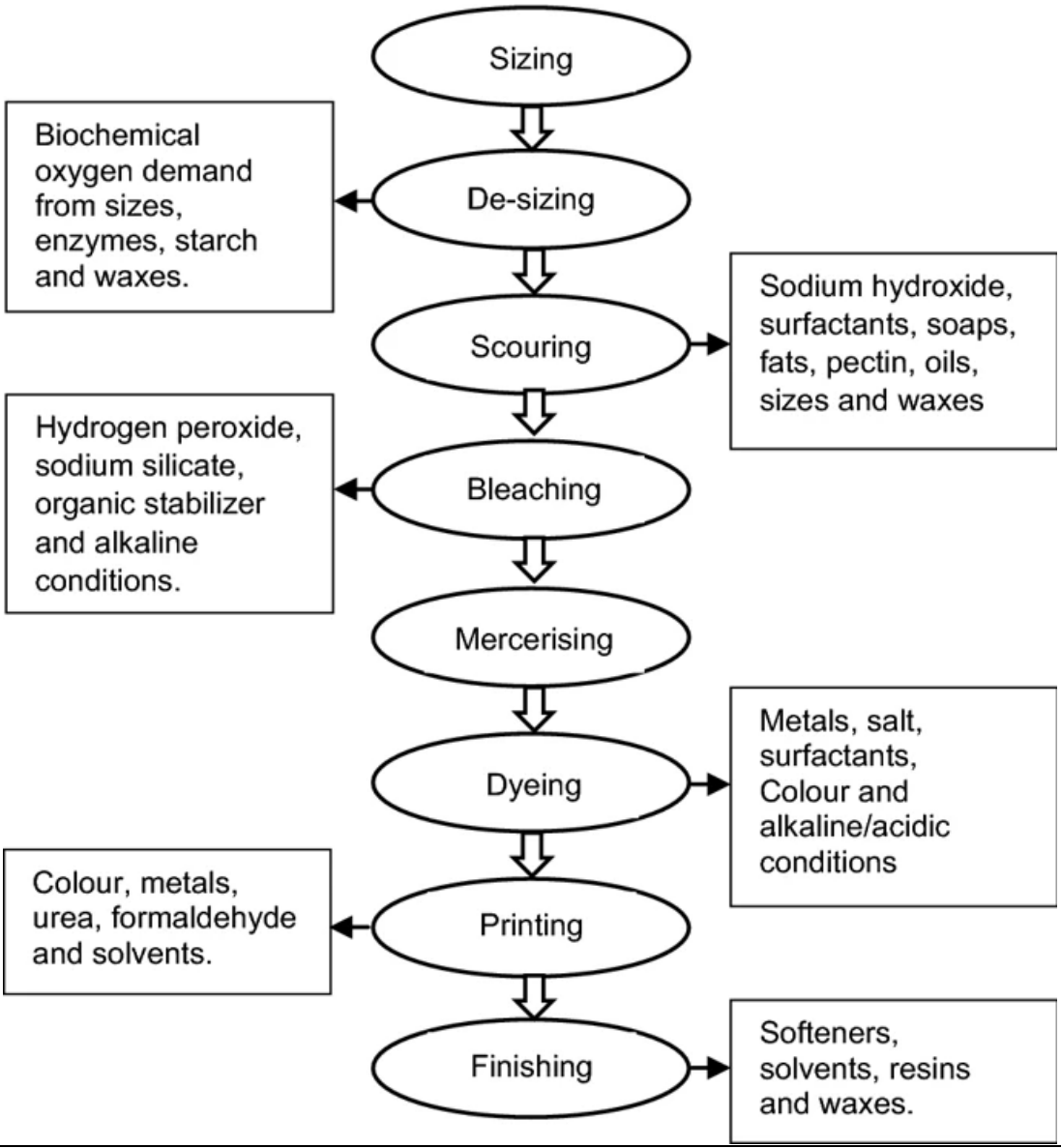
In textile pre-treatment process:

- Sizing

- Desizing
- Scouring
- Bleaching
- Cotton Mercerizing

In textile dyeing process:

- Dyeing
- Rinsing
- Printing



Video Content / Details of website for further learning (if any):
Can be added as link : https://link.springer.com/article/10.1007/s13762-018-2130-z

Important Books/Journals for further learning including the page nos.
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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit :Pollution From Major Industries **Date of Lecture:29.01.2020**

Topic of Lecture:

- Sources, characteristics, of tanneries industries

Introduction :

- The tannery industry belongs to one of the most polluting industrial sectors. Almost every tannery industry uses significant amounts of chemicals in the process of transforming animal hides into leather.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Stages of Tanning

- Soaking
  - The soaking is carried out in two/three stages with respect to removal of salt along with other impurities from raw materials by rationing water and regulated withdrawal of salt from salted hides/skins.
- Liming and unhairing
  - A traditional un hairing and liming process account for more than 50% c;f the BOD and COD load in typical tannery effluents. Also, this is the main source of the ammonium and sulphide present in the wastewater effluent.
  - The common feature of almost unhairing and liming alternative methods is that hair is only loosened and not discomposed. The hair is then subsequently mechanically removed so that it does not come into waste waters (hair-saving methods)
- De-liming and bating
  - Some common charaCi~ristics of alternative methods are that ammonium salts are replaced by agents that not contain ammo.tium salts. Application of these methods tt.en leads to reduction of ammonium nitrogen in tannery effluents.
- Chrome-tanning (Chrome splitting)
  The waste bath from tanning is the main source of chromium in a dissolved form discharged into tannery effluents. Approximately 800/o come from this bath and the samming process (60 and 20% respectively).
- Shaving
- Re-tanning and dying

- Fat-liquoring
- Post-tanning and finishing process
- Pickling
- Fleshing

- **In the soaking stage,** the most polluting stage of the tanning process contributes around 50–55% of the total pollution load of the tanning industry.
- **In the liming stage,** protein, hair, skin and emulsified fats are removed from the hides, they are released in the effluent and increase its total solids contents.
- The effluents from the tan-yard processes, **de-liming and bating** contain sulfides, ammonium salts, and calcium salts, and the effluent is slightly alkaline.
- **The pickling and chrome tanning** effluents contain sulphuric acid, chrome, chlorides, sodium bicarbonate and sulfates.
- The major pollutants of the **post-tanning process** are chrome salts, dyestuff residues, fatliquoring agents, syntans and other organic matter.

Characteristics of wastes

All effluent samples from the tannery industry were measured for parameters like

- **pH,**
- **Electrical Conductivity (EC),**
- **Total Suspended Solids (TSS),**
- **Total Dissolved Solids (TDS),**
- **Biological Oxygen Demand (BOD5)** in 5 days at 20 °C
- **Chemical Oxygen Demand (COD).**

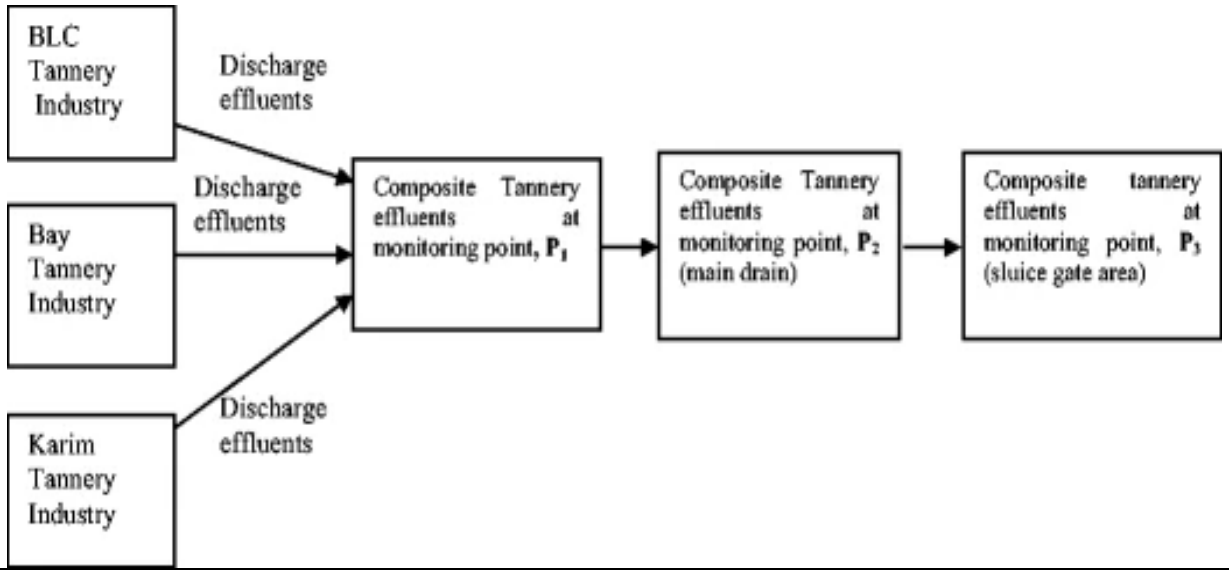
The final composite tannery effluents (wastewater) contain a high load of organic matter, dissolved and suspended solids, organic nitrogen, and ammonia, and possess high pH.

- Recovery of chromium. Precipitation

    - The systems to liquor recycling will require an alteration of the technology applied in the tannery with several engineering works.
    - An alternative approach requiring less technology is to cominue with the normal tannage and collect the maximum volume of chrome liquors (float, drains, sammying extractions and possibly any preneutralization wash).
    - These isolated chrome liquors are treated with and alkali to precipitate the chromium in the hydroxide form. From this form there are two possible means to use the chromium hydroxide: - The hydroxide sludge may be

passed to a filter press, the cake so formed may be redissolved with sulphuric acid and reused.

- The liquor may be left undisturbed overnight, virtually chrome free supernatant may then be draw off and discharged to the effluent stream and the remaining settled hydroxide sludge may be redissolved with acid in situ and subsequently reused.
- The addition of sulphuric acid then must be with cooling due to the high heat of hydration and neutralization with sulphuric acid. After dissolving the liquor is diluted and stored for



Video Content / Details of website for further learning (if any):
Can be added as link : https://link.springer.com/article/10.1007/s40710-015-0065-7/figures/1

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos 3.17 -3.22)

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LECTURE HANDOUTS

MECH

II/ IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit :Pollution From Major Industries **Date of Lecture: 03.02.2020**

Topic of Lecture:

- Sources, characteristics, of pharmaceuticals industries

Introduction :

- The pharmaceutical industry is an important component of health care systems throughout the world; it is comprised of many public and private organizations that discover, develop, manufacture and market medicines for human and animal health (Gennaro 1990).
- The pharmaceutical industry is based primarily upon the scientific research and development (R&D) of medicines that prevent or treat diseases and disorders. Drug substances exhibit a wide range of pharmacological activity and toxicological properties (Hardman, Gilman and Limbird 1996; Reynolds 1989).

Prerequisite knowledge for Complete understanding and learning of Topic:

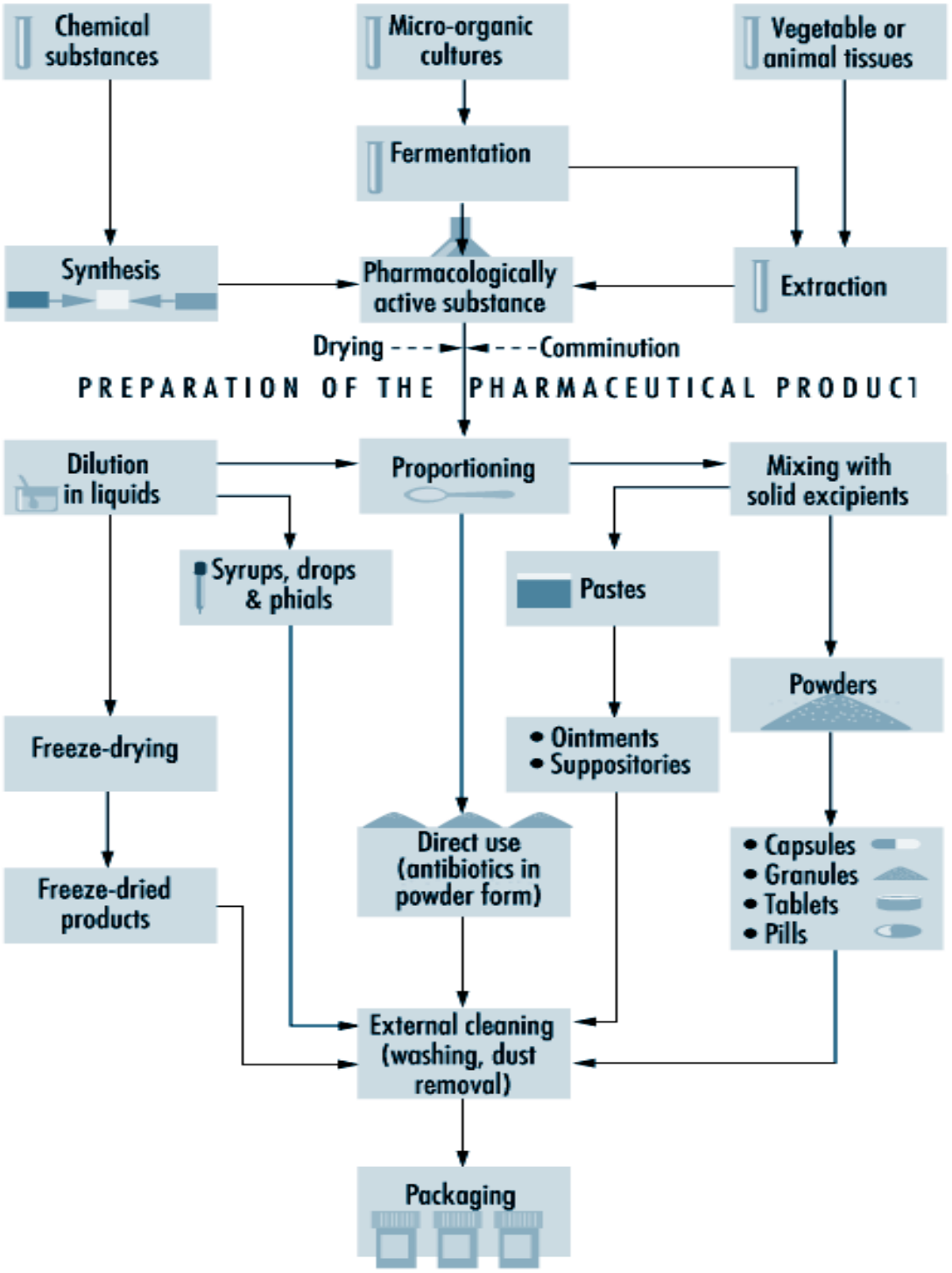
- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Drug development in the pharmaceutical industry

- The pharmaceutical industry is largely driven by scientific discovery and development, in conjunction with toxicological and clinical experience (see figure 79.1).
- Major differences exist between large organizations which engage in a broad range of drug discovery and development, manufacturing and quality control, marketing and sales and smaller organizations which focus on a specific aspect.
- Most multinational pharmaceutical companies are involved in all these activities; however, they may specialize in one aspect based upon local market factors. Academic, public and private organizations perform scientific research to discover and develop new drugs.
- The biotechnology industry is becoming a major contributor to innovative pharmaceutical research (Swarbick and Boylan 1996).
- Often, collaborative agreements between research organizations and large

pharmaceutical companies are formed to explore the potential of new drug substances.



