



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC - 27001 - 2005 Certified)

SUMMER-14 EXAMINATION

Model Answer

Subject code : (12298)

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**Important Instructions to examiners:**

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.



Q No.	Answer	marks	Total marks
1A-a	<p>A substance in the air that can be harmful to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment.</p> <p><b>Natural sources</b></p> <ul style="list-style-type: none"> <li>• Volcano</li> <li>• Forest fire</li> <li>• Soil dust</li> <li>• Fog and mist</li> </ul>	<p>2</p> <p>2</p>	4
1A-b	<p><b>Role of MPCB</b></p> <ol style="list-style-type: none"> <li>To plan a comprehensive program for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof;</li> <li>To advise the State Government on any matter concerning the prevention, control or abatement of water pollution;</li> <li>To collect and disseminate information relating to water pollution and the prevention, control or abatement thereof;</li> <li>To encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;</li> <li>To collaborate with the Central Board in organizing the training of</li> </ol>	One mark for each (any four)	4



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	<p>persons engaged in programs relating to prevention, control or abatement of water pollution and to organize mass education programs relating thereto;</p> <p>f) To inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water, works for the purification thereof and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by this Act;</p>																																					
1A-c	<p><b>Factors affecting waste generation</b></p> <p>1) Location</p> <p>2) Age group of people</p> <p>3) Financial status</p> <p>4) Climatic season</p> <p>5) Population</p> <p>6) Attitude of people</p>	One mark for each (any four)	4																																			
1A-d	<p><b>Typical composition of domestic waste water</b></p> <table><tr><td></td><td></td><td colspan="3"><b>Concentration</b></td></tr><tr><td><b>Contaminants</b></td><td><b>Unit</b></td><td><b>Weak</b></td><td><b>Medium</b></td><td><b>Strong</b></td></tr><tr><td>Solids, total (TS)</td><td>mg L<sup>-1</sup></td><td>350</td><td>720</td><td>1200</td></tr><tr><td>Dissolved, total (TDS)</td><td>mg L<sup>-1</sup></td><td>250</td><td>500</td><td>850</td></tr><tr><td>Fixed</td><td>mg L<sup>-1</sup></td><td>145</td><td>300</td><td>525</td></tr><tr><td>Volatile</td><td>mg L<sup>-1</sup></td><td>105</td><td>200</td><td>325</td></tr><tr><td>Suspended solids (SS)</td><td>mg L<sup>-1</sup></td><td>100</td><td>220</td><td>350</td></tr></table>			<b>Concentration</b>			<b>Contaminants</b>	<b>Unit</b>	<b>Weak</b>	<b>Medium</b>	<b>Strong</b>	Solids, total (TS)	mg L <sup>-1</sup>	350	720	1200	Dissolved, total (TDS)	mg L <sup>-1</sup>	250	500	850	Fixed	mg L <sup>-1</sup>	145	300	525	Volatile	mg L <sup>-1</sup>	105	200	325	Suspended solids (SS)	mg L <sup>-1</sup>	100	220	350	Half mark for each (any eight)	4
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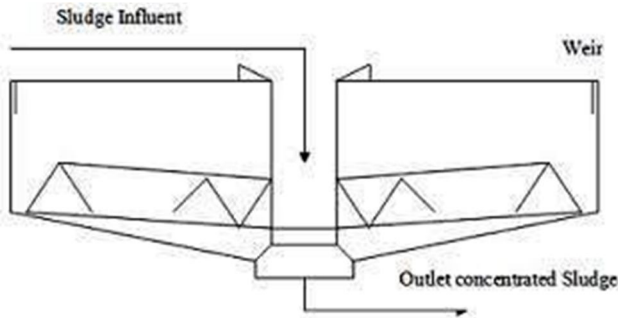
	Fixed	mg L <sup>-1</sup>	20	55	75			
	Volatile	mg L <sup>-1</sup>	80	165	275			
	Settleable solids	mg L <sup>-1</sup>	5	10	20			
	BOD <sub>5</sub> at 20° C	mg L <sup>-1</sup>	110	220	400			
	Total organic carbon (TOC)	mg L <sup>-1</sup>	80	160	290			
	Chemical oxygen demand (COD)	mg L <sup>-1</sup>	250	500	1000			
	Nitrogen (total as N)	mg L <sup>-1</sup>	20	40	85			
	Organic	mg L <sup>-1</sup>	8	15	35			
	Free ammonia	mg L <sup>-1</sup>	12	25	50			
	Nitrites	mg L <sup>-1</sup>	0	0	0			
	Nitrates	mg L <sup>-1</sup>	0	0	0			
	Phosphorus (total as P)	mg L <sup>-1</sup>	4	8	15			
	Organic	mg L <sup>-1</sup>	1	3	5			
	Inorganic	mg L <sup>-1</sup>	3	5	10			
	Chlorides	mg L <sup>-1</sup>	30	50	100			
	Sulfate	mg L <sup>-1</sup>	20	30	50			
	Alkalinity (as CaCO <sub>3</sub> )	mg L <sup>-1</sup>	50	100	200			
	Grease	mg L <sup>-1</sup>	50	100	150			
	Total coliform	CFU 100 mL <sup>-1</sup>	$10^6$ $10^7$	$10^7$ - $10^8$	$10^8$ $10^9$			



