

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY
End Term Examination, December 2023
B. Tech. ME, Semester VII

Roll No.....

ME1225: Industrial Waste Management

Time: 2.5 hours Max. Marks: 30

Instructions to students:

1. Do not write anything other than your roll number on the question paper.
 2. Mention all the assumptions for your answers clearly.
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Case Study-1

Infosys, a global Consulting and Technology leader, has been awarded the LEED (Leadership in Energy and Environmental Design) India 'Platinum' rating by the Indian Green Building Council (IGBC) for its Software Development Block 1 (SDB 1) at its Pocharam campus in Hyderabad.

Key features of this building include:

Water Efficiency: 48% reduction in overall water consumption through the use of efficient plumbing fixtures and water recycling. 100% of wastewater from the campus will be treated on-site, helping in the reduction of potable water consumption.

Energy Efficiency: The building is 40% more efficient than the globally accepted ASHRAE standard. This has been achieved through an efficient building envelope including high-performance glazing and adequate shading, a radiant cooling system, efficient chillers, pumps and fans, an efficient lighting system and smart building automation.

Daylighting: Over 90% of the office space has natural light, reducing the need for artificial lighting during daytime. The design includes light shelves along all windows to ensure that the natural light travels as deep into the building as possible.

Efficient Material Selection and Management: Recycled materials account for 18% of the total value of materials in the building; these include aluminium, glass, steel, plywood and tiles among others. 38% of the total project material by cost was manufactured regionally thereby reducing pollution due to transportation.

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| Q.1.1 Energy efficiency has been given more weightage in the rating systems than all other aspects. Justify this. | 2.0
(LO1) |
| Q.1.2 What are the additional aspects (given in the case) to take care of a green building? | 2.0
(LO1,2) |
| Q.1.3 How the LEED Green Building Rating System can function as a benchmark for the design, construction and operation of high-performance green buildings. | 2.0
(LO1,3) |
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Case Study-2

A mid-sized city faced significant challenges in managing its wastewater due to its diverse industrial presence alongside residential areas. The existing treatment facility was struggling to effectively handle the varied pollutants, both organic and inorganic, present in the wastewater. This case study explores the implementation of various treatment technologies to address specific issues in the wastewater treatment process.

The following scenarios are happening.

Scenario-1: The inflow of wastewater exhibited irregular peaks in contaminants, leading to operational inefficiencies.

Scenario 2: High acidity levels from certain industrial effluents were affecting the pH balance, hindering biological treatment.

Scenario-3: Organic solids were contributing to high BOD (Biochemical Oxygen Demand) levels, affecting the efficiency of aerobic treatment.

Q.2.1	What strategies can be adopted to regulate and balance the incoming flow of wastewater for more consistent treatment?	2.0 (LO2)
Q.2.2	How does neutralization impact subsequent treatment processes, especially biological treatment, and why is it crucial in wastewater management?	2.0 (LO1,2)
Q.2.3	What are the primary techniques for separating and removing suspended organic solids from wastewater?	2.0 (LO2,3)

Case Study-3

Introduction: The Roo Hsing factory is a privately owned, foreign investor garment manufacturing enterprise, located in Phnom Penh, Cambodia. The main products of the company include but are not limited to, Denim cotton Jeans and trousers. For production, the fabric is imported from Taiwan and Hong Kong, and products are mainly exported to the USA, EU, Japan, and Canada. The company has a workforce of over 3700 employees.

The Cambodian Clean Production Programme (as part of UNIDO's clean production initiative) selected the factory as a demonstration company in the textile/garment sector. Within this programme, companies are recommended to implement a range of measures that can improve energy and resource use efficiency. The Roo Hsing factory implemented a wide range of these mechanisms, totalling an investment of \$630,000 that resulted in savings of \$666,000 per year. Other indirect benefits of these mechanisms include inter alia, reduced waste management costs, increased exports, improvements in working conditions, and improved environmental performance.

Production processes

While the Roo Hsing factory produces a range of fabrics, its main product is denim, making it the most energy and resource-intensive product. Denim's production process at Roo Hsing comprises the following steps-

Hot washing- this operation is done to remove any residual sizing chemicals, and improve the fabric's wettability and its absorption capacity.