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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit :Pollution From Major Industries **Date of Lecture:04.02.2020**

Topic of Lecture:

- Sources, characteristics, of electroplating industries

Introduction :

- This industry uses electrolytic processes for plating heavy metals on the metal sheet at a low pH.
- The peculiar characteristic of the electroplating industry is that it contains high loads of heavy metals like Chromium, Copper, Nickel, Zinc, etc. These heavy metals are required in small amounts in the animal body.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

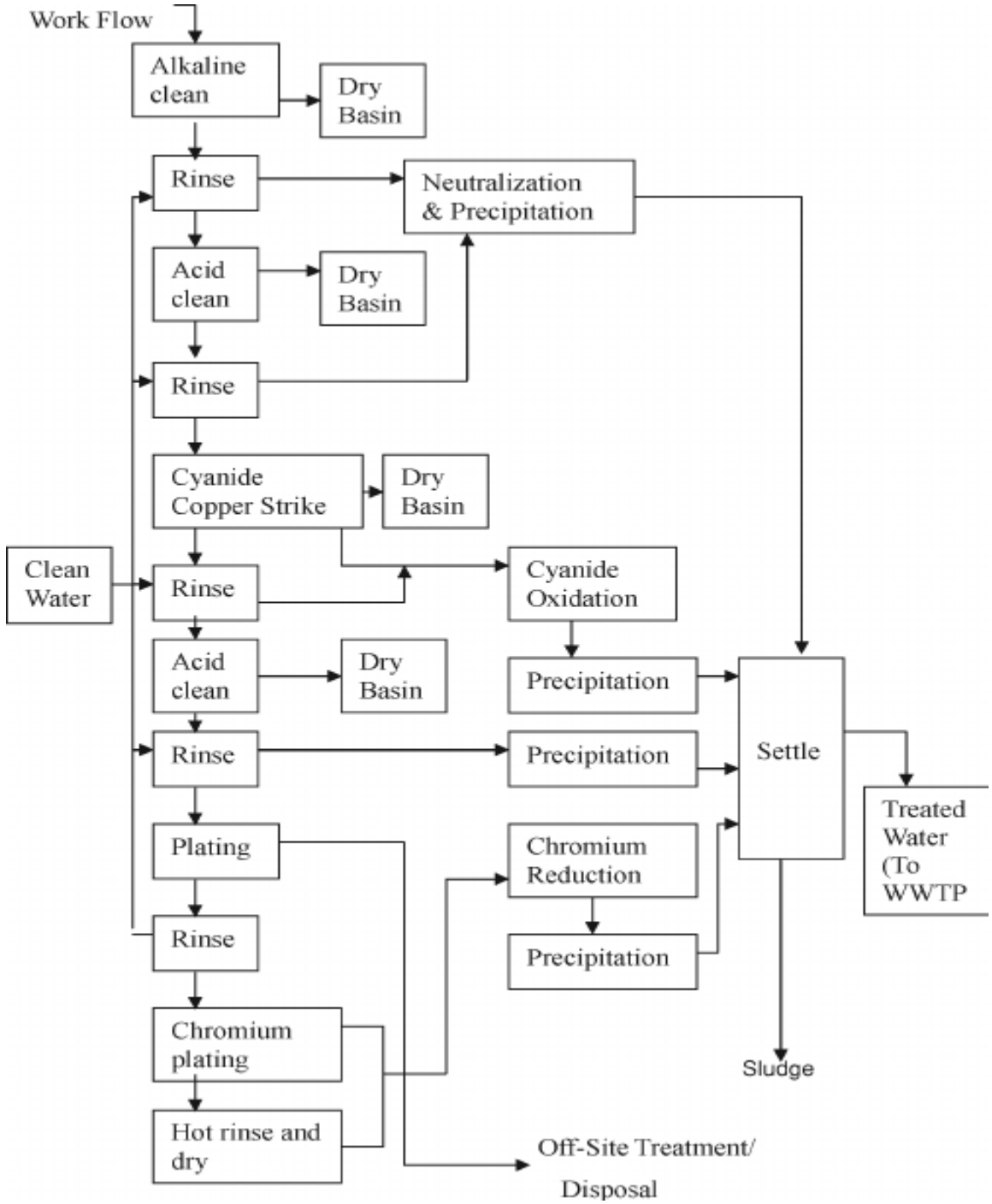
Detailed content of the Lecture:

Electroplating Process

- Plating can occur with individual metals or in various combinations (alloys) that can provide additional value to the electroplating process. Some of the most commonly used metals for electroplating include:
- **Copper:** Copper is often used for its conductivity and heat resistance. It is also commonly used to improve adhesion between layers of material.
- **Zinc:** Zinc is highly corrosion-resistant. Often, zinc is alloyed with other metals to enhance this property. For example, when alloyed with nickel, zinc is particularly resistant to atmospheric corrosion.
- **Tin:** This matte, bright metal is highly solderable and corrosion resistant as well as environmentally friendly. It is also inexpensive compared to other metals.
- **Nickel:** Nickel offers excellent wear resistance, which can be improved through heat treatment. Its alloys are also very valuable, offering elemental resistance, hardness and conductivity. Electroless nickel plating is also valued for its corrosion resistance, magnetism, low friction and hardness.
- **Gold:** This precious metal offers high corrosion, tarnish and wear resistance and is coveted for its conductivity and aesthetic appeal.
- **Silver:** Silver is not as corrosion resistant as gold, but it is highly ductile and

malleable, has excellent resistance to contact wear and offers excellent aesthetics. It is also an alternative to gold in applications where thermal and electrical conductivity is needed.

- **Palladium:** This bright metal is often used instead of gold or platinum for its hardness, corrosion resistance and beautiful finish. When alloyed with nickel, this metal achieves excellent hardness and plating quality.



Uses of Electroplating:

- While electroplating is often used to improve the aesthetic appearance of a base material, this technique is used for several other purposes across multiple industries. These uses include the following:
- **Build thickness:** Electroplating is often used to build up the thickness of a substrate through the progressive use of thin layers.
- **Protect substrate:** Electroplated layers serve as sacrificial metal coatings. This

means that when a part is placed in a harmful environment, the plated layer breaks down before the base material, protecting the substrate from damage.

- **Lend surface properties:** Electroplating allows substrates to benefit from the properties of the metals they are plated with. For example, some metals protect against corrosion, improve electrical conductivity, reduce friction or prepare a surface for better paint adhesion. Different metals lend different properties.
- **Improve appearance:** Of course, electroplating is also commonly used to improve the aesthetic appearance of a substrate. This can mean plating the substrate with an aesthetically pleasing metal or simply applying a layer to improve surface uniformity and quality.

Benefits of Electroplating:

- Protective barrier: Electroplating creates a barrier on the substrate, protecting it against environmental conditions. In some cases, this barrier can protect against corrosion caused by the atmosphere. This property specifically benefits components because the parts last longer in more harsh conditions, meaning that they need less frequent replacement.
- Enhanced appearance: Exterior pieces are often plated with thin layers of precious metals to make them more lustrous and attractive to look at. This plating lends aesthetic appeal without exorbitant costs, meaning that attractive parts can be sold at lower prices. Additionally, electroplating is often used to prevent tarnishing on silverware, improving longevity and aesthetic appearance over time.
- Electrical conductivity: Silver and copper plating help improve electrical conductivity in parts, offering a cost-effective, efficient solution for improving conductivity in electronics and electrical components.
- Heat resistance: Several metals, including gold and zinc-nickel, are resistant to high temperatures, improving the ability of the substrate to resist heat damage. This, in turn, can improve the lifespan of plated parts.
- Improved hardness: Electroplating is often used to improve the strength and durability of substrate materials, making them less susceptible to damage from stress or rough use. This quality can help increase the lifespan of plated parts, reducing the need for replacement.

Video Content / Details of website for further learning (if any):
Can be added as link :https://www.sharrettsplating.com/about/what-electroplating

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos 3.31- 3.34)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit :Pollution From Major Industries **Date of Lecture:05.02.2020**

Topic of Lecture:

- Sources, characteristics, of dairy, sugar industries

Introduction :

Dairy Industries

- The milk is one of the most important commodity entering trades and it is required in everyday life as an article of food. Since the milk is highly perishable, basic public health and economic consideration is required that consumer should be provided with the product which is of good quality, pure, free from pathogenic bacteria. To maintain quality standard, quality control operation have to be performed at all the stages of production of milk which includes maintenances of sanitary conditions at milking place, storage, transportation and handling the milk at reception docks, processing and packing etc.

Sugar Industries

- Sugar can be produce from beet or from sugar cane.
- In India sugarcanes are used, Europe –beet is used.
- The mills are typically operated for 4 to 8 months after the harvesting of sugar cane.
- Odour nuisance near the sugar mills is a very common phenomenon.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

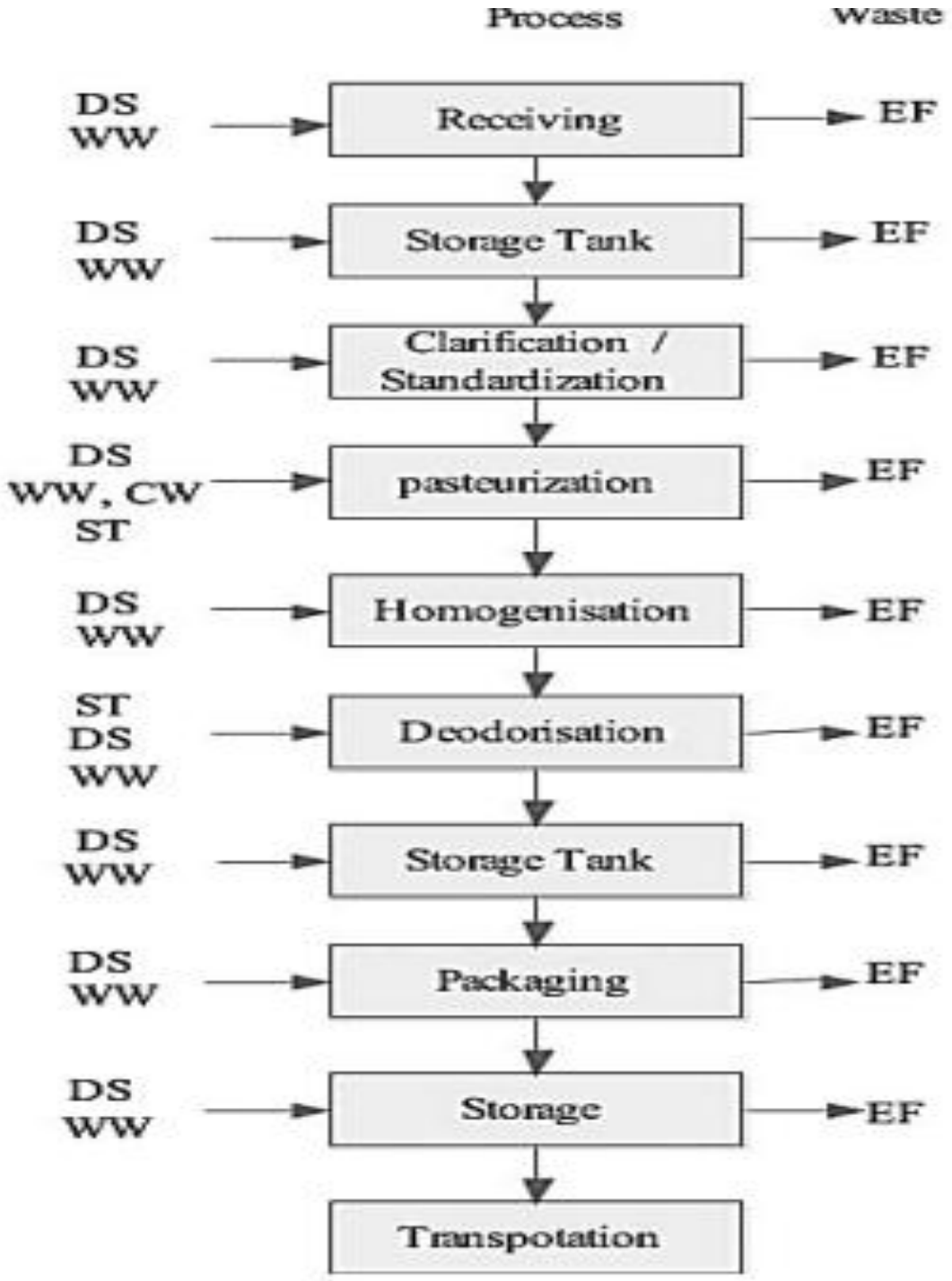
Detailed content of the Lecture:

Characteristics of the Effluent

- Dairy effluent contains soluble organics, suspended solids, trace organics. All these components contribute largely towards their high biological oxygen demand (BODS) and chemical oxygen demand (COD).
- Dairy wastes are white in colour and usually slightly alkaline in nature and become acidic quite rapidly due to the fermentation of milk sugar to lactic acid.
- The suspended matter content of milk waste is considerable mainly due to fine curd found in cheese waste.
- The pollution effect of dairy waste is attributed to the immediate and high oxygen demand.

- Decomposition of casein leading to the formation of heavy black sludge's and strong butyric acid odors and characterize milk waste pollution.

Manufacturing process of diary industries



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Sources of wastewater and characteristics

- The wastewater from mill house include the water used as splashes to extract maximum amount of juice and those used to cool the roller bearings.
- This wastewater contains high BOD due to presence of sugar and oil and grease from machineries.
- The wastewater from occasional washing of filter cloths (used for filtering the juice) though small in volume, contains high BOD and SS.
- The water used for cooling in evaporators also contributes as wastewater.
- The cooling water gets polluted as it picks up some organic substances from the

vapors of boiling syrup in evaporators and vacuum pan.

- Although this water is recirculated it is required to be discharged. This contributes to considerable volume of waste and moderate BOD.
- Additional waste originates due to the leakages and spillages of juice, syrup and molasses in different sections, and also during handling of molasses. Washing of floor (periodic) contributes a lot to pollution load. Though, it is small in volume, strong in BOD concentration.
- Periodic blow-off of the boilers produces another intermittent waste discharge. This is high in SS, low in BOD and usually alkaline.

Video Content / Details of website for further learning (if any):
Can be added as link :https://inpressco.com/wp-content/uploads/2013/11/Paper31611-1615.pdf, http://ghangrekar.com/wp-content/uploads/2016/02/SUGAR-INDUSTRY.pdf

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos 3.34-3.43)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Pollutionfrom Major Industries **Date of Lecture: 10.02.2020**

Topic of Lecture:

- Sources, characteristics, of paper, distilleries industries

Introduction :

Paper Industries

- The pulp and paper industry comprises companies that use wood as raw material and produce pulp, paper, paperboard and other cellulose-based products

Distilleries Industries

- We are supported with a rich industry experience and knowledge that assist us in manufacturing, exporting and supplying a wide range of Distillery Plants. These are used to alcohol manufacturing industries for fermentation, distillation and evaporation with unique zero liquid discharge guarantee. Further, our manufacturing team use contemporary techniques and premium quality basic material in order to meet the set industry standards.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Manufacture of Paper

The basic steps in making paper include;

- Suspension of cellulosic fiber prepared by beating it in water so that the fibers are thoroughly sepa- rated and saturated in water.
- Paper stock filtered on a woolen screen to form matted sheets of fiber.
- The wet sheet pressed and compressed to squeeze out a large proportion of water.
- The remaining water removed by evaporation.
- Depending upon use requirement, the dry paper sheet is compressed, coated or impregnated.
- Hydropulping

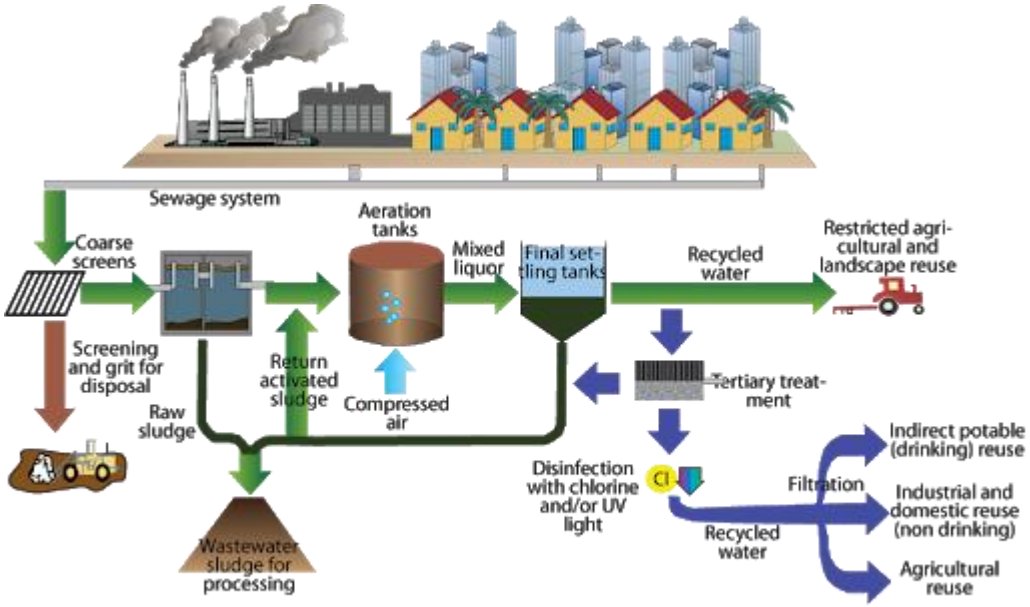
Sources of Waste Generation

- In pulp and paper industry, considerable quantity of water is used in paper making processes. The quantity of water consumption varies according to the quality and

kind of paper to be manufactured. In addition considerable amount of solid waste and gaseous emission occurs.

Characteristics of Pollutants

- Pulp and paper industry is intensive in terms of raw material consumption. Besides pollution load generation, the other consumption includes chemical, energy, water and capital requirements. About 41.8% of wood is recovered as bleached pulp. Of the remaining wood, roughly 4.2% ends up as solid waste, 5.25% goes into wastewaters as dissolved organic matter and 2.3% goes as suspended solids in wastewater (Nemade *et al.* 2003). The potential pollutants from pulp and paper mill fall into four principal categories as under:



Conceptual diagram illustrating a modern central collection and wastewater treatment plant, which can remove nutrients from wastewater to very low levels (i.e., teritary treatment) and provide recycled water for agricultural and landscape uses.
Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Kruczynski, W.L. and P.J. Fletcher (eds.). 2012. Tropical Connections: South Florida's marine environment. IAN Press, University of Maryland Center for Environmental Science, Cambridge, Maryland. 492 pp.

Water effluents

- Suspended solids including bark particles, fiber, pigments and dirt.
- Dissolved colloidal organics like hemicelluloses, sugars, lignin compounds, alcohols, turpentine, sizing agents, adhesives like starch and synthetics.
- Color bodies, primarily lignin compounds and dyes.
- Dissolved inorganics such as NaOH, Na2SO4 and bleach chemicals.
- Thermal loads.

