UNIT 5 HAZARDOUS WASTES

HAZARDOUS WASTES

1. Hazardous wastes are considered highly toxic and therefore disposal of such wastes needs proper attention so as to reduce possible environmental hazards.
2. Industrial growth has resulted in generation of huge volume of hazardous wastes in the country.
3. In addition to this, hazardous wastes sometimes get imported mainly from the re-processing or recycling.
4. Scientific disposal of hazardous wastes has become a major environmental issue in India.
5. Hazardous Wastes (Management and Handling) Rules, 1989have been framed by the Central Government and amended in 2000 and 2003 to deal with the hazardous wastes related environmental problems that may arise in the near future.

Characteristics of hazardous wastes

1. Hazardous wastes, which may be in solid, liquid orgaseous form, may cause danger to health or environment.
2. Hazardouswastes can be identified by the characteristics that theyexhibit viz., ignitability, corrosively, reactivity, or toxicity.
3. Various agencies have defined hazardous wastes indifferent ways and as such, there is no uniformly accepted international definition so far.
4. It is presumed that about10 to 15 percent of wastes produced by industry are hazardous and the generation of hazardous wastes is increasing at the rate of 2 to 5 percent per year4.

Recycling of hazardous wastes

1. Hazardous wastes having the resource values are recycled or reprocessed for value recovery.

2. Used oil, batterywastes and other nonferrous wastes like zinc, lead are commonly recycled in India.
3. Used oil is generated in the industrial sectors and from the automobiles, transformer or capacitor oil etc.
4. Used oil contains high levels of various heavymetals like lead, cadmium, arsenic and chromium etc.
5. It alsocontains contaminants such as chlorinated solvents, polychlorinated bi- phenyls and other carcinogens.
6. It is estimated that one gallon of used oil is sufficient tocontaminate one million gallons of ground water.
7. Import of used oil/waste oil is banned in India due to its potential pollution hazard.
8. However used oil is a precious andnon-renewable resource and can be recycled back to pure lube oil again and again.

Recycling of E-waste

1. Recycling of E-waste is a need of the day to reduce/ avoid pollution, and to extract valuable and limited virgin resources.
2. Recycling reduces the energy used in new product manufacturing.
3. In developed countries, municipalities, publicand private organizations accept used / waste computers and other electronics for recycling.
4. Electronics manufacturerslike Dell and HP are offering recycling services in some countries.
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8. Electronics manufacturers like Dell and HP are offering recycling services in some countries.
9. The retailers and dealers of electronic items may be made responsible to ensure proper end-of-life disposition of E-wastes.
10. It is reported that 1.6 million kg of material each month are recovered in recovery centers of HP in the US and Europe,which is 98% by weight of all material received from customers and from within HP10.
11. The waste and the constituent parts must be sent to specialists, who can deal with the components to recover reusable materials and then safely dispose of the rest.
12. CRTs, LCDs, printed circuit boards, power supplies andbatteries must all be processed individually to ensure that the respective materials are handled safely.
13. The recyclingprograms of Dell and HP have encouraged the Irish peopleto take advantage of E-recycling.
14. Lookingat this Irish trend, continued and concerted effort on behalf ofgovernment, producers and environmental groups is needed in each state level and country as a whole to ensure proper management of increasing volume of E-waste in India.
15. Reusing and recycling the raw materials from obsolete E-products help in conserving natural resources and reducing the air and water pollution as well as reducing greenhouse gas emissions.

16. By donating used electronics to the schools, NGOs, and lower income families, which cannotafford the new-purchase, the society can be benefited.

Table 1: Characteristics of hazardous wastes

Sr. No	Hazardous characteristics	Potential hazards on living animals / environment
1	Flammable/ explosive	This type of waste may cause damage to the surroundings by producing harmful gases at high temperature and pressure or by causing fire hazards.
2	Oxidizing	Type of wastes that may yield oxygen and thereby cause or contribute to the combustion of other materials.
3	Poisonous (Acute)	These wastes have high potential to cause death, serious injury or to harm health if swallowed, inhaled or by skin contact.
4	Infectious substances	Hazardous wastes containing micro-organisms and their toxins, and responsible for diseases in animals or humans.
5	Corrosives	These wastes are chemically active and may cause severe damage to the flora and fauna, or to the other materials by direct contact with them.
6	Eco-toxic	These wastes may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
7	Toxic (Delayed or chronic)	These wastes, if inhaled or ingested or if they penetrate the skin, may cause delayed or chronic effects, including carcinogenicity.
8	Organic peroxides	These are organic waste containing bivalent-O-O- structure and may undergo exothermic self-accelerating decomposition.