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	Volatile organic compounds (VOCs)	mg L <sup>-1</sup>	<100	100-400	>400		
1B-a	<b>Sludge Thickening</b> <p>The sludge thickening involves removal of water from the sludge and reduces sludge volume as much as possible so that the sludge can be handled more efficiently. The common method for thickening is gravity settling.</p> <p><b>Working of gravity thickener:</b> In gravity thickener the sludge is subjected to gentle agitation by means of a slow stirrer which enhances settling. The stirring action serves to release trapped water and gases from the sludge, allowing it to become denser or thicker. The thickened underflow of sludge is withdrawn from the bottom of the tank; the effluent or supernatant overflows a weir and is pumped back to the inlet of the treatment plant. . In this manner the combined sludge from primary and secondary settlers can be thickened so as to contain 5-9% solids.</p> 					3	6
1B-b	<b>Thermal Pollution</b> <p>Thermal pollution includes the waste mainly heat dischrqed from atomic, nuclear and thermal power plants. The discharge of unutilized heat is highest in</p>					3	6



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	<p>the thermal power plants which adversely affect the aquatic environment. Apart from electric power plants; various industries with cooling requirement contribute to thermal loading. Municipal sewage also contributes to thermal pollution. Domestic sewage normally has a higher temperature than receiving water.</p> <p><b>Effect of Thermal pollution on water are:</b></p> <ul style="list-style-type: none"><li>i) Reduction in dissolved oxygen</li><li>ii) Decreases the oxygen saturation percentage</li><li>iii) Increase in BOD</li><li>iv) Early hatching of fish eggs.</li><li>v) Failure of trout (cold water fish) eggs to hatch and salmon to spawn</li><li>vi) Direct fish mortality due to failure in respiratory, nervous or essential cell processes.</li><li>vii) Bacteria multiply rapidly, which in turn become the food of protozoans.</li><li>viii) Undesirable changes in algal population.</li><li>ix) Excessive eutrophication.</li><li>x) increases the toxicity of some chemical pollutants</li><li>xi) migration of aquatic biota</li><li>xii) Decrease in solubility of gases in water.</li><li>xii) Rapid setting of sediment load in water affecting aquatic food supply.</li></ul>	3	
2-a	<p>These pollutants are present in lower atmosphere i.e. troposphere and stratosphere. These pollutants stay here for a long period. They consist of smoke, dust, fumes, mist, &amp; spray particles. These may be organic or inorganic in nature.</p> <p><b>Effects on Human Health, animal :</b></p> <ul style="list-style-type: none"><li>1. The particulate pollutants of size less than one micron enter into the alveoli of lungs &amp; damage lung tissues.</li></ul>	5	8



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	<p>2. Asbestos fibers may cause cancer to the industrial workers. This occurs in the tissue lining the abdomen.</p> <p>3. Lead from automobile exhaust may cause effect on childrens brain.</p> <p>4. Lead interferes with the development &amp; maturation of red blood cells.</p> <p>5. Insoluble aerosols may create toxicity to respiratory system.</p> <p>6. Silicosis, a chronic disease of lung is caused by inhalation of dust containing free silica, SiO<sub>2</sub>.</p> <p>7. Black lung disease is common to coal miners, while white lung disease occurs in textile workers.</p> <p>8. Arsenic is absorbed through the lungs &amp; skin &amp; cause diaahoea, conjunctivitis, lung &amp; skin cancer.</p> <p>9. Traces of mercury cause nerve damage &amp; death.</p> <p>10. The acid particulates &amp; aldehydes cause eye, nose &amp; throat irritation.</p> <p>11. CO present in environment can react with blood and reduces its oxygen carrying capacity which can ultimately leads to death.</p> <p><b>Effects on materials :</b></p> <p>1. The particulate matter i.e. fumes, soot, mist, etc. causes severe damage to buildings &amp; monuments.</p> <p>2. The corrosive activity is enhanced in the presence of particulate pollutants.</p> <p>3. Corrosive particulates cause severe damage.</p> <p>4. Particulates cause cracks &amp; fading in pointed surfaces.</p> <p>5. Particulates accumulate on the soil surfaces causing soil erosion.</p> <p>6. Particulates cause smog formation which may be dangerous to materials.</p>	3	
2-b	<p><b>Factors affecting ground water pollution</b></p> <ul style="list-style-type: none"><li>• Rainfall pattern</li><li>• Depth of water table</li></ul>	2	8



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<ul style="list-style-type: none"><li>• Distance from source of contamination</li><li>• Soil properties</li></ul> <p><b>Effect of ground water pollution</b></p> <p>The effects of groundwater pollution are wide. Human infectious disease is one of the more serious effects of water pollution This alone could cause hundreds of thousands of sicknesses in the area contaminated.</p> <p>Not only are we effected by water pollution but so are animals around us. Nutrient pollution is the most widespread problem. The presence of nitrogen, phosphorus, and other nutrients that come may come from groundwater pollution can turn the area into coastal zone which means it can stimulate harmful overgrowths of algae, can have direct toxic effects and result in low-oxygen conditions. Some algae is toxic and zooplankton eat it causing the pollution to go through the food chain and eventually harming use with sickness or even death.</p> <p>Health side effects depend on the type of chemicals that have been released into the ecosystem. Chromium and lead are often used in pesticides. A lingering residue or improper storage or disposal of the pesticide may lead to groundwater contamination with one of these harmful chemicals. Exposure to these can cause damage to the brain and nervous systems. Kidney damage is also associated with heavy lead and chromium exposure.</p> <p>Arsenic is a deadly chemical that is often found in a contaminated area. Arsenic is naturally occurring, but when chemical contamination increases the concentration it becomes dangerous. Arsenic poisoning can be linked to skin, lung and bladder cancer. High levels of arsenic also lead to cardiovascular damage.</p> <p><b>Prevention</b></p> <ul style="list-style-type: none"><li>• Survey of contaminant sources</li></ul>	4	
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	<ul style="list-style-type: none"> <li>• Locating industrial sources of water and keeping control on them</li> <li>• Doing treatment on water in industry itself</li> <li>• Locating dirking water wells and isolating them form sources of contamination</li> </ul>	2	
2-c	<p><b>3R principle</b></p> <p><b>Reuse:</b> In today's world use and through materials is increasing and hence solid waste. Instead of throwing that material or item if it is used again, energy and environment can be saved. Solid waste generation also will be reduced. In industry various boxes, cans, pallets etc are used for material handling. These can be used again for same purpose. Other examples are</p> <ul style="list-style-type: none"> <li>• Reuse used glass and plastic containers as receptacles.</li> <li>• Reuse your old mouse pad as an insulator for placing hot containers that have just been removed from stove or oven, or as a beer mat.</li> <li>• Use unwanted plastic bags to bag garbage.</li> <li>• Use old clothing as rags for cleaning.</li> <li>• Convert scrap paper into memo pads.</li> <li>• Pass old textbooks, story books, and toys to others. Donate good quality but unwanted items to old folks' homes, charitable organizations etc.</li> <li>• Repair and recondition faulty electronic appliances to extend their useful lives.</li> </ul> <p><b>Recycle :</b> Recycling is a process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for</p>	<p>2</p> <p>3</p>	8