Overview of distillery industry

- **Dilution–** Molasses available from Indian sugar mills has a solid content varying between 76 and 90%.In diluter, solid concentration of molasses is brought down to 20-25o Brix.
- **Fermentation –** Production of alcohol from fermentable sugars in molasses solution
- **Separation–** Substrate is separated into alcoholic solution and yeast sludge by centrifugation. The recuperation of yeast is important in order to reduce the organic load of the wastewater.
- **Distillation –** The produced alcohol is distilled utilising a counter current of steam

Other environmental problems

Air Environment

- The air pollutants resulting from Distillery operations will be SPM, SO2 and Nox emitted from the boiler. The air emission from the boiler will be dispersed through

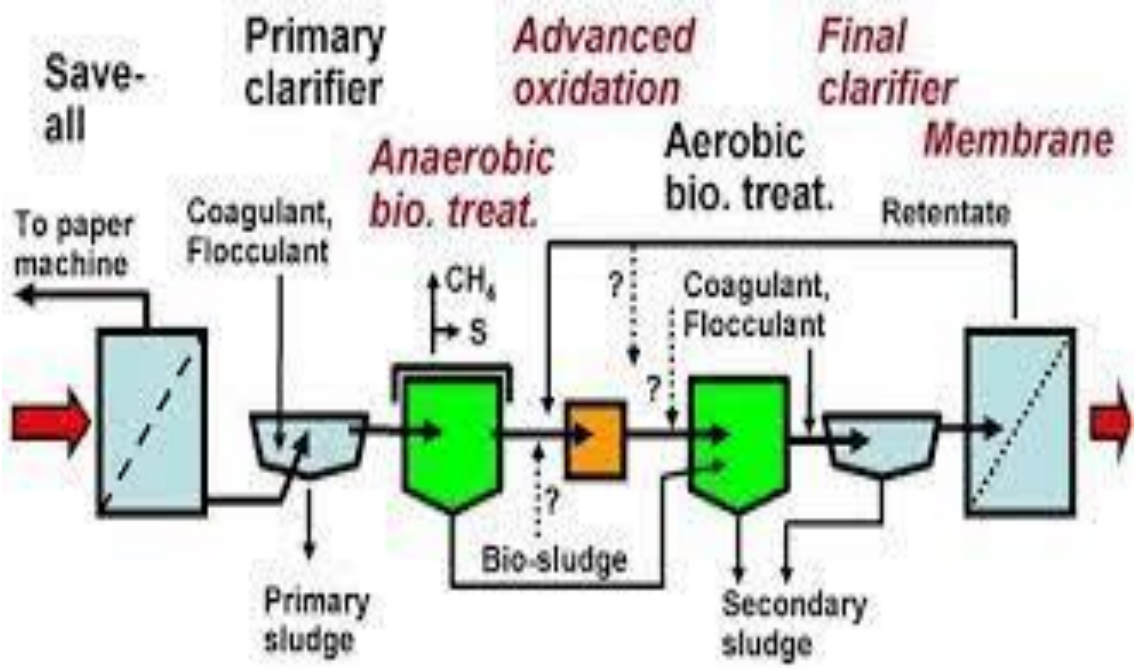
suitable pollution control equipments.

Biological Conditions

- Emission of particulate matter along with oxides will affect vegetation around the unit. The effects may vary from bleaching of leaves, reduction in effective leaf area for photosynthesis to adverse damage like death. This could be overcome by following proper environment management plan.

Noise Impact

- To meet out the industrial noise level prescribed by the Factory Act [90dB(A) for 8hrs working]. Suitable acoustic measures such as proper engineering design acoustic methods; suitable barriers and enclosures are proposed to reduce the noise level.



Advantages of anaerobic treatment of distillery wastewater

Environmental aspects

- Prevention of pollution of water and soil
- Mitigation of greenhouse gases
- Reduction of methane emissions
- Reduction of fossil fuel demand

Socio-economic aspects

- Hygiene aspects
- Nutritional aspects
- Economic aspects
- Fuel savings

Video Content / Details of website for further learning (if any):
Can be added as link :https://civildigital.com/distillery-industry-wastewater-treatment/

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos3.45-3.61)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Pollutionfrom Major Industries **Date of Lecture: 11.02.2020**

Topic of Lecture:

- Sources, characteristics, of steel plants, refineries industries

Introduction :

- Steel slag, a by-product of steel making, is produced during the separation of the molten steel from impurities in steel-making furnaces.
- The slag occurs as a molten liquid melt and is a complex solution of silicates and oxides that solidifies upon cooling.Virtually all steel is now made in integrated steel plants using a version of the basic oxygen process or in specialty steel plants (mini-mills) using an electric arc furnace process. The open hearth furnace process is no longer used.

Prerequisite knowledge for Complete understanding and learning of Topic:

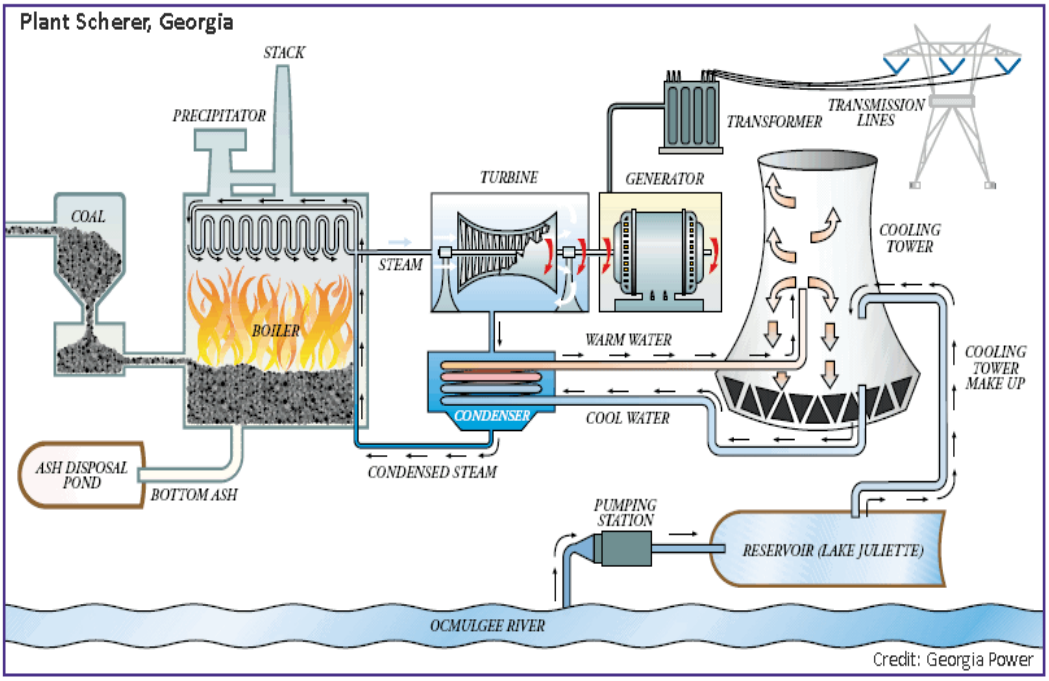
- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Steel Plants Industries

- In the basic oxygen process, hot liquid blast furnace metal, scrap, and fluxes, which consist of lime (CaO) and dolomitic lime (CaO.MgO or "dolime"), are charged to a converter (furnace). A lance is lowered into the converter and high-pressure oxygen is injected.
- The oxygen combines with and removes the impurities in the charge. These impurities consist of carbon as gaseous carbon monoxide, and silicon, manganese, phosphorus and some iron as liquid oxides, which combine with lime and dolime to form the steel slag. At the end of the refining operation, the liquid steel is tapped (poured) into a ladle while the steel slag is retained in the vessel and subsequently tapped into a separate slag pot.
- Iron ore is produced in around 30 countries – in 2017, the largest producers were Australia, Brazil and China. Around 98% of iron ore is used in steel-making. During the iron-making process, a blast furnace is fed with the iron ore, coke and small quantities of fluxes (minerals, such as limestone, which are used to collect

impurities). Air which is heated to about 1200°C is blown into the furnace through nozzles in the lower section. The air causes the coke to burn, producing carbon monoxide which reacts with the iron ore, as well as heat to melt the iron. Finally, the tap hole at the bottom of the furnace is opened and molten iron and slag (impurities) are drained off.



Refineries Industries

- Refining industry operations and processes can have highly detrimental environmental and social impacts not only due to the refinery processes themselves but also as a result of the wider end-usage of the industry's products. As a result, governments impose a range of regulations on the petroleum refining industry. These regulations cover petroleum product specifications, refinery plant emissions, health and safety, release of toxic and hazardous substances

Description of Effluent Treatment Plant

- The Effluent Treatment Plant (ETP) had been constructed in 1997 for 5000 m3/d capacity. Presently 3850 m3/d effluent is received. The waste generates includes formation water from HP, MP, LP (High, Medium and Low pressure) separators, in CSU (Crude stabilization Units) other processes drains, crude tank bottom drains floor wash, cooling tower blow down, floor washing and filters backwashing.
- After proper treatment at ETP and meeting Pollution Control Board (PCB) norms, the wastewater was disposed off into river body.
- The treatment is mainly for reduction of free and emulsified oil, total suspended solids (TSS), bio-chemical oxygen demand (BOD5) and chemical oxygen demand (COD).

Solid Waste Management

- The refinery unavoidably generates enormous quantity of tank bottom oily sludge as well as oil contaminated soil waste which constitutes a major challenge for hazardous waste management as well as environment management. Oil sludge is

removed from the crude oil tanks while cleansing as well as is generated in ETP during various stages of treatment uses specialized bacteria known as Oilzapper which, transforms harmful substances to non-toxic components. One of the technologies is "Bioremediation" of crude oil/oily sludge which is an eco-friendly and cost effective technique. Biotechnology approach is for disposal of oily sludge/oil contaminated soil and wastewater effluent sludge.

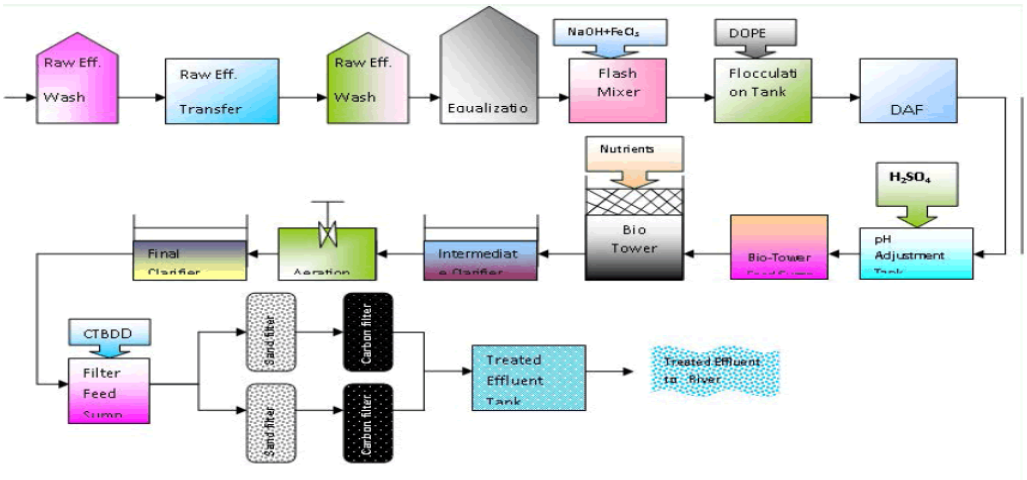
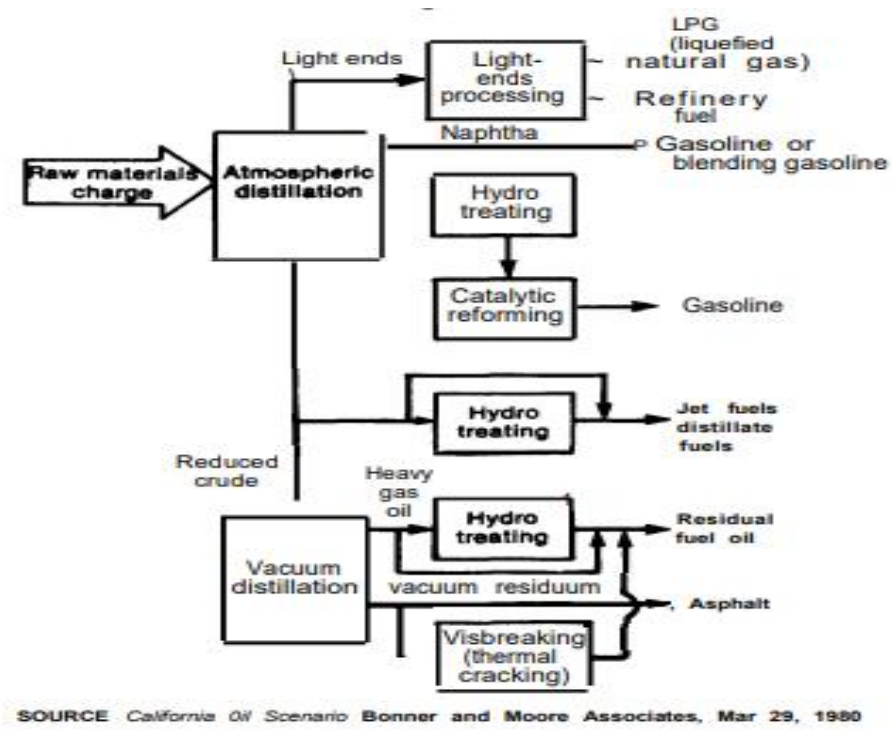


Fig. 1 Schematic diagram for treatment of ETP at refinery



SOURCE *California Oil Scenario* Bonner and Moore Associates, Mar 29, 1980

Video Content / Details of website for further learning (if any):
Can be added as link :https://www.sciencedirect.com/topics/earth-and-planetary-sciences/refining-industry

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos3.62-3.76)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Pollutionfrom Major Industries **Date of Lecture:12.02.2020**

Topic of Lecture:

- Sources, characteristics, of fertilizer and thermal power plants industries

Introduction :

- Fertilizer is a key ingredient in feeding a growing global population, which is expected to surpass 9.5 billion people by 2050. Half of all food grown around the world today, for both people and animals, is made possible through the use of fertilizer. As demand continues to grow, farmers around the world will continue to rely on fertilizer to increase production efficiency to produce more food while optimizing inputs. Fertilizers play an essential role in replenishing nutrients in the soil that are used by plants each growing season. Three primary nutrients are necessary for plant growth: nitrogen, phosphorus, and potassium. All must be present in soil in the right amount to grow healthy crops.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Byproducts/Waste

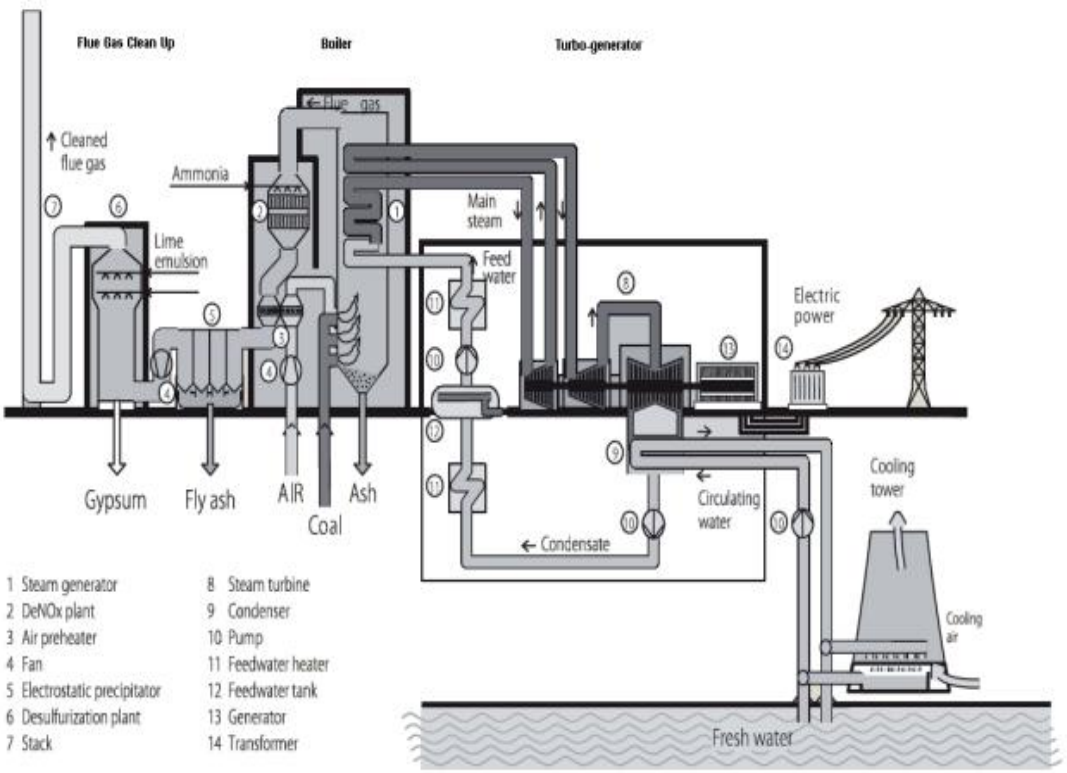
- A relatively small amount of the nitrogen contained in fertilizers applied to the soil is actually assimilated into the plants. Much is washed into surrounding bodies of water or filters into the groundwater.
- This has added significant amounts of nitrates to the water that is consumed by the public. Some medical studies have suggested that certain disorders of the urinary and kidney systems are a result of excessive nitrates in drinking water.
- It is also thought that this is particularly harmful for babies and could even be potentially carcinogenic.
- The nitrates that are contained in fertilizers are not thought to be harmful in themselves. However, certain bacteria in the soil convert nitrates into nitrite ions. Research has shown that when nitrite ions are ingested, they can get into the bloodstream.

