| Reg. No. | | | | | | | | | | |
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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## II SEMESTER M.TECH (INDUSTRIAL BIOTECHNOLOGY)

## END SEMESTER EXAMINATIONS, MAY 2015

SUBJECT: Elective III SOLID WASTE MANAGEMENT [BIO 528]

**REVISED CREDIT SYSTEM**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates**

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

| | | |
|---|---|---|
| **1A.** | The components of ISWM plan are the important tool to operate and manage the waste generated in a city. Enlist the key components of ISWM used for efficient management of wastes. | **4M** |
| **1B.** | The designing of an ISWM system is administered by characteristics and properties of collected solid waste. What are the important physical and geotechnical properties of collected wastes needs to be consider to design an ISWM facility? | **4M** |
| **1C.** | Why we need to consider the lignin content of organic matters to determine the biodegradability of SWM, than the volatile solid content. | **2M** |
| **2A.** | The collected solid waste from a heterogeneous community described in Table 1, using the data, estimate the moisture content, the chemical composition of the organic fraction of waste using dry basis without sulfur and with and without water (% distribution, molar composition, formulae) and predict the energy content from solid waste. | **8M** |
| **2B.** | The hazardous organic compounds needs to be detoxified by sequential physical and chemical process. But the biological route finds the advantage over physical and chemical methods. How will you be describe the efficiency of combined abiotic and biotic transformation process used to detoxify the hazardous waste | **2M** |
| **3A.** | The chemical transformation of solid waste typically involve a change of phase, solid to gas, solid to liquid. List and explain the principal chemical transformation process used to reduce the volume and/or to recover conversion products of SW. | **6M** |
| **3B.** | MSW are usually picked from various locations and centers. Classify the collection systems for MSW. | **2M** |

<table>
<tr><td>3C.</td><td>How RDF materials are formed and what is the expected average production rate of RDF</td><td>2M</td></tr>
<tr><td>4A.</td><td>Assume that home compaction units are to be installed in a residential area. Estimate the volume reduction that could be achieved in the solid wastes collected if the compacted specific weight is equal to 540 Kg/m$^3$, use the data given in column [1], [2] and [4] of Table 1. Determine the volume of compacted wastes, excluding yard wastes, wood, metals (other than aluminum and tin cans); and dirt, ashes, etc.,</td><td>7M</td></tr>
<tr><td>4B.</td><td>In a town, it is determined that the per capita waste generation rate is 1.4 Kg per person per day (persons in family=4). Collection is conducted once per week by the municipality. If the density of MSW in a typical trash container is 150kg/m$^3$, how many 120 L container would be needed?</td><td>3M</td></tr>
<tr><td>5A.</td><td>Land disposal is the most widely used practice allover world. Land disposal should therefore be carried out in a properly designed landfills, for designing a landfill, one need to consider the components of landfills. List the various components of engineered landfills to deposit the waste.</td><td>4M</td></tr>
<tr><td>5B.</td><td>On a single day you observe the following at a landfill, there are 3.82 Kg/cap.day with 2.7 cap/home and all the waste comes from the town (listed in table), estimate the number of homes in the town.
<table>
<tr><th>Item</th><th>Number of loads</th><th>Avg. Volume, m$^3$</th><th>Specific Weight, Kg/m$^3$</th></tr>
<tr><td>Compactor truck</td><td>10</td><td>16</td><td>500</td></tr>
<tr><td>Pickup trucks with leaves loose and dry</td><td>18</td><td>3</td><td>100</td></tr>
<tr><td>private cars</td><td>56</td><td>1</td><td>220</td></tr>
<tr><td>broken concrete</td><td>2</td><td>45</td><td>2595</td></tr>
</table></td><td>3M</td></tr>
<tr><td>5C.</td><td>A colony having a population of 65000 generates solid wastes at the rate of 2 kg/capita/day. The compacted specific weight of solid wastes in landfill is 650 kg/m$^3$ and the average depth of compacted solid wastes in landfill is 5 m. determine the required landfill area</td><td>3M</td></tr>
<tr><td>6A.</td><td>How WBM and HELP methods are used to estimate the quantity of leachate.</td><td>3M</td></tr>
<tr><td>6B.</td><td>Due to a variety of physical, chemical and biological constituents in leachate, the treatment is recommended before disposal. The leachate collected from landfills has high biochemical and chemical oxygen demands, so it’s prefer to use biological treatment. Explain the various biological treatment method available for leachate treatment with reactor design.</td><td>4M</td></tr>
<tr><td>6C.</td><td>A person weighing about 70 kg is exposed to a carcinogen (average concentration in air = 0.01 mg/m$^3$) for 8 hours per day for 300 days per year over a period of 30 years. Average breathing rate of a person is 1.0 m$^3$/h. Estimate the risk of cancer if the carcinogen has a potency factor of 0.1 (mg/kg/day)$^{-1}$. Assume the average life of person to be 65 years.</td><td>3M</td></tr>
</table>

Table 1: Typical components, composition, moisture content, specific weight, energy content and ultimate analysis data of solid waste.

| Component [1] | Waste, based on 100 Kg [2] | Moisture Contents [3] | Specific weight, $Kg/m^3$ [4] | Energy content, KJ/Kg [5] | Chemical Composition (% by weight on a dry basis) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | H | O | N | S | Ash |
| Food Wastes | 9.0 | 70.0 | 490 | 2000 | 48 | 6.4 | 37.6 | 2.6 | 0.4 | 5 |
| Paper | 34.0 | 6.0 | 150 | 7200 | 43.5 | 6 | 44 | 0.3 | 0.2 | 6 |
| Cardboard | 6.0 | 5.0 | 167 | 7000 | 44 | 5.9 | 44.6 | 0.3 | 0.2 | 6 |
| Plastics | 7.0 | 2.0 | 110 | 14000 | 60 | 7.2 | 22.8 | 0 | 0 | 10 |
| Textiles | 2.0 | 10.0 | 110 | 7500 | 55 | 6.6 | 31.2 | 4.6 | 0.15 | 2.5 |
| Rubber | 0.5 | 2.0 | 220 | 10000 | 78 | 10 | 0 | 2 | 0 | 10 |
| Leather | 0.5 | 10.0 | 270 | 7500 | 60 | 8 | 11.6 | 10 | 0.4 | 10 |
| Yard wastes | 18.5 | 60.0 | 170 | 2800 | 47.8 | 6 | 38 | 3.4 | 0.3 | 4.5 |
| Wood | 2.0 | 20.0 | 400 | 8000 | 49.5 | 6 | 42.7 | 0.2 | 0.1 | 1.5 |
| Glass | 8.0 | 2.0 | 330 | 60 | 0.5 | 0.1 | 0.4 | 0.1 | 0 | 98.9 |
| Tin Cans | 6.0 | 3.0 | 150 | 300 | 4.5 | 0.6 | 4.3 | 0.1 | 0 | 90.5 |
| Aluminium | 0.5 | 2.0 | 270 | -- | 4.5 | 0.6 | 4.3 | 0.1 | 0 | 90.5 |
| Other metal | 3.0 | 3.0 | 540 | 300 | 4.5 | 0.6 | 4.3 | 0.1 | 0 | 90.5 |
| Dirt, Ash, Etc. | 3.0 | 8.0 | 810 | 3000 | 36.3 | 3 | 2 | 0.5 | 0.2 | 68 |