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<p>"conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, and Recycle" waste hierarchy. Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. In the strictest sense, recycling of a material would produce a fresh supply of the same material-for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. Benefits of Recycling</p> <ul style="list-style-type: none"><li>• Reduces the amount of waste sent to landfills and incinerators;</li><li>• Conserves natural resources such as timber, water, and minerals;</li><li>• Prevents pollution caused by reducing the need to collect new raw materials;</li><li>• Saves energy;</li><li>• Reduces greenhouse gas emissions that contribute to global climate change;</li><li>• Helps sustain the environment for future generations;</li><li>• Helps create new well-paying jobs in the recycling and manufacturing industries in the United States.</li></ul> <p><b>Reduce:</b> When you avoid making garbage in the first place, you don't have to worry about disposing of waste or recycling it later. Changing your habits is the key - think about ways you can reduce your waste when you shop, work and play. There's a ton of ways for you to reduce waste, save yourself some time and money, and be good to the Earth at the same time. Buy products in bulk. Larger, economy-size products or ones in concentrated form use less packaging and usually cost less per ounce.</p>	3	
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	<ul style="list-style-type: none"><li>• Avoid over-packaged goods, especially ones packed with several materials such as foil, paper, and plastic. They are difficult to recycle, plus you pay more for the package.</li><li>• Avoid disposable goods, such as paper plates, cups, napkins, razors, and lighters. Throwaways contribute to the problem, and cost more because they must be replaced again and again.</li><li>• Buy durable goods - ones that are well-built or that carry good warranties. They will last longer, save money in the long run and save landfill space.</li><li>• At work, make two-sided copies when ever possible.</li><li>• Maintain central files rather than using several files for individuals.</li></ul>		
3-a	<b>Need of ISO14001:</b> <ul style="list-style-type: none"><li>i) Environmental improvements</li><li>ii) Regulatory compliance</li><li>iii) Improvement of corporate image</li><li>iv) Cost containment &amp; cost saving</li><li>v) Competitive advantage</li><li>vi) Opening of international market &amp; partners</li><li>vii) Improvement in employee awareness about environment</li><li>viii) An ethical or social commitment</li></ul>	1 mark each for any 4	4
3-b	<b>Performance criteria for waste water management system includes:</b> <ul style="list-style-type: none"><li>i) Health criteria: The system should be so designed that pathogenic organisms do not spread either by direct contact with the soil or sewage or indirectly via soil, water or food.</li><li>ii) Reuse criteria: The treatment processes used should be such that the</li></ul>	1 mark each for any 4	4



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	<p>treatment effluent is safe to be reused for aquaculture, agriculture, industrial cooling and ground water recharge.</p> <p>iii) Ecological criteria: If the treated effluent is not reused, but is disposed of in the receiving water, its characteristics should be such that the aquatic environment is protected and the self-purification capacity of the recipient water is not exceeded.</p> <p>iv) Nuisance Criteria: The treatment system should be so designed that either it does not release objectionable odour or the degree of odour released must be below the nuisance thresholds.</p> <p>v) Cultural criteria: The methods chosen for collection, treatment, disposal and reuse should be such that they match with local habits, social customs and religious practices of the people of the area.</p> <p>vi) Operational criteria: The system should be such that it may operate with minimum difficulties, and greater degree of spill is not required. It should be such that operation is possible with locally available staff, with minimum possible training.</p> <p>vii) Cost criteria: The system should have minimum possible capital and running costs, which can be easily paid by the community.</p>		
3-c	<p>The categories of medical waste treatment technologies are:</p> <p>i) Mechanical ii) Thermal iii) Chemical iv) Irradiation v) Biological</p> <p><b>Autoclaving</b> for medical waste treatment: Autoclaving is a low heat thermal process and is designed to bring steam into direct contact with the waste in a controlled manner and for sufficient duration to disinfect the waste. The three basic types of steam autoclave systems are gravity, pre-vacuum and retort systems. Gravity type autoclaves, in which pressure alone is used to evacuate</p>	1  3	4