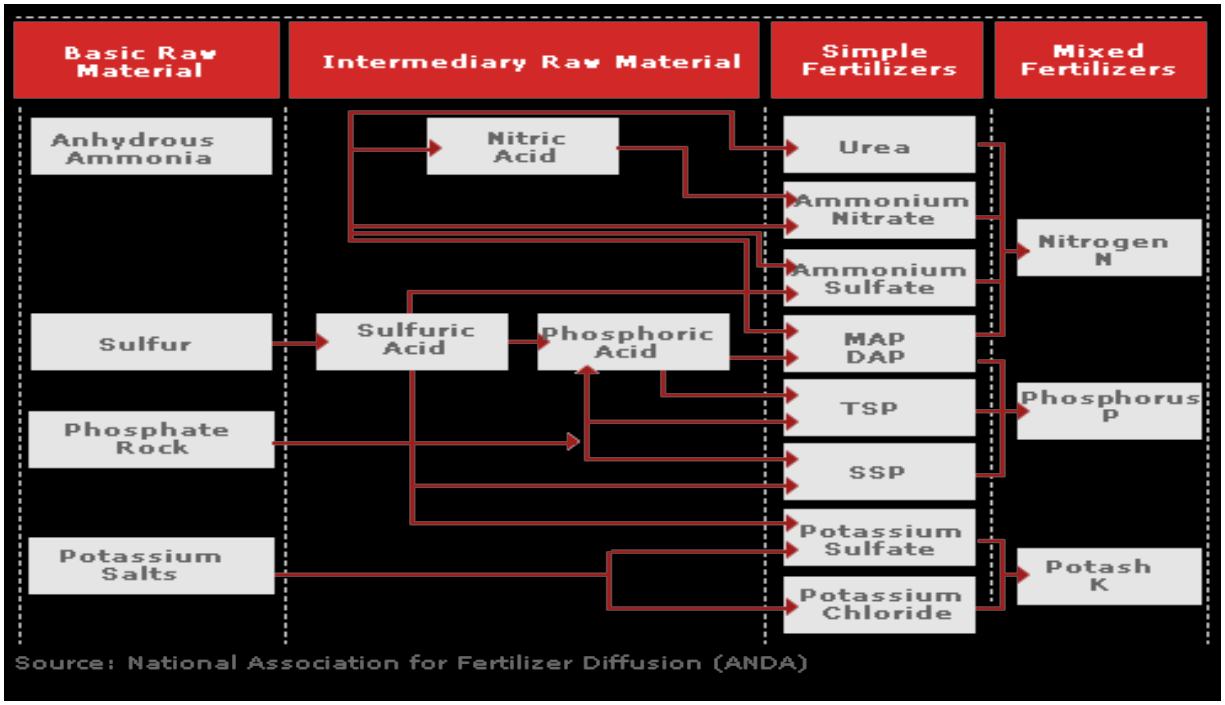
- There, they bond with hemoglobin, a protein that is responsible for storing oxygen. When a nitrite ion binds with hemoglobin, it loses its ability to store oxygen, resulting in serious health problems.
- Nitrosamines are another potential byproduct of the nitrates in fertilizer. They are the result of a natural chemical reaction of nitrates.
- Nitrosamines have been shown to cause tumors in laboratory animals, feeding the fear that the same could happen in humans. There has, however, been no study that shows a link between fertilizer use and human tumors.

The Manufacturing Process

- Nitrogen fertilizer component
  - Nitrogen fertilizers are made from ammonia (NH_3) produced by the Haber-Bosch process.
  - In this energy-intensive process, natural gas (CH_4) usually supplies the hydrogen, and the nitrogen (N_2) is derived from the air.
  - This ammonia is used as a feedstock for all other nitrogen fertilizers, such as anhydrous ammonium nitrate (NH_4NO_3) and urea ($CO(NH_2)_2$)
  - Deposits of sodium nitrate ($NaNO_3$) (Chilean saltpeter) are also found in the Atacama desert in Chile and was one of the original (1830) nitrogen-rich fertilizers used.
  - It is still mined for fertilizer.[26] Nitrates are also produced from ammonia by the Ostwald process.
- Phosphorous fertilizer component
  - Mineral deposits are the major supply of phosphorus. All phosphate mineral was derived from apatite by weathering.
  - Mostly phosphate is found in different forms like quartz, calcite, dolomite, apatite, Fe-oxide minerals and clay minerals.
  - Apatite mineral is used for manufacturing fertilizers.
- Potassium fertilizer component
  - Potassium is the third key nutrient of commercial fertilizers.
  - It helps strengthen plants' abilities to resist disease and plays an important role in increasing crop yields and overall quality.
  - Potassium also protects the plant when the weather is cold or dry, strengthening its root system and preventing wilt.
- Granulating and blending
  - Granulation is a size enlargement process in which mixtures of fine powders are combined into larger agglomerates or granules. In wet granulation, a liquid and a binder material are added to an agitated powder bed to form granules.
- Bagging

  It is the final process, after done in all the manufacturing process the remaining product and by product will bagged with required limits





Video Content / Details of website for further learning (if any):
Can be added as link :http://library.umac.mo/ebooks/b28312636.pdf

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos3.79-3.88)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Pollutionfrom Major Industries **Date of Lecture: 17.02.2020**

Topic of Lecture:

- Wastewater reclamation concepts

Introduction :

- Reclaimed or recycled water (also called wastewater reuse or water reclamation) is the process of converting wastewater into water that can be reused for other purposes.
- Reuse may include irrigation of gardens and agricultural fields or replenishing surface water and groundwater (i.e., groundwater recharge).
- Reused water may also be directed toward fulfilling certain needs in residences (e.g. toilet flushing), businesses, and industry, and could even be treated to reach drinking water standards.
- This last option is called either "direct potable reuse" or "indirect potable" reuse, depending on the approach used. Colloquially, the term "toilet to tap" also refers to potable reuse.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Methods of reclamation:

- Urban reuse
- Agricultural reuse
- Environmental reuse
- Industrial reuse
- Planned potable reuse
- Indirect potable reuse
- Direct potable reuse
- Reuse in space

Benefits

- Increased water availability
- Drinking water substitution - keep drinking water for drinking and reclaimed water for non-drinking use (i.e. industry, cleaning, irrigation, domestic uses, toilet flushing, etc.)
- Reduced over-abstraction of surface and groundwater
- Reduced energy consumption associated with production, treatment, and distribution of water compared to using deep groundwater resources, water importation or desalination
- Reduced nutrient loads to receiving waters (i.e. rivers, canals and other surface water resources)
- Reduced manufacturing costs of using high quality reclaimed water
- Increased agricultural production (i.e. crop yields)
- Reduced application of fertilizers (i.e. conservation of nutrients, reducing the need for artificial fertilizer (e.g. soil nutrition by the nutrients existing in the treated effluents))
- Enhanced environmental protection by restoration of streams, wetlands and ponds
- Increased employment and local economy (e.g. tourism, agriculture).

Design considerations

- Distribution
- Treatment processes
- Alternative options
- Costs

Barriers to implementation

- Full-scale implementation and operation of water reuse schemes still face regulatory, economic, social and institutional challenges
- Economic viability of water reuse schemes
- Costs of water quality monitoring and identification of contaminants
- Full cost recovery from water reuse schemes - lack of financial water pricing systems comparable to already subsidized conventional treatment plants.
- Psychological barriers, sometimes referred to as the "yuck factor" can also be an impediment to implementation, particularly for direct potable reuse plans. These psychological factors appear to be closely associated with disgust, specifically pathogen avoidance

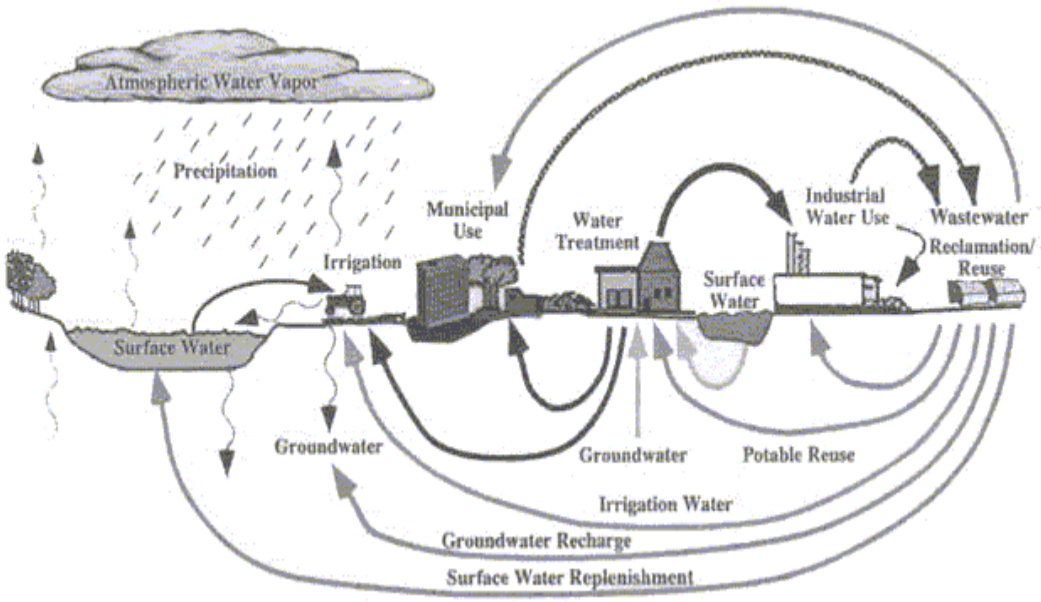
Health aspects

- Reclaimed water is considered safe when appropriately used. Reclaimed water planned for use in recharging aquifers or augmenting surface water receives adequate and reliable treatment before mixing with naturally occurring water and undergoing natural restoration processes. Some of this water eventually becomes part of drinking water supplies.

- A water quality study published in 2009 compared the water quality differences of reclaimed/recycled water, surface water, and groundwater.Results indicate that reclaimed water, surface water, and groundwater are more similar than dissimilar with regard to constituents.
- The researchers tested for 244 representative constituents typically found in water. When detected, most constituents were in the parts per billion and parts per trillion range.

Environmental aspects

- The main potential risks that are associated with reclaimed wastewater reuse for irrigation purposes, when the treatment is not adequate are the following:[39][40]
- contamination of the food chain with microcontaminants, pathogens (i.e. bacteria, viruses, protozoa, helminths), or antibiotic resistance determinants;
- soil salinization and accumulation of various unknown constituents that might adversely affect agricultural production;
- distribution of the indigenous soil microbial communities;
- excessive growth of algae and vegetation in canals carrying wastewater (i.e. eutrophication);
- groundwater quality degradation by the various reclaimed water contaminants, migrating and accumulating in the soil and aquifers.



Video Content / Details of website for further learning (if any):
Can be added as link :https://www.jstor.org/stable/25037489?seq=1

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos3.94-3.98)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code :Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture: 18.02.2020**

Topic of Lecture:

- Equalization -neutralization

Introduction :

Equalization

- The main objective is to minimize or control fluctuations in waste water characteristics in order to provide better condition for subsequent treatment.

Neutralization

- The excessively acidic or alkaline waste should not be discharged without treatment into a receiving stream, sewer, and effluent treatment plant or on land.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Equalization:

- It is the method of retaining waste in a basin so that the effluent discharge is fairly uniform in its characteristics.
- The main objective is to minimize or control fluctuations in waste water characteristics in order to provide better condition for subsequent treatment.
- The purpose of equalization is to provide adequate damping of organic fluctuations inorder to prevent shock loading of biological treatment.
- It also provide adequate pH control or to minimize the chemical requirements for

Neutralization.

- It helps in providing continuous feed to biological systems once a period, when the manufacturing plant is not operating.
- It helps in preventing high concentration of toxic materials from entering the biological treatment plant.

Types of equalization:

- **Inline equalization:** In the inline equalization all of the flow passes through the equalization basin. This arrangement can be made to achieve a considerable amount

of constituent concentration and flow rate damping.

- **Offline equalization:** In the offline arrangement only the flow above some predetermined flow limit is diverted into the equalization tank although the pumping requirement are minimized in this arrangement. The amount ofconstituent concentration clamming is considerably removed. Offline equalization is sometimes used to capture first flush from combined collection.

Neutralization:

- The excessively acidic or alkaline waste should not be discharged without treatment into a receiving stream, sewer, and effluent treatment plant or on land.
- There are many acceptable methods for neutralization of acidic or alkaline waste water and they are as follows:
- Neutralization of acidic waste:
- Mixing the waste by the waste from other industry.
- Passing acidic waste through beds of lime stone.
- Mixing acidic waste with lime slurry
- Adding proper proportion of caustic soda or soda ash.
- Neutralization of alkaline waste:
- Use of waste boiler flue gas
- CO2CO2 treatment for alkaline waste
- Producing CO2CO2 in alkaline waste
- H2SO4H2SO4 treatment
- Acid waste neutralization in industrial process

Video Content / Details of website for further learning (if any):
Can be added as link : https://www.ques10.com/p/12197/explain-in-detail-process-of-equalization-and-ne-1/

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.1-4.8)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture: 19.02.2020**

Topic of Lecture:

- Removal of suspended organic solids

Introduction :

- Produced or fresh water being treated may have suspended solids, such as formation sand, rust from piping and vessels, and scale particles, or dissolved solids (various chemical ions).
- For most uses or disposal methods, these solids may need to be removed. It may be necessary to remove these solids to prevent wear in high-velocity areas, prevent solids from filling up vessels and piping and interfering with instruments, and comply with discharge restrictions on oil-coated solids. This page discusses appropriate removal technologies and handling of the removed material.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Removing suspended solids

- Suspended solids can be separated from the water stream by:
- Gravity settling
- Hydrocyclone desanders
- Filters
- Centrifuges

Solids handling

- Once solids separation is identified as a need in a produced-water system, facilitating the solids handling becomes an important need in overall system design. Systems are based on modular designs that can be built to handle a very wide range of process needs for either land-based or offshore systems. These systems should be manufactured to require minimal operator intervention and, in case of hazardous disposal, minimal contact.
- Solids handling can be broken down into five areas

Separate

- Separation is defined as diverting the solids and liquids contained in a mixed slurry stream to different locations. The solids are removed from the produced-water stream by one of the following:
- Gravity vessel (tank bottoms or vessel drain)

- Desander
- Sand-jet system
- Filter dump

Collect

- Collection is defined as gathering all separated solids into a central location and physically isolating them from the production process. By collecting the solids in one location, a simpler system can be designed to isolate the solids from the process. Collection can be as simple as either of the following:
- Desander accumulator vessel
- Dedicated sump tank

Clean

- In many cases, the sand may require cleaning of adsorbed oil or chemicals before further handling. Sand-cleaning systems are handled in one of two ways:
- Offered as modular add-on packages
- Integrated into the separation system

Dewater

- The total volume of sand slurry to be transported and disposed of can be greatly reduced by a dewatering step, which involves removing the liquids from the collected (cleaned) solids slurry. A range of systems is available to provide dewatering from a sand-drainage bag to a filter press or screw classifier. The goal is to reduce the liquid to less than 10% by volume.

Haulage

- Haulage is a simple term used to define removing, hauling, and disposing of the solids. The design of the haulage system will be dependent upon location (land-based or offshore) and disposal requirements (i.e., disposal well, overboard, landfill, road surfacing, etc.). Offshore systems typically involve crane-to-boat-to-truck transport, while land-based systems may use a truck to a landfill.
- Every solids-handling and -disposal system will be different because of:
- Economics
- Environmental and hazardous regulations
- Location
- Total solids to be handled

Removing dissolved solids from water

- Various chemical compounds are dissolved in water as ions to form an aqueous solution. The term "dissolved solids" is used to describe these ions in water; some of the more common are:
- Silica
- Calcium
- Magnesium
- When water is thermally evaporated or treated with membranes, these ions become saturated and exceed their solubility in water. They will then precipitate or crystallize to form scale. Scale formation plugs piping and fouls the following

equipment:

- Water-handling system
- Steam-generator tubes
- Membranes
- Scaling sometimes can be controlled with an inhibitor chemical; however, when this does not work, these ions should be removed from the system.

The dissolved ions can be removed from water with:

- Membranes
- Ion exchange
- Hot or warm softening

Membranes

- Membranes are predominantly used to remove species of salts and organics from water.
- Reverse osmosis (RO) can remove 95 to 99% of the metallic ions, such as sodium and potassium salts, as well as a relatively high percentage of organic material. Nanofiltration (NF) can remove most divalent ions, such as sulfate and nitrate, from water.

Ion exchange

- The ion-exchange process is used to remove specific ions from solution. Its primary application in produced-water treatment is the removal of calcium and magnesium ions, which make up the "hardness" in water.
- Ion exchange used for this purpose is called "water softening." It also can be used to remove residual minerals and, in this instance, is called demineralization

Water softening

- The water-softening process is used in the oil industry for steamflood operations. To operate reliably at high temperatures and pressures, steam generators require a very low hardness content in the feed water.
- Scale precipitation can coat the heating tubes, causing localized overheating and tube failure. typical water-softener bank used in steamflood operations.
- For this case, the divalent ions, calcium and magnesium, are exchanged with the sodium ions from an ion-exchange resin. After the exchange, the ion-exchange resin is saturated with the divalent ions.
- It is regenerated with a higher-concentration brine solution, which is rich in sodium ions. This brine solution is generally a 10 to 20% salt (sodium chloride) solution.

Video Content / Details of website for further learning (if any):
Can be added as link : https://petrowiki.org/Removing_solids_from_water

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.9-4.10)

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LECTURE HANDOUTS

MECH

II / IV

CourseName with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture: 22.02.2020**

Topic of Lecture:

- Removal of dissolved organic solids

Introduction :

- Dissolved organic Solids (DOS) is problematic in water recycling or wastewater disposal when it provides precursors for disinfection by-product formation or when it provides a carbon/energy source for microorganisms and biofilms in receiving waters and in distribution systems. Biologically stable water protects receiving waters and recycled water systems.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Methods of Inorganic Dissolved Substance Removal

The operations and procedures applied in the removal of inorganic dissolved substances are:

- Chemical precipitation
- Ion exchangers
- Ultra filtration
- Reverse osmosis
- Lectrolysis

Chemical precipitation

- The chemical precipitation of phosphorous from wastewater is currently accompanied by alum, lime or ferric salts and organic polymers. Simultaneously, the addition of these chemical reagents for phosphorous removal also removes many inorganic ions, mainly heavy metals
- In cases where industrial wastewater is treated alongside domestic wastewater, the addition of chemical reagents within the primary sedimentary installations may be necessary when on-site pretreatment measures are not efficient.

Ion exchangers

- The ion exchangers procedure boasts the widest use in domestic wastewater softening, where sodium ions, from a cationic exchange resin, exchanges the calcium and magnesium ions in the treated domestic wastewater, softening it. For the removal of the total dissolved substances, both anionic as well as cationic

exchange resins must be used.

Ultra filtration

- Ultra filtration systems are systems of porous membranes that are operated by means of pressure, which retain colloidal and dissolved matter. These systems differ from reverse osmosis systems through a relatively reduced operating pressure, usually under 1.034 kN/m2 .
- Ultra filtration is normally used to retain colloidal matter and macromolecules with a molecular weight over 5.000. Applications of ultra filtration include the retention of oils within the water and turbidity reduction

Reverse osmosis (hyper filtration)

- This is a process in which water is separated from dissolved salts in the mixture through filtration by means of a semi permeable membrane at a pressure greater than osmotic pressure at which wastewater salts are dissolved

Electrolysis

- In the process of electrolysis, ionic components of a mixture are separated by means of a selective semi permeable ion membrane.
- The application of an electric potential between to electrodes produces an electric current that passes through the mixture, producing a migration of the cations toward the negative electrode and of the anions toward the positive electrode. Due to the alternation of the cation permeable and anion permeable membrane spaces, concentrated or diluted salt cells are formed.