Health effects of hazardous wastes

1. Hazardous wastes are considered very harmful to man and environment.
2. These wastes pose a severe environmental hazard to the human health and to various components of environment, viz. soil, air or water.
3. Health impacts of hazardous pollutants have been studied in great detail by many organizations and individuals including the Government Organizations in India and other countries.
4. In addition to research on health impacts, there are impact-related guidelines advocating for a full-fledged Health Impact Assessment (HIA) developed by several organizations.

PHYSICO CHEMICAL TREATMENT

1. The objective of this work is to reduce the pollution & cost of the industry waste waters.
2. There are many methods to treat the wastewater, but we are using simple methods like stabilization pond & chemical coagulation (with alum & $FeCl_3$) which reduced 90% of color & chemical oxygen demand (COD) present in textile industry.
3. Aeration tank is used to reduce the concentration of taste & odor causing substance such as hydrogen sulphide and various organic compounds by volatilization or oxidation.

Physico chemical treatment in textile industries

1. Two different oxidation treatments, ozonation and electro flocculation, were experimented on a pilot scale to test their efficiency in removing polluting substances from waste waters of textile industries.
2. The overall efficiency is around 90 – 99%.
3. The industry mainly manufactures socks, stockings and cloths and the water is treated in order to be reused.
4. The waste waters was characterized and jar – tests experiments were carried out with different coagulants and flocculants, at different concentrations and pH in order to obtain clarified water that can be treated by means of ultra-filtration or Nano filtration.
5. The combination of the physic – chemical treatment and the Nano filtration leads to a COD removal of almost 100%.
6. Chemical coagulation and electro chemical oxidation for textile wastewater treatment.

Material & Methods

1. The overall treatment is divided in three stage namely
   i. Stabilization pond
   ii. Chemical coagulation
   iii. Aeration tank.

Stabilization Pond

1. It is the circular plate having diameter of 40 – 50 cm & 15 – 20 cm depth and it open to an atmosphere.
2. The influent (wastewater) is charged in them & retention time of wastewater is 10 days. This process is done in presence of sun light.
3. The sludge will settle down & clear liquid will be collected from the top.
4. For further purification we provide filtration to treated water.
5. The filtrate is send to next process and filter – cake is sending to land filling station with sludge. The overall reduction of COD during this process is around 60%.

Chemical Coagulation

1. In this process a 250 ml of beaker & magnetic stirrer are there.
2. We take a clear liquid from stabilization pond as feed.
3. And add an optimal dose of coagulant in beaker, and then we provide mixing with the help of magnetic stirrer for 2 hour.
4. After that we provide 1 hour for settle down sludge.
5. Now we collect the clear liquid from top, here we provide filtration unit for further purification.
6. And clear liquid is send to further process.
7. The overall reduction in COD level up to this process is 90%.
8. The colour is also reduced in this process.
9. The reduction in colour level is up to 90%.
10. In chemical coagulation process we optimize the dose of coagulant & pH range by perform a jar test.
11. A jar test is the simple process to optimize the dose of the coagulant & decide the pH range.

Aeration Tanks

1. In aeration tank feed is entered.
2. The treated water of chemical coagulation process is feed for aeration tank.
3. The feed is enters from top of tank.
4. At the bottom of the tank air pipe is provided.
5. In that air is supplied at flow rate of 0.566 m3/min (optimal flow rate).
6. The purpose of filtration is to remove suspended solids.
7. In this process removing odour and taste causing substances by means of oxidation.

SOLIDIFICATION

1. Solidification was conducted using ordinary Portland cement (OPC) and Municipal Solid Waste (MSW) incineration fly ash to solidify and stabilize three different types of industrial sludge.
2. A total of eight mix proportions for each sludge type were prepared for compressive strength and leachate tests.
3. The specimens were air-cured and tested for their 3-day and 7-day compressive strength. The results showed significant increase in the compressive strength of those specimens treated with fly ash and cement.
4. Specimens with only 5%-15% cement content was observed to be insufficient to achieve the target compressive strength of 0.3 MPa required for landfill disposal.
5. Fly ash was found to be a good material in stabilizing the heavy metal sludge.
6. The optimum mix was found to be that having 45% fly ash, 5% cement and 50% sludge. TCLP tests indicated leaching from the stabilized matrix was reduced to very low levels.