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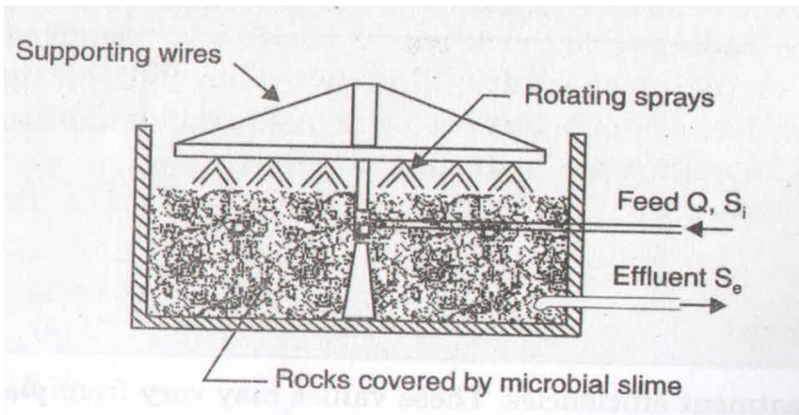
	<p>air from the treatment chamber, operate with steam temperature of about 121°C. These systems require a cycle time of approximately 60-90 minutes. Prevacuum-type autoclave systems evacuate air from the treatment chamber using vacuum pumps. This enables them to reduce cycle times to about 30-60 minutes and system operate at about 132°C. Retort type autoclaves comprise large volume treatment chambers designed for much higher steam temperatures and pressures and therefore their cycle times can be substantially less than other systems.</p> <p>An innovation of autoclave is hydroclave. Here, indirect heating is done by providing steam into the outer jacket of a double-walled container. The treatment time is 15 minutes at 132°C, or 30min at 121°C to achieve sterilization. In this process, the resultant waste is fragmented and dehydrated with reduction in volume and weight</p>		
3-d	<p><b>BOD:</b> It is the amount of oxygen required to degrade organic waste present in water by purely biological means. The biological oxygen demand, ie, BOD in wastewater, is a measure of the quantity of bio-organic substances in wastewater. These can be in the form of fat, oils, carbohydrates and proteins. BOD helps determine the quantum of organic chemicals contained in wastewater that are synthetic and biodegradable</p> <p><b>COD:</b> - It is the amount of oxygen required to degrade organic waste present in water by purely chemical means. COD can help gauge the quantum of both biodegradable and non-biodegradable organics. It is quick method to determine strength of waste in water.</p>	2  2	4
3-e	<p><b>Manmade sources of air pollution are:</b></p> <ul style="list-style-type: none"> <li>i) Rapid industrialization</li> <li>ii) Transportation</li> </ul>	½ mark each for any 8	4



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	<ul style="list-style-type: none"><li>iii) Burning of fossil fuels &amp; fires</li><li>iv) Deforestation</li><li>v) Increase in population</li><li>vi) Agricultural activities</li><li>vii) Solid waste disposal</li><li>viii) Radioactive fallout</li><li>ix) Wars</li><li>x) Construction activities</li></ul>		
4A-a	<p><b>Trickling filter</b></p> <p>Trickling filters are always preceded by primary treatment to remove coarse and settleable solids. The primary effluent is sprayed over the surface of the crushed stone bed and trickles downward through the bed to an under drain system.</p>  <p>Feed :- Inlet for waste water Effluent :- Outlet for treated water Rotating sprays :- For sprinkling waste water on rock bed Supporting wire :- To provide support for rotating arm</p>	3	4



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	Rocks :- to support biological slime	1	
4A-b	<b>Business Benefits of ISO14000:</b> 1. Efficiency, discipline and operational integration with ISO 9000 2. Greater employee involvement in business operations with a more motivated workforce 3. Easier to obtain operational permits and authorizations 4. Assists in developing and transferring technology within the company 5. Helps reduce pollution 6. Fewer operating costs 7. Savings from safer workplace conditions 8. Reduction of costs associated with emissions, discharges, waste handling, transport & disposal 9. Improvements in the product as a result of process changes 10. Safer products 11. Minimizes hazardous and non-hazardous waste 12. Conserves natural resources - electricity, gas, space and water with resultant cost savings 13. Prevents pollution and reduces wastage 14. Demonstrates to customers that the firm has met environmental expectations 15. Meets potential national and international government purchasing requirements 16. Delivers profits from marketing "green" products 17. Provides a competitive marketing tool	½ mark each for any 8	4



	18. Improves international competitiveness 19. Improves the organization's relationship with insurance companies 20. Elimination of costs associated with conformance to conflicting national standards 21. Process cost savings by reduction of material and energy input 22. Satisfying investor / shareholder criteria 23. Helps reduce liability and risk 24. Improved access to capital		
4A-c	<p><b>Necessity of disposal of waste:</b> In every town or city, wastes of different types such as used water from bath rooms, kitchens, basins, semi-liquid wastes of human and animal excreta, dry refuse from sweepings in house and streets, from broken furniture and crockery and waste from various industrial processes etc. are produced daily. The waste will go on accumulating and it will create such an atmosphere that the safety of structures like buildings, roads will be in danger due to accumulated waste in their foundation, if proper arrangements to collect, treat and dispose of all the wastes produced in the town or city are not made . Bacterial diseases will breed up in the stagnant water and the public health will be in danger, total insanitary conditions will be developed, the drinking water will be polluted. Improper handling of solid wastes is a health hazard and causes damage to the environment. The main risks to human health arise from the breeding of disease vectors, primarily flies and rats. T</p> <p><b>Block diagram of solid waste management</b></p>	2	4