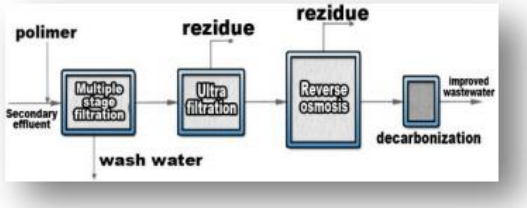


Figure 1. Technological scheme for the ultra filtration procedure

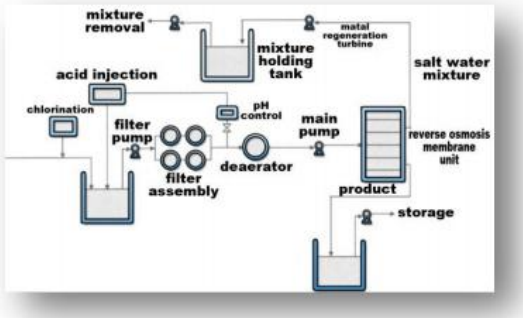
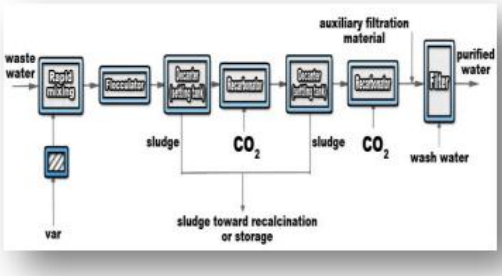


Figure 2. Technological scheme for single step reverse osmosis procedure

a) Single stage system



b) Two-stage system

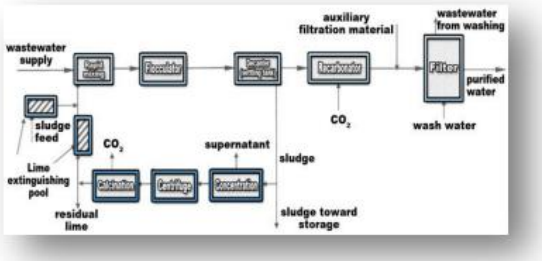


Figure 3. Technological schemes for phosphorous removal utilizing

Video Content / Details of website for further learning (if any):
Can be added as link : http://www.ijrdet.com/files/Volume3Issue4/IJRDET_1014_01.pdf

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.9-4.10)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture: 24.02.2020**

Topic of Lecture:

- Chemical oxidation

Introduction :

- Chemical oxidation is a process involving the transfer of electrons from an oxidizing reagent to the chemical species being oxidized. In water and wastewater engineering, chemical oxidation serves the purpose of converting putrescible pollutant substances to innocuous or stabilized products.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

- The Chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate.
- These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation.
- In general the oxidants have been capable of achieving high treatment efficiencies (e.g., > 90 percent) for unsaturated aliphatic (e.g., trichloroethylene [TCE]) and aromatic compounds (e.g., benzene), with very fast reaction rates (90 percent destruction in minutes).
- Field applications have clearly affirmed that matching the oxidant and in situ delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

Ozone addition

- Ozone gas can oxidize contaminants directly or through the formation of hydroxyl radicals. Like peroxide, ozone reactions are most effective in systems with acidic pH.
- The oxidation reaction proceeds with extremely fast, pseudo first order kinetics. Due to ozone's high reactivity and instability, O3 is produced onsite, and it requires closely spaced delivery points (e.g., air sparging wells).

- In situ decomposition of the ozone can lead to beneficial oxygenation and biostimulation.

Peroxide

- Oxidation using liquid hydrogen peroxide (H2O2) in the presence of native or supplemental ferrous iron (Fe+2) produces Fenton's Reagent which yields free hydroxyl radicals (OH-).
- These strong, nonspecific oxidants can rapidly degrade a variety of organic compounds. Fenton's Reagent oxidation is most effective under very acidic pH (e.g., pH 2 to 4) and becomes ineffective under moderate to strongly alkaline conditions. The reactions are extremely rapid and follow second-order kinetics.

Permanganate

- The reaction stoichiometry of permanganate (typically provided as liquid or solid KMnO4, but also available in Na, Ca, or Mg salts) in natural systems is complex.
- Due to its multiple valence states and mineral forms, Mn can participate in numerous reactions. The reactions proceed at a somewhat slower rate than the previous two reactions, according to second order kinetics.
- Depending on pH, the reaction can include destruction by direct electron transfer or free radical advanced oxidation—permanganate reactions are effective over a pH range of 3.5 to 12.

Limitations

The following factors may limit the applicability and effectiveness of chemcial oxidation include:

- Requirement for handling large quantities of hazardous oxidizing chemicals due to the oxidant demand of the target organic chemicals and the unproductive oxidant consumption of the formation.
- Some COCs are resistant to oxidation.
- There is a potential for process-induced detrimental effects. Further research and development is ongoing to advance the science and engineering of in situ chemical oxidation and to increase its overall cost effectivenes.

Video Content / Details of website for further learning (if any):
Can be added as link : https://frtr.gov/matrix2/section4/4_4.html

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.20-4.24)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture: 25.02.2020**

Topic of Lecture:

- Adsorption

Introduction :

- The process involves adsorption of organic compounds in the wastewater by the microbial slime layer, diffusion of air into the slime layer to provide the oxygen required for the biochemical oxidation of the organic compounds. The end products include carbon dioxide gas, water and other products of the oxidation.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Wastewaters containing heavy metals and other contaminants: mining applications

- One of the two major environmental problems concerning the management of liquids in mining and mining-related activities, particularly relevant to a country like Chile, is the natural generation of acidic mine drainages (AMD) or acidic rock drainages (ARD) produced by chemical and/or microbial oxidation of sulphides in the presence of air and water.
- Obviously, the other problem is the impact of industrial residual aqueous solutions originated in the metallurgical and mining processing plants. All these solutions exhibit an important amount of chemical contaminants, either dissolved or suspended, at concentrations that normally surpass the limit fixed by the national discharge regulations and their discard in an acceptable manner into surface and groundwater bodies is an imperious need

Wastewater treatment paths and their comparison to adsorption operations

Solubility driven treatments

- Precipitation operations widely used in the removal of heavy metals are implemented based on pH or the addition of counter-ions leading the formation of sparingly soluble compounds

Cementation and other electrochemically driven treatments

- Cementation operations correspond to spontaneous electrochemical reactions largely displaced towards the formation of the products. They have identical problems to those found in classic precipitation operations and, additionally, the process have to deal with the release of the reduction agent (R)

Membrane-based separation treatments

- This path includes ultrafiltration, nanofiltration and reverse osmosis. Ultrafiltration allows the removal of dissolved and colloidal materials.
- Isolated metal ions are difficult to remove directly due to their small sizes so the use of micelles and other complexing agents enhances its separation capabilities. Reverse osmosis removes a wide range of dissolved species from aqueous solutions; however, it has high power pumping requirements to restore the membranes.
- Membrane separation techniques have gone through significant progresses developing liquid membrane processes based on the formation of emulsions; however, there is still room for improvement with regard to their instability in salty and acidic conditions and fouling produced by other species present in the wastewater.
- Electrodialysis does not require the addition of external species to the wastewater, exhibits high selectivity and does not produce sludges, which makes it a promising technology. However, energy consumption and anodic/cationic membrane fouling is still a challenge.

Ion-exchange treatment

- Ion-exchange resins either natural or synthetic are selected when high treatment capacity, high efficiency and fast kinetics are required. The stronger resins are built on sulphonic or carboxylic groups.
- In both cases, the acidification of the aqueous media is commonly observed as it occurs in the case of solvent extraction using kerosene and implemented in countercurrent when using oximes. The only difference between ion exchange and solvent extraction would be that the organic phase would be in the dissolved phase in the organic phase rather than in the solid phase.

Froth flotation

- This process can be used to treat wastewaters contaminated with heavy metals and can be implemented following different technologies such as dissolved air flotation (DAF), electro flotation, ion flotation or precipitation flotation.
- DAF processes are based on the gas oversaturation and decompression producing micro bubbles that are able to separate small particles or agglomerates.
- The electro flotation process is associated with the water electrolysis producing the smallest bubble sizes of hydrogen and oxygen known at the industrial level.
- Ion flotation is based on ionic complex formation with surfactant molecules and subsequent frother-aided flotation.
- The precipitation flotation is a mixed technology between the precipitation followed by flotation operations (sulphide precipitation are commonly implemented).

Adsorption separation treatments

- In heterogeneous systems, whenever two immiscible states of the matter, namely

gas and liquid, gas and solid or liquid and solid, are set in contact they are separated by a surface layer having properties different to those of the two states forming it.

- When one or more components present in one of the two phases (or in both) tend towards increasing its concentration in the surface layer, it is said that the adsorption process is taking place

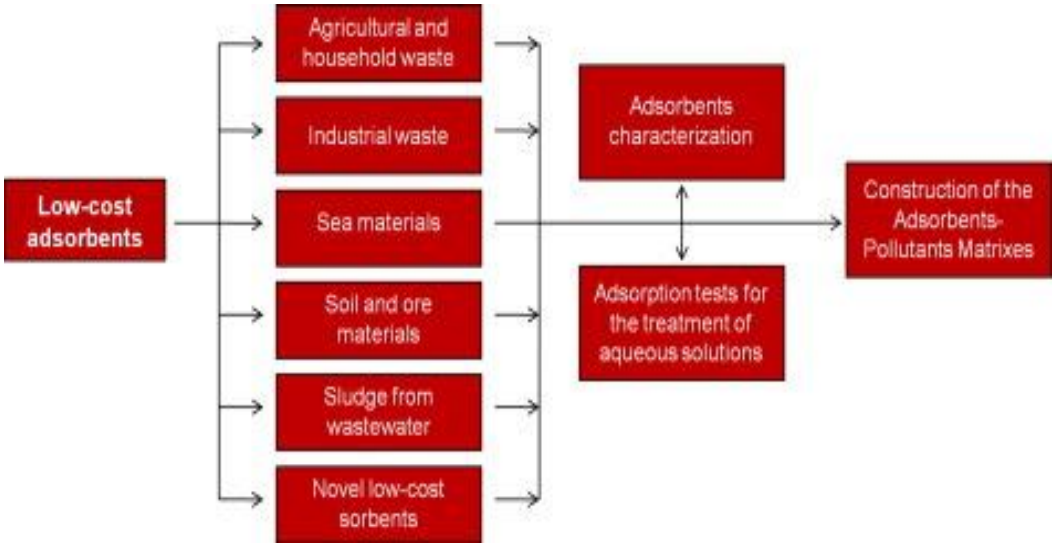
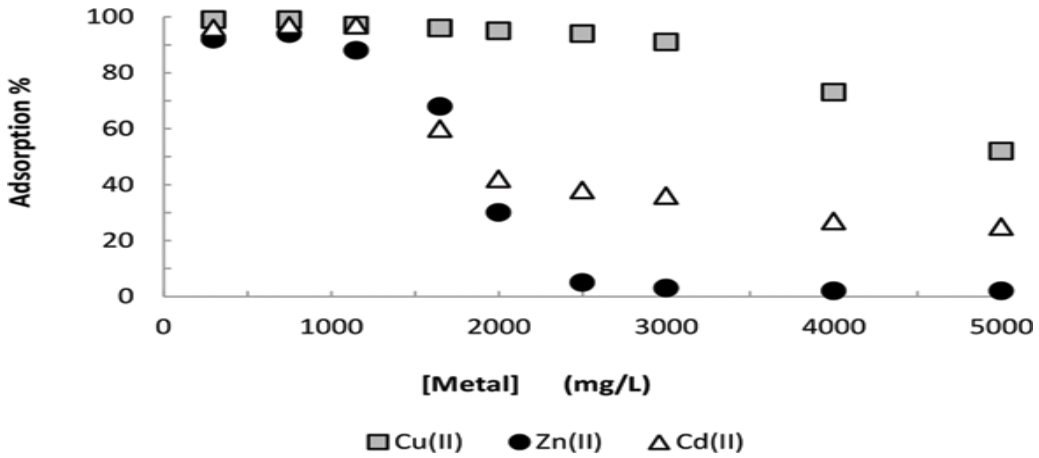


Fig. Adsorption of some metallic ions onto nanostructured calcium silicate.



Video Content / Details of website for further learning (if any):
Can be added as link : https://www.intechopen.com/books/physico-chemical-wastewater-treatment-and-resource-recovery/wastewater-treatment-through-low-cost-adsorption-technologies

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.24-4.31)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher : Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture:26.02.2020**

Topic of Lecture:

- Removal of dissolved inorganic

Introduction :

- The process of identifying a cost-effective treatment process should be undertaken Potential water treatment processes for inorganic contaminants can be grouped into three categories: physical, chemical, and biological. The goal of this article is to describe the physical treatment technologies that may be considered.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

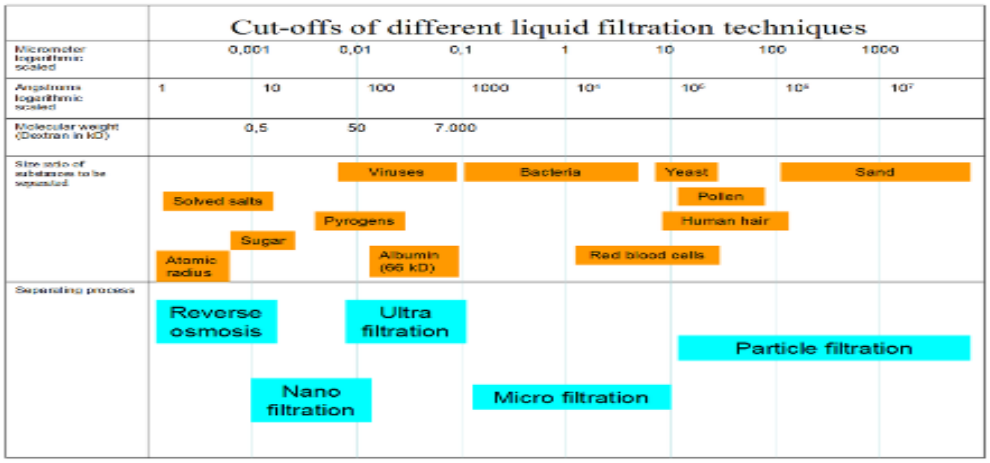
- Typical contaminants of concern in industrial waters include suspended metals, dissolved metals, nitrate, sulfate, and cyanide. Common metals and metalloids include arsenic, antimony, selenium, lead, copper, cadmium, and zinc.

Physical treatment technologies can be further divided into three categories:

- Clarification
  - Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation.[1] A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and/or thickening. Concentrated impurities, discharged from the bottom of the tank are known as sludge, while the particles that float to the surface of the liquid are called scum.
- Applications
  - Pretreatment
  - Potable water treatment
  - Waste water treatment
  - Mining
- Filtration
  - Deep bed filtration processes have been used in industrial and

municipal wastewater treatment, in combination with other unit operations, such as activated sludge, chemical coagulation, oxidation, reduction and ion exchange, etc.

- Membrane processes
  - Membrane separation processes have a very important role in the separation industry. Nevertheless, they were not considered technically important until the mid-1970s.
  - Membrane separation processes differ based on separation mechanisms and size of the separated particles. The widely used membrane processes include microfiltration, ultrafiltration, nanofiltration, reverse osmosis, electrolysis, dialysis, electro dialysis, gas separation, vapor permeation, evaporation, membrane distillation, and membrane contactors.
  - All processes except for evaporation involve no phase change. All processes except (electro) dialysis are pressure driven.
  - Microfiltration and ultra filtration is widely used in food and beverage processing (beer microfiltration, apple juice ultra filtration), biotechnological applications and pharmaceutical industry (antibiotic production, protein purification), water purification and wastewater treatment, the microelectronics industry, and others.
  - Nan filtration and reverse osmosis membranes are mainly used for water purification purposes. Dense membranes are utilized for gas separations (removal of CO2 from natural gas, separating N2 from air, organic vapor removal from air or a nitrogen stream) and sometimes in membrane distillation. The later process helps in the separation of azeotropic compositions reducing the costs of distillation processes.



Video Content / Details of website for further learning (if any):

Can be added as link : https://www.wateronline.com/doc/industrial-water-treatment-for-inorganic-contaminants-physical-treatment-processes-0001

Important Books/Journals for further learning including the page nos.

N.Mathan Kumar, Industrial Waste Management (Page.nos4.31-4.32)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture:02.03.2020**

Topic of Lecture:

- Combined treatment of industrial and municipal wastes

Introduction :

- The process of identifying a cost-effective treatment process should be undertaken Potential water treatment processes for inorganic contaminants can be grouped into three categories: physical, chemical, and biological. The goal of this article is to describe the physical treatment technologies that may be considered.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

- Typical contaminants of concern in industrial waters include suspended metals, dissolved metals, nitrate, sulfate, and cyanide. Common metals and metalloids include arsenic, antimony, selenium, lead, copper, cadmium, and zinc.

Physical treatment technologies can be further divided into three categories:

- Clarification
- Filtration
- Membrane processes

Clarification

- Clarification utilizes multiple processes to remove suspended particles, i.e., contaminants that are present in particulate form rather than dissolved. These processes include coagulation, flocculation, and settling. Except for the most rigorous membrane process (reverse osmosis), physical processes will generally not remove dissolved contaminants.