Solidification procedure

1. The protection of public health and environment from hazardous pollutants has always been an important priority for most industrialized nations.
2. With the advancement in technology, there has also been a rise in the amount of waste sludge produced from these high-tech processes.
3. Land filling such sludge is widely practiced, but there are many limitations.
4. Sludge can be stabilized through biological and non-biological means such as
   i. Sludge digestion
   ii. Chlorine oxidation
   iii. Lime stabilization
   iv. Chemical-fixation
   v. Heat treatment
   vi. Chemical fixation
   vii. Cementitious stabilization
5. Cementitious stabilization has a great appeal because of its simplicity and low cost.
6. Hazardous materials could be turned into inert “waste Crete” just by adding cement or fly ash.
7. It limits the solubility of the hazardous elements in the waste and improves its handling characteristics and physical properties.

8. This method of stabilization also has the added advantage of reusing fly ash, which otherwise would also be disposed of at landfills.

Materials & Methods

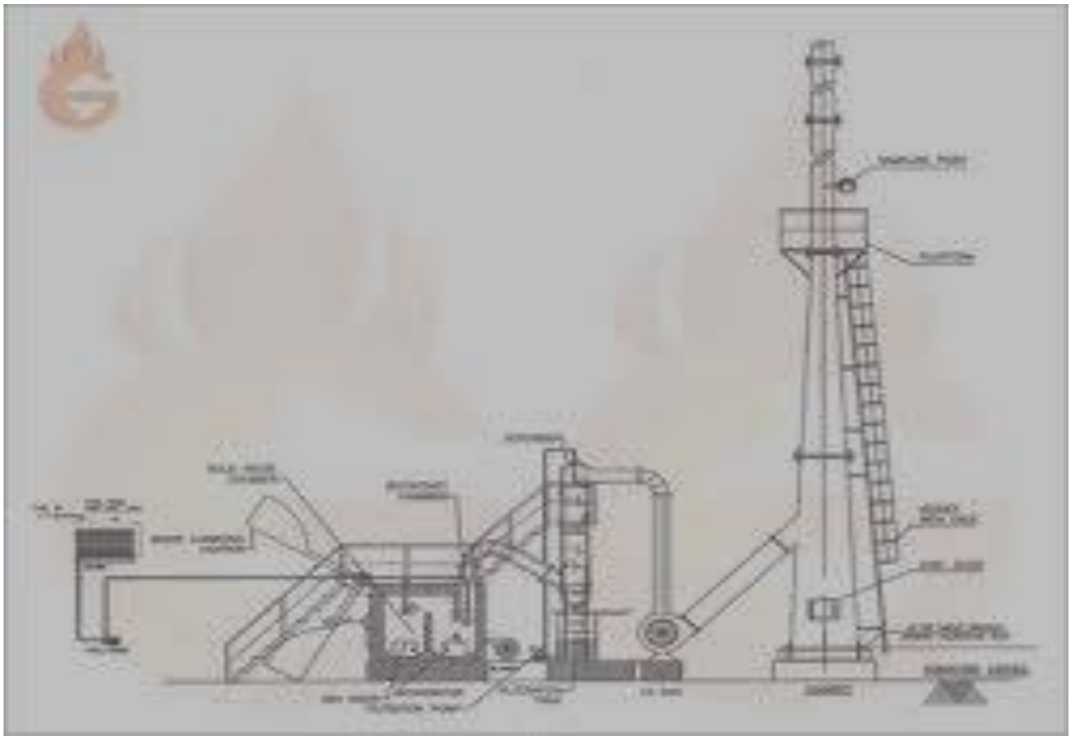
1. Preparation of different mix proportions.
2. The MSW fly ash used in this experiment was collected from the Senoko Incineration Plant.
3. The three industrial waste sludge's (labeled as A, B and C) were collected from different chemical and electronics plants in Singapore.
4. During this experiment, efforts were made to ensure the homogeneity of the fly ash and sludge by taking samples from different locations.
5. Wet curing was initially selected but samples with a high proportion of fly ash disintegrated in the curing water.
6. This is due to the high lime content in the fly ash, which reacts with water.
7. The heat released caused thermal cracking in the cubes and weakened the sludge matrix.
8. Air curing was subsequently adopted for all the samples.
9. Only mix proportions 3 to 8 were cast for the three sludge samples, as mix proportions 1 and 2, which were without OPC, were deemed to be too weak for compressive strength tests.