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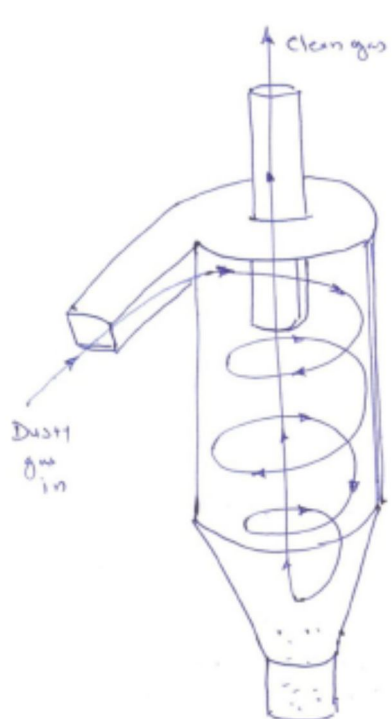
	<p style="text-align: center;">Types of Solid Wastes</p> <table border="1"><thead><tr><th>Food Wastes</th><th>Rubbish</th><th>Ashes and Residues</th><th>Demolition and Construction Wastes</th><th>Special Wastes</th></tr></thead><tbody><tr><td><ul style="list-style-type: none"><li>Animal, fruit or vegetable residues resulting from the handling, preparation, cooking and eating of foods</li></ul></td><td><ol style="list-style-type: none"><li>Combustible paper, plastics, leather, cardboard, wood, rubber etc.</li><li>Non-combustible glass, aluminium cans, crockery, tin cans, dirt, construction wastes etc.</li></ol></td><td><ul style="list-style-type: none"><li>Material remaining from the burning of wood, coal and coke and other combustible wastes in homes, stores, industrial and municipal facilities for the purpose of heating and cooking.</li></ul></td><td><ul style="list-style-type: none"><li>Wastes from the construction, remoulding and repairing of residential, commercial and industrial buildings.</li></ul></td><td><ul style="list-style-type: none"><li>Street sweepings.</li><li>Road side litter from municipal litter containers.</li><li>Dead animals</li></ul></td></tr></tbody></table> <table border="1"><thead><tr><th>Treatment plant wastes</th><th>Hazardous wastes</th><th>Agricultural wastes from agricultural activities like</th></tr></thead><tbody><tr><td><ul style="list-style-type: none"><li>From water, waste water and industrial waste treatment plant.</li></ul></td><td><ul style="list-style-type: none"><li>Chemical</li><li>Biological</li><li>Flammable</li><li>Explosive</li></ul></td><td><ul style="list-style-type: none"><li>Planting</li><li>Harvesting of crop, field etc.</li></ul></td></tr></tbody></table>	Food Wastes	Rubbish	Ashes and Residues	Demolition and Construction Wastes	Special Wastes	<ul style="list-style-type: none"><li>Animal, fruit or vegetable residues resulting from the handling, preparation, cooking and eating of foods</li></ul>	<ol style="list-style-type: none"><li>Combustible paper, plastics, leather, cardboard, wood, rubber etc.</li><li>Non-combustible glass, aluminium cans, crockery, tin cans, dirt, construction wastes etc.</li></ol>	<ul style="list-style-type: none"><li>Material remaining from the burning of wood, coal and coke and other combustible wastes in homes, stores, industrial and municipal facilities for the purpose of heating and cooking.</li></ul>	<ul style="list-style-type: none"><li>Wastes from the construction, remoulding and repairing of residential, commercial and industrial buildings.</li></ul>	<ul style="list-style-type: none"><li>Street sweepings.</li><li>Road side litter from municipal litter containers.</li><li>Dead animals</li></ul>	Treatment plant wastes	Hazardous wastes	Agricultural wastes from agricultural activities like	<ul style="list-style-type: none"><li>From water, waste water and industrial waste treatment plant.</li></ul>	<ul style="list-style-type: none"><li>Chemical</li><li>Biological</li><li>Flammable</li><li>Explosive</li></ul>	<ul style="list-style-type: none"><li>Planting</li><li>Harvesting of crop, field etc.</li></ul>		
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4A-d	<p><b>Cyclone separator</b></p> <p>A dust laden gas enters in a cyclone separator takes spiral motion. It utilizes a centrifugal force generated by spinning gas stream to separate particle matter from the gas. The centrifugal force on a particles in spinning gas stream is much greater than gravity, there for it is effective in removing small particles. The gas spirals downwards to the bottom of the cone and at, and at the bottom the gas flow reverses to form an inner vortex which leaves through the outlet pipe.</p>	2	4																



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	<p>Cyclone separator is used to separate gas-solid, gas-liquid in Cement industry ,Oil refinery, Petrochemical Plant, Power plants, and Metallurgical Industry etc.</p> 	2	
4B-a	<p>Accreditation process: Accreditation is initial evaluation and periodic review of the competence of certifying bodies or EMS auditors or Training bodies for EMS auditors. In certification mechanism, a government agency designates or recognizes an Accreditation Body. There may be a single accreditation Body for both certifying agencies and auditors or two different bodies for each of them. The accreditation body thus established, accredits the certifying bodies as per the standards and these certifying bodies, in turn audits and grants ISO 14001 certificate to the industries. To get ISO 14001 certification, an enterprise has to establish and maintain EMS as per ISO14001 standard. Once, EMS is</p>	3	6