Types of clarification

Coagulation

- Coagulation is the process of adding a chemical coagulant to destabilize a stabilized charged particle, thereby allowing it to agglomerate with other particles.
- Common coagulants are ferric chloride or ferric sulfate, aluminum sulfate (alum), and proprietary chemicals provided by companies such as BASF and Nalco. Typical dosages are 10 to 100 ppm. Vigorous mixing is typically used during coagulation.

Flocculation

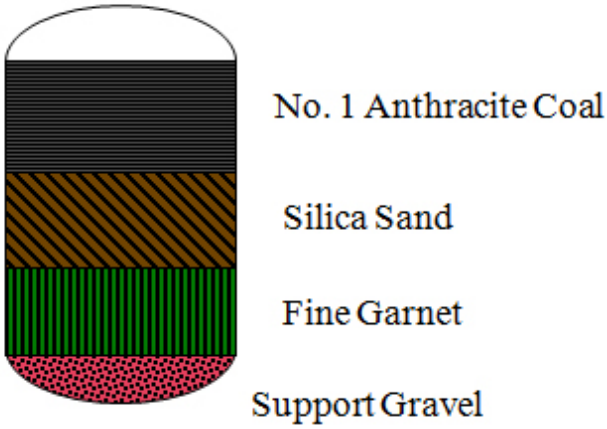
- Flocculation is the process, typically following coagulation or often used as a stand-alone technology, that promotes agglomeration and enhances particle settling.

During flocculation, gentle mixing accelerates the rate of particle collision, and destabilized particles are aggregated to create larger precipitates.

Filtration

- Filtration methods include bag filters, cartridge filters, sand filters, and multimedia filters. Multimedia filters which typically utilize anthracite coal, sand, and garnet, are probably the most common filters now in use.
- These filters are pressure vessels that use downflow operation to remove suspended contaminants and a periodic upflow backwash to transfer these contaminants to a waste stream. Backwashing can be triggered via an adjustable differential pressure switch, a timer (e.g., every 12 hours), or manually (the operator pushes a "backwash" button).

Typical Multimedia Filter



Membrane processes

- The most common membrane technologies are microfiltration, ultrafiltration, nanofiltration, and reverse osmosis. These have been listed in order of decreasing pore size, increasing removal efficiency, and increasing pressure requirements.
- Microfiltration (MF) is the most common membrane process. It provides "sterile filtration" by utilizing pore sizes of 0.05 to 3 microns. MF removes most suspended solids but no dissolved contaminants.
- Ultrafiltration (UF) is a "tighter" membrane technology than MF in that it removes colloidal particles, polymers, and bio-molecules. UF (Figure 7) utilizes pore sizes of 0.03 to 0.1 micron and operates at pressures of 30 to 150 psi. UF also does not remove dissolved contaminants.

Video Content / Details of website for further learning (if any):
Can be added as link : https://www.wateronline.com/doc/industrial-water-treatment-for-inorganic-contaminants-physical-treatment-processes-0001

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.36-4.38)

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LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture:03.03.2020**

Topic of Lecture:

- Residue management

Introduction :

- The residue that accumulates in sewage treatment plants is called sludge (or biosolids). Sewage sludge is the solid, semisolid, or slurry residual material that is produced as a by-product of wastewater treatment processes.
- This residue is commonly classified as primary and secondary sludge. Primary sludge is generated from chemical precipitation, sedimentation, and other primary processes, whereas secondary sludge is the activated waste biomass resulting from biological treatments.
- Some sewage plants also receive septage or septic tank solids from household on-site wastewater treatment systems. Quite often the sludges are combined together for further treatment and disposal.

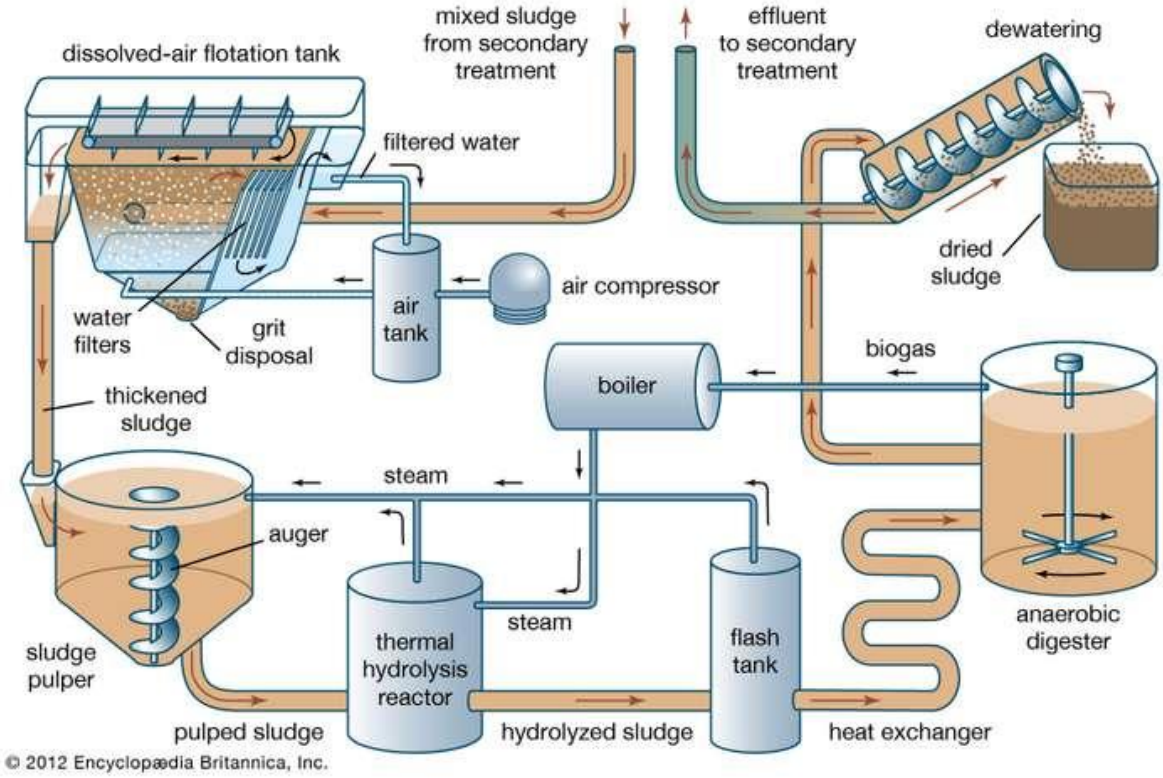
Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

- Sewage sludge treatment using thermal hydrolysis and anaerobic digestionMixed sludge received from secondary wastewater treatment is passed through a dissolved-air flotation tank, where solids rise to the surface and are skimmed off.
- The thickened sludge is pulped with steam, then passed to thermal hydrolysis, where large molecules such as proteins and lipids are broken down under heat and pressure.
- The hydrolyzed sludge is passed through a flash tank, where a sudden drop in pressure causes cells to burst, and then to anaerobic digestion, where bacteria convert dissolved organic matter to biogas (which can be used to fuel the treatment process).

- Digested sludge is passed through a dewatering step; the dried solids are disposed of, and the water is sent back to secondary treatment.
- Treatment and disposal of sewage sludge are major factors in the design and operation of all wastewater treatment plants.
- Two basic goals of treating sludge before final disposal are to reduce its volume and to stabilize the organic materials.
- Stabilized sludge does not have an offensive odour and can be handled without causing a nuisance or health hazard. Smaller sludge volume reduces the costs of pumping and storage.



Video Content / Details of website for further learning (if any):
Can be added as link :https://www.britannica.com/technology/wastewater-treatment/Sludge-treatment-and-disposal

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.38-4.39)

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L36

LECTURE HANDOUTS

MECH

II / IV

Course Name with Code : Industrial Waste Management /16CEE09

Course Teacher :Mr.G.Sankar AP/Civil

Unit : Treatment Technologies **Date of Lecture:04.03.2020**

Topic of Lecture:

- Dewatering - disposal

Introduction :

- The residue that accumulates in sewage treatment plants is called sludge (or biosolids). Sewage sludge is the solid, semisolid, or slurry residual material that is produced as a by-product of wastewater treatment processes. This residue is commonly classified as primary and secondary sludge.
- Primary sludge is generated from chemical precipitation, sedimentation, and other primary processes, whereas secondary sludge is the activated waste biomass resulting from biological treatments. Some sewage plants also receive septage or septic tank solids from household on-site wastewater treatment systems. Quite often the sludges are combined together for further treatment and disposal.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Types of industrial and its waste
- Waste management techniques

Detailed content of the Lecture:

Treatment methods

- Treatment of sewage sludge may include a combination of thickening, digestion, and dewatering processes.

Thickening

- Thickening is usually the first step in sludge treatment because it is impractical to handle thin sludge, a slurry of solids suspended in water. Thickening is usually accomplished in a tank called a gravity thickener. A thickener can reduce the total volume of sludge to less than half the original volume. An alternative to gravity thickening is dissolved-air flotation. In this method, air bubbles carry the solids to the surface, where a layer of thickened sludge forms.

Digestion

- Sludge digestion is a biological process in which organic solids are decomposed into stable substances. Digestion reduces the total mass of solids, destroys pathogens, and makes it easier to dewater or dry the sludge. Digested sludge is inoffensive, having the appearance and characteristics of a rich potting soil.

Dewatering

- Digested sewage sludge is usually dewatered before disposal. Dewatered sludge still contains a significant amount of water—often as much as 70 percent—but, even with that moisture content, sludge no longer behaves as a liquid and can be handled as a solid material. Sludge-drying beds provide the simplest method of dewatering.
- A digested sludge slurry is spread on an open bed of sand and allowed to remain until dry. Drying takes place by a combination of evaporation and gravity drainage through the sand.
- A piping network built under the sand collects the water, which is pumped back to the head of the plant. After about six weeks of drying, the sludge cake, as it is called, may have a solids content of about 40 percent. It can then be removed from the sand with a pitchfork or a front-end loader.
- In order to reduce drying time in wet or cold weather, a glass enclosure may be built over the sand beds. Since a good deal of land area is needed for drying beds, this method of dewatering is commonly used in rural or suburban towns rather than in densely populated cities.
- Alternatives to sludge-drying beds include the rotary drum vacuum filter, the centrifuge, and the belt filter press. These mechanical systems require less space than do sludge-drying beds, and they offer a greater degree of operational control.
- However, they usually have to be preceded by a step called sludge conditioning, in which chemicals are added to the liquid sludge to coagulate solids and improve drain ability.

Disposal

- The final destination of treated sewage sludge usually is the land. Dewatered sludge can be buried underground in a sanitary landfill. It also may be spread on agricultural land in order to make use of its value as a soil conditioner and fertilizer. Since sludge may contain toxic industrial chemicals, it is not spread on land where crops are grown for human consumption.
- Where a suitable site for land disposal is not available, as in urban areas, sludge may be incinerated. Incineration completely evaporates the moisture and converts the organic solids into inert ash. The ash must be disposed of, but the reduced volume makes disposal more economical. Air pollution control is a very important consideration when sewage sludge is incinerated. Appropriate air-cleaning devices such as scrubbers and filters must be used.
- Dumping sludge in the ocean, once an economical disposal method for many coastal communities, is no longer considered a viable option. It is now prohibited in the United States and many other coastal countries.

Video Content / Details of website for further learning (if any):
Can be added as link :https://www.britannica.com/technology/wastewater-treatment/Dewatering

Important Books/Journals for further learning including the page nos.
N.Mathan Kumar, Industrial Waste Management (Page.nos4.38-4.39)

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LECTURE HANDOUTS

L37

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP / CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 07.03.2020**

Topic of Lecture: Introduction to Hazardous Waste

Introduction : (Maximum 5 sentences)

- ✓ Hazardous wastes are those that may contain toxic substances generated from industrial, hospital, some types of household wastes.
- ✓ These wastes could be corrosive, inflammable, explosive, or react when exposed to other materials.
- ✓ Radioactive waste was generated from use of radioactivity, in many but not all cases.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

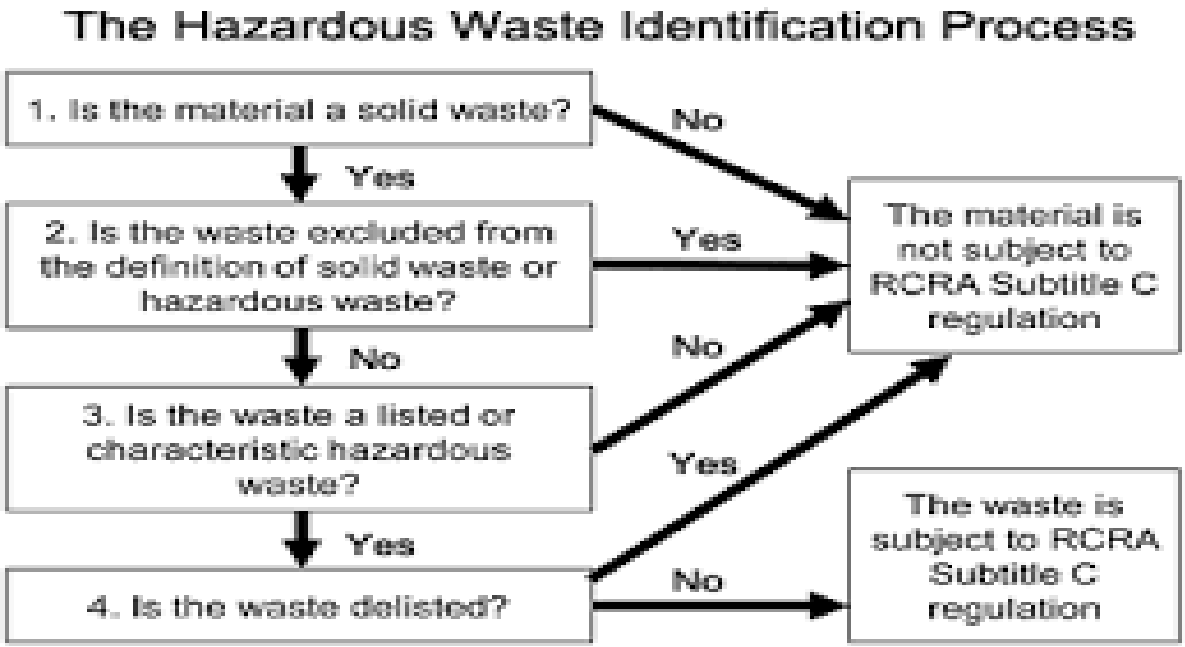
- ✓ A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may

  (a) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

  (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.
- ✓ This broad statutory definition provides a general indication of which wastes Congress intended to regulate as hazardous, but it obviously does not provide the clear distinctions

necessary for industrial waste handlers to determine whether their wastes pose a sufficient threat to warrant regulation or not.

- ✓ Congress instructed EPA to develop more specific criteria for defining hazardous waste.
- ✓ There are therefore two definitions of hazardous waste under the RCRA program: a statutory definition and a regulatory definition.
- ✓ The statutory definition cited above is seldom used today.
- ✓ It served primarily as a general guideline for EPA to follow in developing the regulatory definition of hazardous waste.
- ✓ The regulatory definition is an essential element of the current RCRA program.
- ✓ It precisely identifies which wastes are subject to RCRA waste management regulations.
- ✓ Congress asked EPA to fulfill the task of developing a regulatory definition of hazardous waste by using two different mechanisms: by listing certain specific wastes as hazardous and by identifying characteristics which, when present in a waste, make it hazardous.
- ✓ Following its statutory mandate, EPA developed a regulatory definition of hazardous waste that incorporates both listings and characteristics.



Video Content / Details of website for further learning (if any):

1. https://www.epa.gov/sites/production/files/2015-09/documents/hwid05.pdf

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.

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LECTURE HANDOUTS

L38

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

CourseFaculty :Mr.G.Sankar, AP /CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 09.03.2020**

Topic of Lecture: Classification of Hazardous Waste

Introduction : (Maximum 5 sentences)

- ✓ When it comes to **hazardous waste disposal** and management, understanding the waste your organization generates is imperative.
- ✓ Hazardous waste is heavily regulated, and thus cannot just be tossed out with your everyday trash. T
- ✓ o know if your organization is handling hazardous waste, the first step is to assess its characteristics.
- ✓ If you need help assessing your organization's waste, call us at **800-936-2311**.
- ✓ We specialize in providing businesses and organizations with affordable nationwide hazardous waste disposal services.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

When categorizing hazardous waste, the EPA breaks it down by four characteristics:

- ✓ ignitability, or something flammable
- ✓ corrosivity, or something that can rust or decompose
- ✓ reactivity, or something explosive
- ✓ toxicity, or something poisonous

These high level categories each have their own characteristics that further help you as a generator define with what you are dealing.

Ignitability:

- ✓ There are three types of ignitable forms:
- ✓ Liquids with a flash point–the lowest temperature at which fumes above waste ignite–of 60 degrees Celsius or 140 degrees Fahrenheit. Examples include alcohol, gasoline, and acetone.
- ✓ Solids that spontaneously combust.
- ✓ Oxidizers and compressed gasses.