Compressibility Tests

1. Compression strength of the specimens was tested using the unconfined compression machine with a maximum load of 5 kN.
2. The cubes were tested for their 3-day and 7-day compression strength at a loading rate of 1.52 mm/min.
3. Between 1 and 3 test samples for each mix series were tested.
4. While efforts were made to provide 3 samples for each test series, some samples were damaged during the demoulding process due to their very low strength.

INCINERATION

1. Incineration is the process of destruction of all high calorific and highly toxic wastes by burning the waste at high temperature.
2. Incineration at 12000 C mineralizes (breaks down into basic non-toxic components) all kinds of organic matter in the waste.
3. However, the process of incineration releases toxic air pollutants like dioxins, furans, etc., if the waste is not incinerated at very high temperature.
4. Therefore, destruction efficiencies of toxic compounds during incineration (effectively 99.99%) with no generation of persistent organic pollutants (POP) should be the prime criteria for design of an incinerator system.
5. Incineration serves the dual purpose of reduction of both the toxicity and the volume of the waste, which is an important consideration when the disposal of wastes is finally destined for landfills.
6. Most of the process wastes from chemical unit operations can very well be treated in properly designed incinerators.



SECURE LANDFILLS

1. A landfill is a facility which is designed for the safe disposal of solid wastes.
2. The bottom liners and a top Cover, of the landfill are considered as the most critical components.
3. Penetration of Leachate in to the soil is the major problem in landfills.
4. For existing landfills the main factor affecting the quality of liners/covers is its permeability which should not be greater than 1.0×10^{-9} m/sec.
5. The compacted ball clay in the form of tiles (green) had undergone heavy compaction which in turn reduces permeability and the thickness of the liners/covers.
6. By reducing the thickness of liners more amount of municipal solid waste can be accommodated.
7. Usage of alternative materials will reduce the overall thickness of liner system by about 40-50cm
8. The hazardous wastes generated by industries are required to be collected in secure landfill.
9. But latter these landfill sites generate leachate.
10. This leachate, if not collected and treated properly, can contaminate the groundwater resources.
11. CPCB has taken up a project on "Development of Standards for leachate from Hazardous Waste Disposal Site".
12. The Project has been ready and the draft report has been prepared.
13. The criteria for disposal of hazardous wastes in landfill and leachate collection, removal and detection systems, as suggested in the report.

14. The following listed wastes should not be allowed to dispose off directly into the landfill facility
    i. Waste, which is a fluid, slurry or paste?
    ii. Waste, which is delivered under pressure or under vacuum.
    iii. Waste, which has an obnoxious odour.
    iv. Waste, which reacts with moisture to produce considerable amount of heat or gases.
    v. Waste, which is highly inflammable (flash point < 550C).
    vi. Waste, which contains shock sensitive substances.
    vii. Waste, which contains very strong oxidizing agents.
    viii. Waste, which contains volatile substances of significant toxicity.
    ix. Waste, which falls below a pH value of 4 and exceeds the value of 13, if evaluated in distilled water in the ratio of 1: 10.
15. Waste, which possesses a calorific value of more than 3200 Kcal/kg. These wastes have to go for authorized energy recovery or for incineration

METHODOLOGY

Sample collection

1. Sample of Dwaraka Tirumala ball clay occurring near Bhimadolu, West Godavari Dist, A.P, India is collected from M/S Vennar ceramic Industries Ltd., Perikigudem, near Gudiwada Krishna Dist, A.P, India

Preparation of granulated ball clay powder

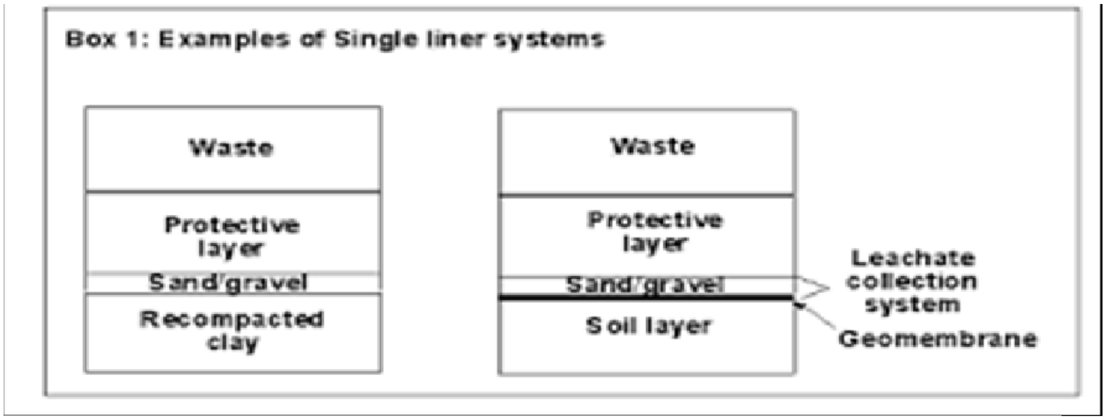
1. Ball clay ground in pot mill with 40% of water, for 3 minutes and the slurry is transferred into a Galvanized Iron (GI) tray.
2. This slip is dried in a lab oven and the dried flakes are ground.
3. 6% of water is sprinkled on the powder, mixed and made to pass through 20 IS mesh to prepare granulated powder.
4. This powder is tested for bulk density using a density bottle.