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<p>established and is in operation for sometimes say six months, then the industry can approach to a certifying agency for audit and certification.</p> <p>Different phases of Audit: a) Adequacy Audit: After the application has been scrutinized and accepted, the documented EMS (Environmental Manual etc.) shall be examined by BIS for verifying the conformance to IS/ISO 14001.</p> <p>b) Pre Audit: BIS official shall visit the premises of the organization to resolve any deficiencies observed during the adequacy audit.</p> <p><b>Certification Process:</b></p> <p>Certification is initial evaluation and periodic review of an organization's EMS to determine whether it conforms to the ISO140001 standards. In general, the terms of certification and EMS audit are used interchangeably.</p> <p>An audit team from BIS shall visit the organization for assessment of the organization's compliance to the procedures and activities enumerated in the documented environmental Management System and ISO 14001:1996.</p> <p>The assessment will comprise the following sequence.</p> <p>a) Opening Meeting: The meeting will be conducted by the In charge Audit team with Chief Executive officer of the industry, the environmental management representatives and heads of all the departments. The In charge Audit will explain the scope and extent of the audit and the important terms used in the assessment.</p> <p>b) Conduct of audit: Each auditor has to be accompanied by a guide who is conversant with the activities of the department, the auditor is auditing. Guide must sign the observations recorded by the auditor.</p> <p>c) Closing of meeting and report: The audit team will present their findings during the meeting where the members present in the opening meeting are present preferably.</p>	3	
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	Based on the findings of the audit team and satisfactory report, organization will be granted a license by BIS. Certification indicates that the documentation, implementation and effectiveness of the EMS conform to the specific requirements of ISO 14001. Various certifying agencies in operation are Bureau of Indian standard, Korea Management Association Quality Assurance, International Certification ltd, KPMG quality register etc.		
4B-b	<p><b>Activated Sludge :</b></p> <p>Activated Sludge is aerated sewage containing aerobic microorganisms which help to break it down.</p> <p><b>Activated Sludge Process</b></p> <p>The most common suspended growth process used wastewater treatment is the activated sludge process as shown in figure. Activated sludge plant involves:</p> <ol style="list-style-type: none"> <li>1. wastewater aeration in the presence of a microbial suspension,</li> <li>2. solid-liquid separation following aeration</li> <li>discharge of clarified effluent,</li> <li>4. wasting of excess biomass, and</li> <li>5. Return of remaining biomass to the aeration tank.</li> </ol> <p>In activated sludge process wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolize the suspended and soluble organic matter. Part of organic matter is synthesized into new cells and part is oxidized to CO<sub>2</sub> and water to derive energy. In activated sludge systems the new cells formed in the reaction are removed from the liquid stream in the form of a flocculent sludge in settling tanks. A part of this settled biomass, described as activated sludge is returned to the aeration tank and the remaining forms waste or excess sludge.</p>	1  3	6



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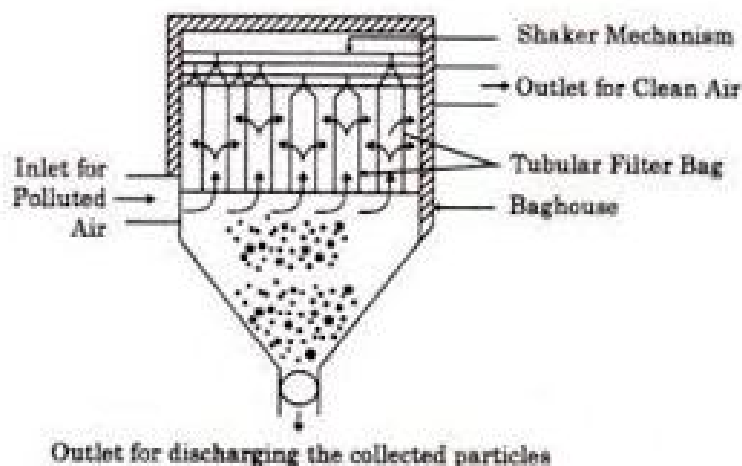
	<p>1. Pretreatment 2. Primary clarifier 3. Aeration tank 4. Secondary clarifier 5. Thickener 6. Sludge digestion</p> <p>—→ Liquid flow ---→ Sludge flow</p>	2	
5-a	Diagram:	3	8



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**Fabric Filter (Baghouse Filter)**

**Working of fabric filter:**

Most fabric filter use long, cylindrical bags (or tubes) made of woven or felted fabric as a filter medium. For applications where there is relatively low dust loading and gas temperatures are 250 °F or less, pleated, nonwoven cartridges are sometimes used as filtering media instead of bags. Dust-laden gas or air enters the fabric filter through hoppers (large funnel-shaped containers used for storing and dispensing particulate) and is directed into the fabric filter compartment. The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it. When sufficient pressure drop ( $\Delta P$ ) occurs, the cleaning process begins. Cleaning can take place while the fabric filter is online (filtering) or is offline (in isolation). When the compartment is clean, normal filtering resumes.

Fabric filter are very efficient particulate collectors because of the dust cake formed on the surface of the bags. The fabric provides a surface on which dust

2

2



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	<p>collects through the following four mechanisms:<sup>[9]</sup></p> <p>Inertial collection - Dust particles strike the fibers placed perpendicular to the gas-flow direction instead of changing direction with the gas stream.</p> <p>Interception - Particles that do not cross the fluid streamlines come in contact with fibers because of the fiber size.</p> <p>Brownian movement- Submicrometre particles are diffused, increasing the probability of contact between the particles and collecting surfaces.</p> <p>Electrostatic forces - The presence of an electrostatic charge on the particles and the filter can increase dust capture.</p> <p>A combination of these mechanisms results in formation of the dust cake on the filter, which eventually increases the resistance to gas flow. The filter must be cleaned periodically.</p> <p><b>Application:</b></p> <ol style="list-style-type: none"><li>Flat fabric filter to be used in wet/dry cleaning system.</li><li>Envelope bags are cleaned by shaking arrangement.</li><li>Round or tubular bags are opened at one side and closed at the other side and are used in variety of forms. Etc.</li></ol> <p><b>Example:</b></p> <p>Metallurgical industry</p> <p>Foundries</p> <p>Cement industry</p> <p>Chalk and lime plant etc.</p>	1	
5-b	<p><b>Solid waste collection from house to house :</b></p> <p>Types:</p> <ul style="list-style-type: none"><li>• Curb service</li><li>• Alley service</li></ul>	4	8