Corrosivity:

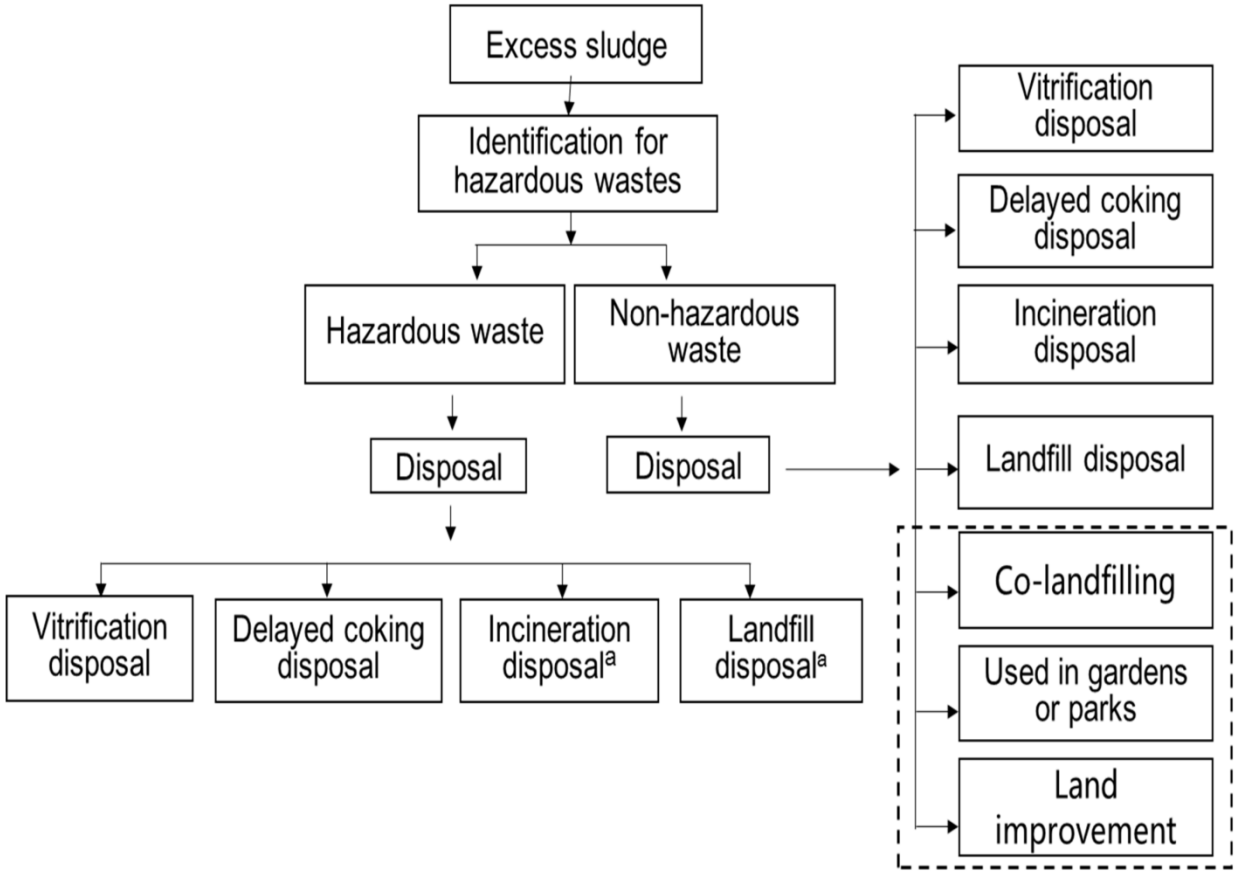
- ✓ Corrosive substances, such as hydrochloric acid, nitric acid, and sulfuric acid, have the ability eat through containers, causing the leakage of harmful materials.
- ✓ A corrosive is anything liquid with a pH of less than or equal to 2 or greater than or equal to 12.5, or has the ability to corrode steel.
- ✓ Everyday example of corrosives includes battery acid and rust removers.

Reactivity:

- ✓ Given their instability, reactive wastes can be very dangerous.
- ✓ The EPA recognizes that there are too many conditions and situations to identify all types of reactive materials. However, they use the following as guidelines to assist generators:
- ✓ unstable, and routinely experiences violent change without detonating
- ✓ potential for explosive mixture or violent reaction when combined with water
- ✓ toxic gasses are released when mixed with water

Toxicity:

- ✓ Poisonous materials pose a threat to our groundwater, which can have long term effects to human health and the environment.
- ✓ This is different from the first three characteristic groups, which the EPA views as containing immediate and firsthand dangers.
- ✓ There are 60 contaminants on the toxicity characteristics list.
- ✓ These contaminants are identified solely through a test method called Toxicity Characteristic Leaching Procedure or TCLP.
- ✓ As a generator of any the above, you have two options to determine which characteristics above best define the waste you generate: test it, or use appliedknowledge from previous company records or industry data and studies.



Video Content / Details of website for further learning (if any):

1. https://www.hazardouswasteexperts.com/understanding-the-four-characteristics-of-hazardous-waste/

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.9

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LECTURE HANDOUTS

L39

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP/CIVIL

Unit : V Hazardous Waste Management **Date of Lecture:10.03.2020**

Topic of Lecture: Physical Treatment

Introduction : (Maximum 5 sentences)

- ✓ One method used to treat hazardous waste biologically is called landfarming.
- ✓ Physical treatment, on the other hand, concentrates, solidifies, or reduces the volume of the waste.
- ✓ Physical processes include evaporation, sedimentation, flotation, and filtration

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

Physical Treatment Methods:

- ✓ Various physical treatment methods adopted in industry are: adsorption, resin adsorption, sedimentation, electro dialysis, reverse osmosis, solvent extraction, distillation, evaporation and filtration.

Adsorption:

- ✓ Adsorption on activated carbon occurs when a molecule is brought up to its surface and held there by physical and /or chemical forces.
- ✓ This process is reversible, thus allowing activated carbon to be regenerated and reused by proper application of heat and steam, or solvent.

- ✓ Greater surface area produces greater adsorption capacity [e.g: Activated carbon has large surface area (500-1500 m2/g)]
- ✓ Adsorptivity increases as the solubility of the solute (in solvent) decreases. Thus, for

Resin adsorption:

Waste treatment by resin involves two basic steps:

- ✓ Contacting the liquid waste stream with resin and allowing the resin to absorb the solutes from the solution; and
- ✓ Subsequently regenerating the resins by removing the adsorbed chemicals, by simply washing with proper solvent.

Sedimentation:

- ✓ Sedimentation is a physical process whereby particles suspended in a liquid settle by means of gravity.
- ✓ The fundamental elements of most sedimentation processes are:

Electro-dialysis:

- ✓ The electro-dialysis involves the separation of an aqueous stream (more concentrated in electrolyte than the original) and a depleted stream.
- ✓ Success of the process depends on special synthetic membranes, usually based on ion-exchange resins, which are permeable only to a single type of ion.

Reverse osmosis:

- ✓ This technique which is most widely used consists of a membrane permeable to solvent but impermeable to most dissolved species, both organic and inorganic.
- ✓ Cellulose acetate membranes were used in the past, but nowadays polysulphones and polyamides are increasingly popular for use at high pH values.
- ✓ Because of the susceptibility of the membranes to chemical attack and fouling, and the susceptibility of the flow system to plugging and erosion, it is common to preprocess the feed water to remove oxidising materials. T

Solvent extraction:

- ✓ Solvent extraction is the separation of the constituents of a liquid solution by contact with another immiscible liquid. If the substances comprising the original solution distribute themselves differently between the two liquid phases, a certain degree of separation will result and this may be enhanced by the use of multiple contacts. The major application of solvent extraction to waste treatment has been in the removal of phenol from by-product water produced in coal coking, petroleum refining, and chemical synthesis that involve

phenol.

Distillation:

- ✓ Distillation is expensive and energy intensive and can probably be justified only in cases where valuable product recovery is feasible (e.g., solvent recovery).
- ✓ This technique has only limited application in the treatment of dilute aqueous hazardous wastes.

Evaporation:

- ✓ Evaporation process is used for the treatment of hazardous waste such as radioactive liquids and sludges and concentrating of plating and paint solvent waste among many other applications
- ✓ The major disadvantages of evaporation are high capital and operating costs and high energy requirements. This process is more adaptable to waste waters with high concentrations of pollutants.

Filtration:

- ✓ Filtration is well-developed economical process used in the full scale treatment of many industrial waste waters and waste sludges.
- ✓ Energy requirements are relatively low, and operational parameters are well defined.
- ✓ However it is not a primary treatment process and is often used in conjunction with precipitation, flocculation, and sedimentation to remove these solids.

Flocculation:

- ✓ The various phenomena that occur during flocculation can be grouped in to two sequential mechanisms.
- ✓ Chemically induced destabilisation of repulsive surface related forces, thus allowing particles to stick together when they touch and Chemical bridging and physical enmeshment between the non repelling particles, allowing for the formation of large particles.

Video Content / Details of website for further learning (if any):

1. http://www.yourarticlelibrary.com/essay/hazard-waste-treatment-hwt-technologies-physical-and-chemical-treatment-methods/27478

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.24

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LECTURE HANDOUTS

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MECH

II / IV

Course Name with Code : Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP/CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 11.03.2020**

Topic of Lecture: Chemical Treatment

Introduction : (Maximum 5 sentences)

- ✓ Chemical treatment transforms waste into less hazardous substances using such techniques as pH neutralisation, oxidation or reduction, and precipitation.
- ✓ Biological treatment uses microorganisms to degrade organic compounds in the waste stream.
- ✓ Thermal destruction processes include incineration, which is increasingly becoming a preferred option for the treatment of hazardous wastes, and pyrolysis, which is the chemical decomposition of waste, is brought about by heating the material in the absence of oxygen.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

Chemical Treatment Methods:

- ✓ Chemical treatment of wastes will help us to transform high hazardous waste to lesser hazardous nature.
- ✓ Chemical treatment also helps us to recover valuable bi-products from Hazardous wastes,

thus by reducing overall costs of the disposal of wastes. Thus chemical treatment options shall be adopted before the consideration of land fill options.

- ✓ Different chemical treatment processes adopted in hazardous waste management industries are: solubility, neutralization, precipitation, coagulation and flocculation, oxidation and reduction, ion exchange method

Solubility:

- ✓ Hazardous waste may be organic and inorganic containing various chemical elements and with various structural configurations. Water, known as the universal solvent, will dissolve many of these substances, while others have only limited water solubility.
- ✓ Solubility of various salts inorganic and organic is utilized as a means of treatment of hazardous waste when waste water treatment facilities are available and land fill options are limited

Neutralization:

- ✓ Neutralization of acids and alkaline waste streams is an example of the use of chemical treatment to mitigate waste characterized as corrosive.
- ✓ Neutralization of an acid or base is easily determined by measuring its pH.
- ✓ Acid based reactions are most common chemical process used in hazardous waste treatment.
- ✓ Neutralization prior to land fill will be necessary so that inter reactions are avoided in land fill.
- ✓ As neutralization process is exothermic in nature, if pre-neutralization did not take place, temperature of land fill layers increase and thus by damaging liners

Precipitation:

- ✓ Often undesirable heavy metals are present in liquid and solid wastes which are in slurry form. Simple precipitation.
- ✓ The usual method of removal of in organic heavy metals is chemical precipitation. Metals precipitate at varying pH levels depending on the metal ion, resulting in the formation of an insoluble salt.
- ✓ Hence neutralization of an acidic waste stream can cause precipitation of heavy metals.
- ✓ They hydroxides of heavy metals are usually insoluble so lime or caustic is commonly used to precipitate them.

Coagulation and flocculation:

- ✓ Precipitation is greatly improved by adding coagulants.

- ✓ Most commonly used co-agulant is alum. Many poly electrolytes are used as coagulants.
- ✓ These coagulants neutralize the charge of colloids in suspended condition thus by allowing them to settle rapidly.
- ✓ Oxidation and Reduction:
- ✓ The chemical processes of oxidation and reduction can be used to convert toxic pollutants to harmless or less toxic substances.
- ✓ Heavy metals wastes are subjected to reduction process to precipitate to safer compounds of heavy metals.
- ✓ Example is Hexavalent chromium is precipitated into trivalent chromic hydroxide. Similarly alkaline chlorination of cyanide neutralizes highly toxic cyanide wastes.

Ion exchange methods:

- ✓ Ion exchange is reversible exchange of ions between liquid and solid phases.
- ✓ Ions held by electrostatic forces to charged functional groups on the surface of an insoluble solids are replaced by ions of similar charge in a solution Ion exchange is stoichiometric, reversible and selective removal of dissolved ionic species.

Video Content / Details of website for further learning (if any):

1. https://www.britannica.com/technology/hazardous-waste-management/Treatment-storage-and-disposal

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.24

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LECTURE HANDOUTS

L41

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP / CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 16.03.2020**

Topic of Lecture: Physical, Chemical / Physic – Chemical Treatment

Introduction : (Maximum 5 sentences)

- ✓ The chemical, thermal, and biological treatment methods outlined above change the molecular form of the waste material.
- ✓ Physical treatment, on the other hand, concentrates, solidifies, or reduces the volume of the waste.
- ✓ Physical processes include evaporation, sedimentation, flotation, and filtration.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

Treatment, Storage and Disposal

- ✓ Several options are available for hazardous-waste management.
- ✓ The most desirable is to reduce the quantity of waste at its source or to recycle the materials for some other productive use.
- ✓ Nevertheless, while reduction and recycling are desirable options, they are not regarded as the final remedy to the problem of hazardous-waste disposal.
- ✓ There will always be a need for treatment and for storage or disposal of some amount of hazardous waste.

Treatment

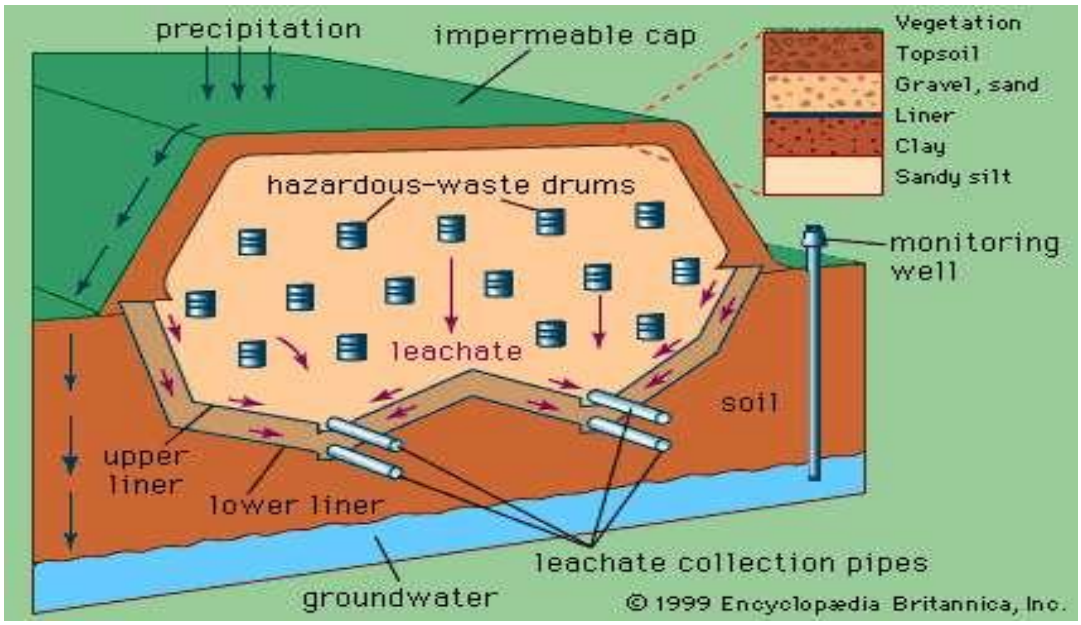
- ✓ Hazardous waste can be treated by chemical, thermal, biological, and physical methods. Chemical methods include ion exchange, precipitation, oxidation and reduction, and neutralization.
- ✓ Among thermal methods is high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.
- ✓ Special types of thermal equipment are used for burning waste in either solid, liquid, or sludge form.
- ✓ These include the fluidized-bed incinerator, multiple-hearth furnace, rotary kiln, and liquid-injection incinerator.
- ✓ One problem posed by hazardous-waste incineration is the potential for air pollution.
- ✓ Biological treatment of certain organic wastes, such as those from the petroleum industry, is also an option.
- ✓ One method used to treat hazardous waste biologically is called landfarming. In this technique the waste is carefully mixed with surface soil on a suitable tract of land.
- ✓ Microbes that can metabolize the waste may be added, along with nutrients.
- ✓ In some cases a genetically engineered species of bacteria is used.
- ✓ Food or forage crops are not grown on the same site.
- ✓ Microbes can also be used for stabilizing hazardous wastes on previously contaminated sites; in that case the process is called bioremediation.
- ✓ The chemical, thermal, and biological treatment methods outlined above change the molecular form of the waste material.
- ✓ Physical treatment, on the other hand, concentrates, solidifies, or reduces the volume of the waste.
- ✓ Physical processes include evaporation, sedimentation, flotation, and filtration. Yet another process is solidification, which is achieved by encapsulating the waste in concrete, asphalt, or plastic.
- ✓ Encapsulation produces a solid mass of material that is resistant to leaching. Waste can also be mixed with lime, fly ash, and water to form a solid, cementlike product.

Surface storage and land disposal:

- ✓ Hazardous wastes that are not destroyed by incineration or other chemical processes need to be disposed of properly.
- ✓ For most such wastes, land disposal is the ultimate destination, although it is not an

attractive practice, because of the inherent environmental risks involved.

- ✓ Two basic methods of land disposal include landfilling and underground injection.
- ✓ Prior to land disposal, surface storage or containment systems are often employed as a temporary method.
- ✓ Temporary on-site waste storage facilities include open waste piles and ponds or lagoons.
- ✓ New waste piles must be carefully constructed over an impervious base and must comply with regulatory requirements similar to those for landfills.
- ✓ The piles must be protected from wind dispersion or erosion.
- ✓ If leachate is generated, monitoring and control systems must be provided.
- ✓ Only noncontainerized solid, nonflowing waste material can be stored in a new waste pile, and the material must be landfilled when the size of the pile becomes unmanageable.
- ✓ A common type of temporary storage impoundment for hazardous liquid waste is an open pit or holding pond, called a lagoon.