Preparation of ball clay tiles (green)

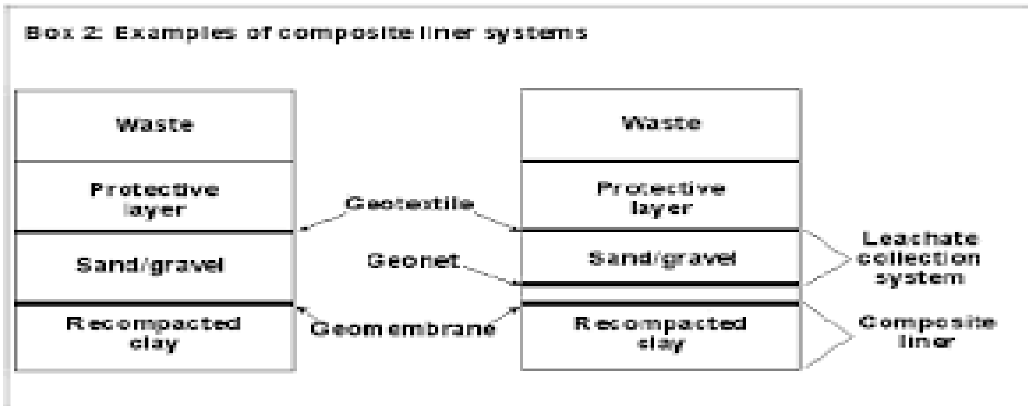
1. Granulated ball clay powder is pressed in a lab scale hydraulic press at a pressure of 100kg/cm2 to obtain the green tile.
2. These tiles are subjected for testing of flexural strength, dry shrinkage, bulk density

Testing of vitrified ceramic tiles

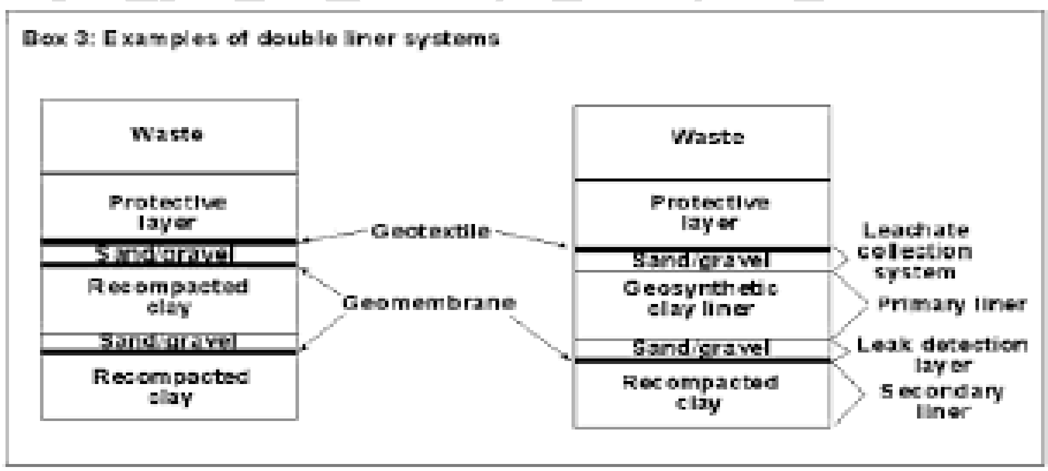
1. Samples of vitrified tiles of 300x300x10mm are collected from the market and subjected to testing of flexural strength, water absorption, chemical resistance in accordance with IS 15622.
2. Further it is tested for reactivity with leachate by keeping it in solid waste for 2 months and comparing with fresh sample.



Box 1: Examples of Single liner systems



Box 2: Examples of composite liner systems



Box 3: Examples of double liner systems