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	<ul style="list-style-type: none"><li>• Set-out service</li><li>• Set-out set-back service</li><li>• Back-yard service</li></ul> <p>i) Curb service: the refuse containers placed at the curb on the scheduled day by house-owner are collected by workers from refuse vehicle and emptied into vehicle.</p> <p>ii) Alley service: this method is similar to the previous one, except that the containers are placed at the alley line instead of curb.</p> <p>iii) Set-out service: the workers with refuse vehicles collect the containers from individual houses and empty them in refuse vehicles. The empty containers are collected by the house – owners.</p> <p>iv) Set-out set-back service: set-out men collect the containers from individual houses and empty them in refuse vehicle. Set- back men return the empty containers to house owner.</p> <p>v) Back-yard service: the workers with refuse vehicle carry bin, wheel barrow etc. to the back yard and empty the refuse containers in it.</p>	1 mark each for any 2	
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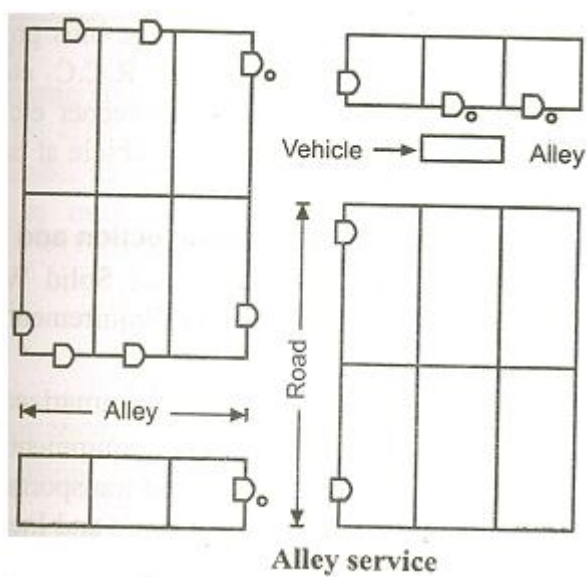
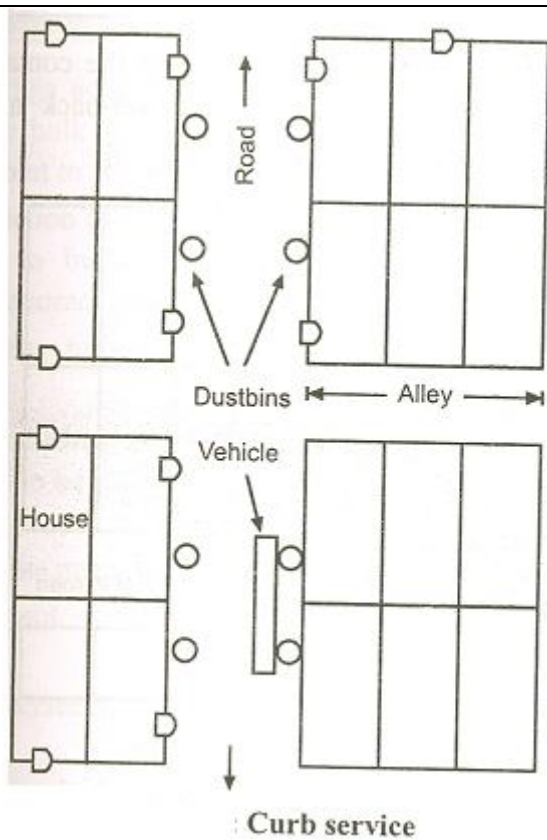


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diagrams

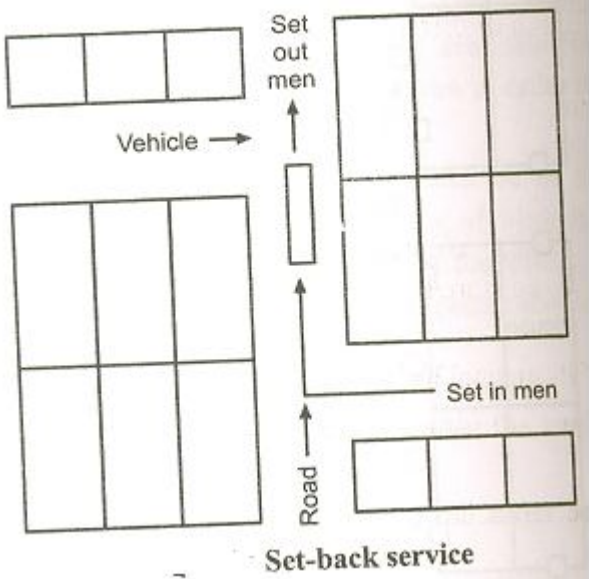




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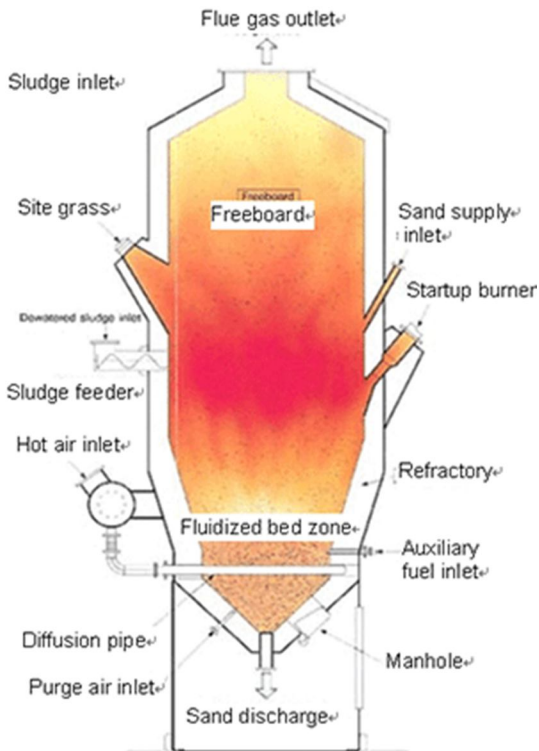
			