Soap washing and scouring- soap washing is done to remove superfluous color, and impurities like gums, waxes and pectin. Scouring is done to improve the wettability of the fabric, and improve its brightness and softness.

Softening/ finishing- softening and finishing operations are done to improve luster, evenness, dust-proofing, and anti-crease properties.

Spinning and drying- during this step, the garment is subjected to mechanical dewatering through centrifuges and steam. It is then ironed, accessorized, and dispatched.

It is evident that producing denim is highly water and energy-intensive, with a high potential to generate large amounts of waste. The clean production team conducted a site study of the factory to assess areas for improving resource and energy use efficiency. It was observed that consumption of energy sources such as fuel oil and electricity was very high relative to benchmarks in other countries. The factory processes were also marked by high water and chemical use, resulting in high liquid and gaseous waste generation. These can be attributed to factors such as poor combustion, low efficiency of steam generation, poor steam distribution, and high cloth-to-liquor ratio.

Q.3.1 Suggests the suitable actions and impacts for cleaner production

5.0
(LO2,3)

Case Study-4

The sugar canes are cut into pieces and crushed in a series of rollers to extract the juice, in the mill house. Juice is extracted from the sugar cane, leaving a fibrous residue called bagasse, which can be used as fuel for the boilers or can be disposed of as solid waste. The milk of lime is then added to the juice and heated when all the colloidal and suspended impurities are coagulated; much of the colour is also removed during this lime treatment. Lime is added to the extracted juice to raise its pH and to prevent the inversion of the sucrose molecule to glucose and fructose. The coagulated juice is then clarified to remove the sludge. The clarifier is further filtered through filter presses, and then disposed of as solid waste. The filtrate is recycled to the process, and the entire quantity of clarified juice is treated by passing sulphur dioxide gas through it. The process is known as the "sulphitation process"; the colour of the juice is completely bleached out due to this process.

The clarified juice is then preheated and concentrated in evaporators and vacuum pans. The partially crystallized syrup from the vacuum pan, known as "massecuite" is then transferred to the crystallizers, where complete crystallization of sugar occurs. The massecuite is then centrifuged, to separate the sugar crystals from the mother liquor. The spent liquor is discarded as "black strap molasses". The sugar is then dried and bagged for transport. The black strap molasses may be used in the distilleries.

Q.4.1 Explain the Sources of Waste Water and the Characteristics of the Waste generated from the sugar manufacturing industry. 3.0 (LO1,4)

Q.4.2 What are the Effects of the waste from the sugar manufacturing industry on receiving streams and suggest the treatment methods? 3.0 (LO2,4)

Case Study-5

There are seven integrated iron and steel plants in India, out of which five are under the Steel Authority of India Limited (SAIL), one in the private sector; the seventh is the Visakhapatnam Steel Project in Visakhapatnam. The total annual production of steel is 715.4 million tonnes of which India contributes 14.05 million tonnes. Steel Manufacturing involves several process steps, which consume 25 to 60 cubic meters of water and 4 to 5 tonnes of input material for each tonne of steel produced. The water consumption in other countries varies from 3 to 6 cubic meters compared to 25 to 60 in India.

In an Integrated Iron and steel Industry (IISI), wastewater generated from the Coke Oven Byproduct (COBP) Plant is considered to be the most polluting stream. This wastewater contains toxic chemicals, like phenol, cyanide and ammonia, which are harmful to the receiving water bodies when discharged untreated.

In recent years, due to increasing pressure from pollution control authorities, the industry has responded by upgrading or installing new wastewater treatment plants. In existing plants, this COBP wastewater is treated by biochemical oxidation of cyanide, ammonia and phenol. These Effluent Treatment Plants are commonly known as Biochemical Oxidation and dephenolisation Plants or BOD plants. Apart from treatment, it is also necessary to minimize discharge of wastewater and concentration of pollutants at the source itself.

Q.5.1 Design a Wastewater management system for wastewater generated from the Coke Oven Byproduct (COBP) Plant. 5.0 (LO3,5)

Q.5.2 Suggest ways to reduce the Impact of Steel Industry Effluents on Water Bodies 2.0 (LO4,5)

all the best!