Video Content / Details of website for further learning (if any):

1. https://www.britannica.com/technology/hazardous-waste-management/Treatment-storage-and-disposal

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.24

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LECTURE HANDOUTS

L42

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP /CIVIL

Unit : VHazardous Waste Management **Date of Lecture:17.03.2020**

Topic of Lecture: Solidification

Introduction : (Maximum 5 sentences)

- ✓ Solidification and stabilization (denoted hereafter as S/S) waste treatment processes involve mixing specialized additives or reagents with hazardous waste materials to reduce, by physical or chemical means, the solubility or mobility of contaminants in the surrounding environmental matrix.
- ✓ Solidification and stabilization are closely related; both use several chemical, physical, and thermal processes, or an appropriate combination of them, to detoxify hazardous wastes.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

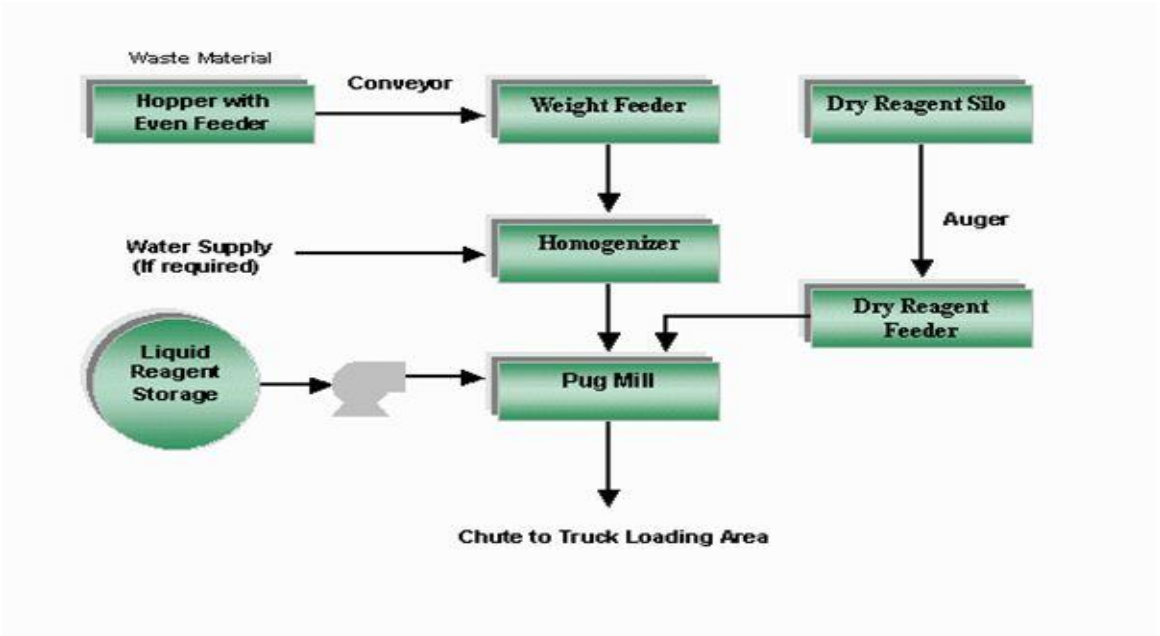
- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:
Solidification:

- ✓ Solidification refers to processes that encapsulate a waste to form a solid material and to restrict the migration of contaminant by decreasing the available surface area, which is exposed to leaching, when contacting liquids and also by coating the waste with lowpermeability materials.
- ✓ Solidification can be accomplished by a chemical reaction between the hazardous waste and the binding (solidifying) reagents or by the application of mechanical processes (e.g., compaction).

Stabilization:

- ✓ Stabilization refers to processes that involve chemical reactions, which reduce the leachability of the product (stabilized waste).
- ✓ Stabilization immobilizes the hazardous materials or reduces their solubility through appropriate chemical reactions.
- ✓ The physical nature of the waste may or may not be changed by this process.
- ✓ The S/S technology may not be applicable at polluted sites, containing wastes that include organic compounds, especially when volatile organic contaminants are present.
- ✓ The application of mixing and heating processes, associated with the hydration of binders, may release organic vapors.
- ✓ Pretreatment, such as air stripping or incineration, may be used to remove the volatile organics during preliminary treatment and to prepare the waste for the S/S of residues.
- ✓ The chemical composition of the contaminated matrix, the amount of water present, and the ambient temperature also affect the application of S/S technologies.



Video Content / Details of website for further learning (if any):

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/047147844X.ww237

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.41

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LECTURE HANDOUTS

L43

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP/CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 18.03.2020**

Topic of Lecture: Incineration process

Introduction : (Maximum 5 sentences)

- ✓ Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment".
- ✓ Incineration of waste materials converts the waste into ash, flue gas and heat.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

Waste incineration is one of many societal applications of combustion. The typical waste-incineration facility includes the following operations:

Waste storage and feed preparation.

- ✓ Combustion in a furnace, producing hot gases and a bottom ash residue for disposal.
- ✓ Gas temperature reduction, frequently involving heat recovery via steam generation.
- ✓ Treatment of the cooled gas to remove air pollutants, and disposal of residuals from this treatment process.
- ✓ Dispersion of the treated gas to the atmosphere through an induced-draft fan and stack.
- ✓ There are many variations to the incineration process, but these unit operations are

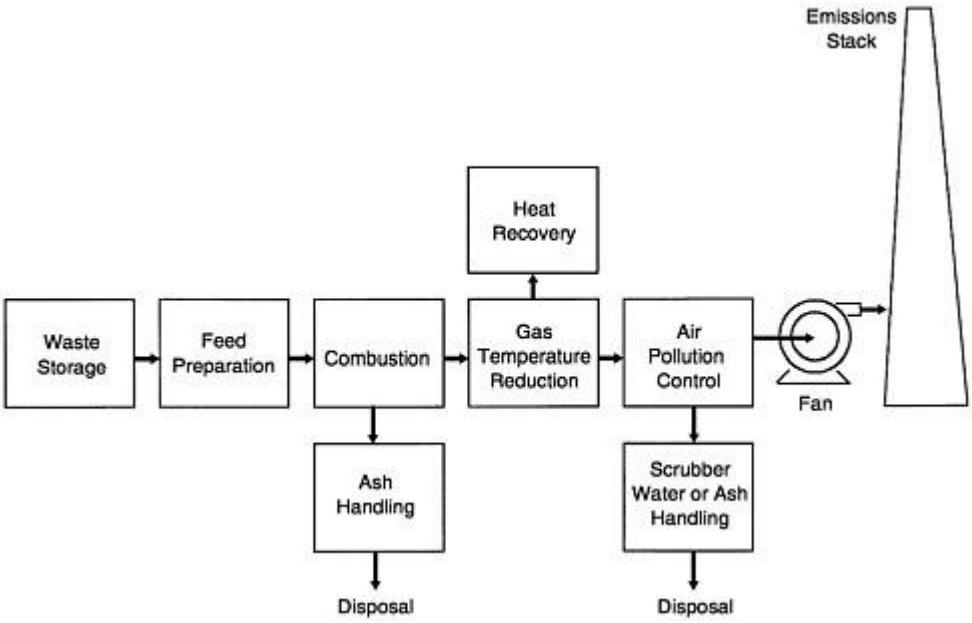
common to most facilities.

Waste Storage, Feed Preparation, and Feeding

- ✓ The common waste storage, waste staging, feed preparation and feeding practices for municipal solid-waste, hazardous-waste, and medical-waste incinerators.
- ✓ These practices are highly waste-and facility-specific.

Proper design and operation of these "front-end" plant operations are important for several reasons:

- ✓ While the plant is operating, the potential for worker exposure to hazardous materials is the greatest in this part of the facility.
- ✓ Without appropriate engineered and administrative controls, including personnel protective equipment, operators can be exposed to hazardous dust and vapors.
- ✓ This part of the plant is the highest potential source of fugitive dust and vapor emissions to the environment, and the greatest potential fire hazard.
- ✓ Without proper waste preparation and feeding, the furnace combustion performance may be impaired.



Combustion Processes

General Considerations:

- ✓ Combustion is a rapid, exothermic reaction between a fuel and oxygen (O2).
- ✓ In incineration applications, the fuel is predominately waste (although fossil fuels may be co-fired) and the oxygen source is air.
- ✓ Combustion produces many of the same stable end products, whether the material burned is natural gas, coal, wood, gasoline, municipal solid waste, hazardous waste, or medical

waste.

- ✓ The flame zone of a well-designed incinerator is sufficiently hot to break down all organic and many inorganic molecules, allowing reactions between most volatile components of the waste and the oxygen and nitrogen (N2) in air.
- ✓ The predominant reactions are between carbon (C) and oxygen, producing carbon dioxide (CO2), and between hydrogen (H) and oxygen, producing water vapor (H2O). Incomplete combustion of organic compounds in the waste feedstream produces some carbon monoxide (CO) and carbon-containing particles.
- ✓ Hydrogen also reacts with organically-bound chlorine to produce hydrogen chloride (HCl).
- ✓ In addition, many other reactions occur, producing sulfur oxides (SOx) from sulfur compounds, nitrogen oxides (NOx) from nitrogen compounds (and, a little, from the nitrogen in the air), metal oxides from compounds of some metals, and metal vapors from compounds of others.

Video Content / Details of website for further learning (if any):

1. https://www.nap.edu/read/5803/chapter/5#37

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.51

Course Faculty

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MUTHAYAMMAL ENGINEERING COLLEGE

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LECTURE HANDOUTS

L44

MECH

II / IV

Course Name with Code :Industrial Waste Management&16CEE09

Course Faculty :Mr.G.Sankar, AP /CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 21.03.2020**

Topic of Lecture: Incineration process

Introduction : (Maximum 5 sentences)

- ✓ Incineration is the most direct way to treat and dispose of hazardous waste.
- ✓ With mature and reliable technology that adapts through its design to every type of waste, Veolia's Hazardous Waste to Energy facilities can help customers meet stable operation, easy maintenance, reasonable economics, scientific management, environmental protection and health and safety goals.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

Detailed content of the Lecture:

Challenges:

- ✓ Increase of waste generation
- ✓ Difficulties for industrial to tackle by themselves waste they produce
- ✓ Lack of proper technologies
- ✓ Strict regulation and standards to be respected

Objectives:

- ✓ Destroy hazardous waste that are not recyclable or landfillable
- ✓ Implement a hazardous waste management system that is in compliance with the strict

regulations

Our solutions:

- ✓ High temperature incineration

  High Temperature Incineration is proven safe for hazardous organic chemicals and materials not suitable for other treatments.
- ✓ It's considered as the most environmentally friendly choice for chemicals and high-density materials: some waste including persistent organic pollutants and high-density materials must be destroyed with the highest level of security in accordance with the law and commercial security.
- ✓ Incineration under high temperature is widely used and effective. This process – with temperatures above 1100°C – achieves a destruction rate of 99.99% and is the best way to thoroughly destroy hazardous waste, whether it be excess and expired products, laboratory waste and reagents, electronic waste or contaminated soil.

Our expertise:

- ✓ Destruction of hazardous waste at a cost-effective price
- ✓ Energy recovery
- ✓ The security of complete cradle-to-grave services, from collection and transportation of your hazardous waste materials, through the final disposal of any ash or other residue in a secure land disposal facility
- ✓ A full-range incineration system that includes both rotary kilns and fixed-hearth incineration technology for the ultimate in flexibility for handling your most difficult hazardous wastes
- ✓ The ability to handle bulk or drummed wastes, eliminating the expense of special containers or special packaging of your wastes

Video Content / Details of website for further learning (if any):

1. https://www.veolia.in/our-services/incineration-hazardous-waste

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.52

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LECTURE HANDOUTS

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MECH

II / IV

Course Name with Code : Industrial Waste Management&16CEE09

Course Faculty : Mr.G.Sankar, AP /CIVIL

Unit : V Hazardous Waste Management **Date of Lecture: 23.03.2020**

Topic of Lecture: Secured landfill

Introduction : (Maximum 5 sentences)

- ✓ Hazardous waste disposal must be deposited in so-called secure landfills, which provide at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table.
- ✓ A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems.

Prerequisite knowledge for Complete understanding and learning of Topic:
(Max. Four important topics)

- ✓ Sources of waste
- ✓ Treatment methods
- ✓ Treatment technologies
- ✓ Waste management

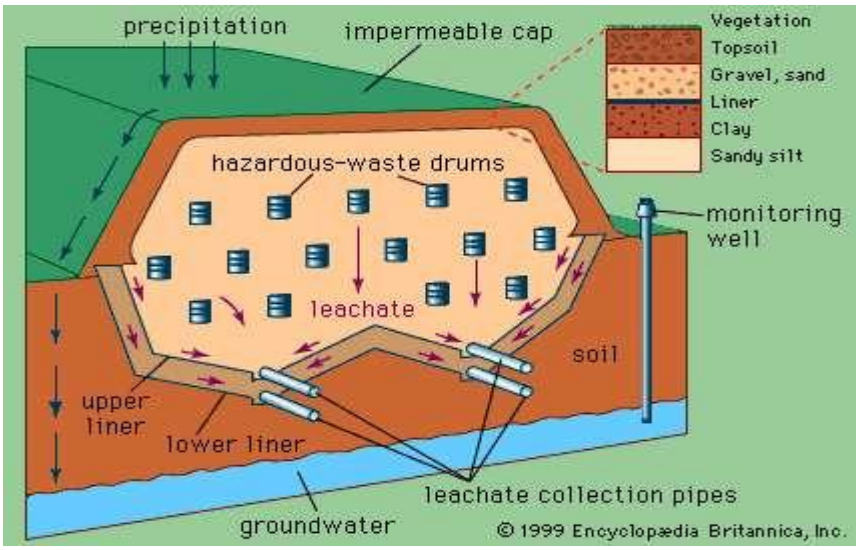
Detailed content of the Lecture:

Secure landfills:

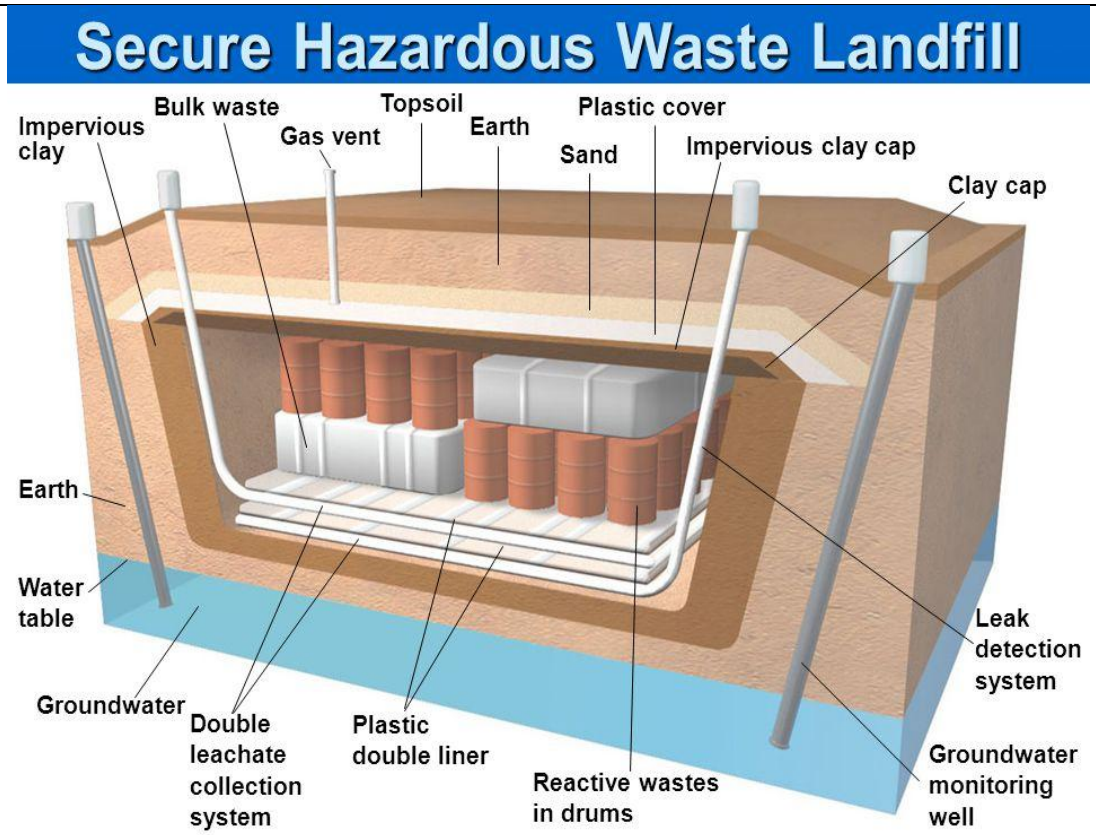
- ✓ Landfilling of hazardous solid or containerized waste is regulated more stringently than landfilling of municipal solid waste.
- ✓ Hazardous wastes must be deposited in so-called secure landfills, which provide at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table.
- ✓ A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems. The double leachate collection system consists of a

network of perforated pipes placed above each liner.

- ✓ The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup.
- ✓ Collected leachate is pumped to a treatment plant. In order to reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cap or cover is placed over a finished landfill.



- ✓ Schematic diagram of a secure hazardous-waste landfill with a double leachate collection system.
- ✓ A groundwater monitoring system that includes a series of deep wells drilled in and around the site is also required.
- ✓ The wells allow a routine program of sampling and testing to detect any leaks or groundwater contamination.
- ✓ If a leak does occur, the wells can be pumped to intercept the polluted water and bring it to the surface for treatment.
- ✓ One option for the disposal of liquid hazardous waste is deep-well injection, a procedure that involves pumping liquid waste through a steel casing into a porous layer of limestone or sandstone.
- ✓ High pressures are applied to force the liquid into the pores and fissures of the rock, where it is to be permanently stored.
- ✓ The injection zone must lie below a layer of impervious rock or clay, and it may extend more than 0.8 km (0.5 mile) below the surface.
- ✓ Deep-well injection is relatively inexpensive and requires little or no pretreatment of the waste, but it poses a danger of leaking hazardous waste and eventually polluting subsurface water supplies.



✓ Fig. 17-19, p. 406

Video Content / Details of website for further learning (if any):

1. https://www.britannica.com/technology/hazardous-waste-management/Treatment-storage-and-disposal

Important Books/Journals for further learning including the page nos.:

1. Industrial waste management by N.Mathankumar in the page No:5.62

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