5-c	<p><b>Sludge incineration:</b></p> <p>Types:</p> <ul style="list-style-type: none"><li>i) combustion of waste material: when solid waste material combusted , the gaseous end products like <math>\text{CO}_2</math>, <math>\text{H}_2\text{O}</math> , <math>\text{N}_2</math>, <math>\text{SO}_2</math>, other gaseous components are formed.</li><li>ii) incineration with heat recovery :existing mass-fired incinerator, waste heat boiler installed to extract heat from the combustion of gases.</li><li>iii) water wall incinerator: the internal walls of the combustion chamber are lined with boiler tube that are arranged vertically and welded together in continuous sections of these incinerator. When in place of refractory materials water walls are used they are useful for heat recover by controlling furnace wall temperature without introducing excess air.</li></ul> <p>Diagram (any one type):</p>	5	8



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		3	
6-a	<p><b>Role of environmental audit in sustained development:</b></p> <ul style="list-style-type: none"><li>i) It is in the interest of industry to practice EA to protect, conserve and manage the environment.</li><li>ii) EA in the industrial sector would entail a “cradle to grave ” approach in which all steps of manufacturing a product, selection of raw material, process design, identification of technology for manufacturing, use of energy , reuse of materials, recycling and disposal of the products are taken into consideration.</li><li>iii) adoption of these EA approach opens many economics opportunities to the manufacturing sector.</li><li>iv) sustainability demands the overall maintenance of ecosystems and related ecological processes for the functioning of the biosphere, and</li></ul>	4	4



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	<p>the industry must realize its responsibilities and contributes its share in maintenance of ecological balance.</p> <p>v) EA conducted for an “industry ” focusses itself:</p> <p>a. to input-output analysis in respect of raw materials, energy and water</p> <p>b. to conduct health and safety audit</p> <p>c. to conduct environmental quality audit.</p>														
6-b	<table><tr><th colspan="2">Types of solid wastes</th></tr><tr><th>types</th><th>Example of sources</th></tr><tr><td>Food wastes</td><td>Animal, fruits and vegetable residues resulting from the handling and preparation, cooking and eating of foods</td></tr><tr><td>Rubbish</td><td>1.cobustible papers, plastics, leather, cardboard, wood, rubber etc. 2. Non-combustible glass, aluminium cans ,crockery, tin cans , dirt, construction wastes.</td></tr><tr><td>Ashes and residue</td><td>Material remaining from the burning of wood, coal, and coke and other combustible wastes in homes, stores, industrial and municipal facilities for the purpose of heating and cooking</td></tr><tr><td>Demolition and construction waste</td><td>Wastes from construction, remoulding, repairing of residential , commercial and industrial buildings</td></tr></table>	Types of solid wastes		types	Example of sources	Food wastes	Animal, fruits and vegetable residues resulting from the handling and preparation, cooking and eating of foods	Rubbish	1.cobustible papers, plastics, leather, cardboard, wood, rubber etc. 2. Non-combustible glass, aluminium cans ,crockery, tin cans , dirt, construction wastes.	Ashes and residue	Material remaining from the burning of wood, coal, and coke and other combustible wastes in homes, stores, industrial and municipal facilities for the purpose of heating and cooking	Demolition and construction waste	Wastes from construction, remoulding, repairing of residential , commercial and industrial buildings	4	4
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6-c	<b>Effect of acid rain:</b>  i. Acid rain causes acidification of lakes and streams ii. Acid rain contributes to the damage of trees at high elevations iii. Acid rain damage many sensitive forest soils. iv. Acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. v. SO <sub>x</sub> and nitrogen oxide (NO <sub>x</sub> ) gases and their particulate matter derivatives—sulfates and nitrates—contribute to visibility degradation and harm public health. vi. nitrogen fixing activity by soil bacteria is inhibited. vii. human nervous system, respiratory system , digestive system etc. may get affected.	4	4								
6-d	<b>Sources of oil pollutant in sea water pollution:</b>  i) Cargo tanker washings at sea: a recent estimate indicates that about 3 million tonnes of oil are added annually to the sea by using sea	4	4								



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	<p>water as ballast for empty tankers.</p> <p>ii) import oil losses: collisions in port contribute one million tonne of oil in sea water annually</p> <p>iii) Bilge pumping at sea :the dumping of bilge contents by ships adds nearly 500000 tonne of oil per year in sea water, while total influx of oil into ocean has been 5 to 10 million tonne annually.</p> <p>iv) oil leakage from 20000 miles of pipe lines which cross water ways may undergo corrosion, cracks or punctures and would lead to oil pollution in sea water.</p> <p>v) the blow out of wells, disposal of drilling muds, accidental damages to offshore drilling rigs add to oil pollution in water.</p> <p>vi) Recent- oil-based technology and vessel accidents near sea shore add to extensive marine oil pollution.</p>		
6-e	<p><b>Land application and marketing for treated sewage sludge:</b></p> <p><i>Land application:</i></p> <p>Most of the treated sewage sludge is applied to farmland as a soil amendment .Rules regulating sewage sludge treatment and land application may be insufficient to protect public health and the environment. We used qualitative research methods to evaluate health and quality of life near land application sites.</p> <p>Municipal wastewater must be treated before it is returned to the environment. Sewage sludge is the solid by-product of wastewater treatment. Most of the sludge created by municipal wastewater treatment plants undergoes biological, chemical, or thermal treatment and is then applied to farmland as a soil amendment or fertilizers.]. Treated sewage sludge, also called bio- solids, contains nutrients useful as fertilizers . Treated sludge is usually applied to land</p>	2	4



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	<p>as a liquid spray or solid cake, creating aerosols and dust particles that can drift downwind from the application sites.</p> <p><i>Marketing:</i></p> <p>Sewage sludge is an increasing concern in Country, because of the extended sewerage control and advanced wastewater treatments resulting from urbanization and economic growth. Based on the evolution of municipal sewage generation and treatment technologies in the last decade, as well as the long-term national and local plans in country, the Marketing for treated sewage sludge business has a considerable market potential for globalization</p>	2	
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