CHAPTER-2

SOLID WASTE
SOLID WASTE GENERATION FROM MAJOR INDUSTRIES IN ORISSA

Sugar Industries generate two types of Solid Wastes, Bagasse and Press mud.

Bagasse: - The residue left after crushing Sugar Cane is about one third of the total cane crushed. More than 90% of the bagasse is consumed as fuel in boilers.

Press mud: - This is settled sludge in the Juice Clarification. It contains all non-sucrose impurities in the piece along with calcium carbonate and sulphate. It contains valuable nutrients like N P.K. etc and is used mainly as organic manure.

The most important solid waste in Chlor-Alkali industry is brine mud generated during the process of purification of brine. In India for every 1000 tons of caustic alkali, 16 tons of calcium carbonate and 12.6 tons of magnesium hydroxide are generated. Brine mud contains substantial amounts of mercury (10.30mg/gm) carried by the return brine from the electrolytic cell.

The solid waste generated in Rourkela Steel Plant is Blast Furnace flue dust. It is collected in dust catcher. The dust generated per annum is about 70,000 tons, which
are disposed off presently as useless waste. Another solid waste, slag was generated from charge chrome plant. Around 66,000 tons of slag for the production of 58,000 tons of charge chrome per annum. This slag is used for road making and filling low-lying areas.

**Gypsum from Phosphatic Fertilizer Plants:**

About 20% by weight of phosphogypsum is generated in the production of phosphatic fertilizer by the decomposition of phosphatic rock with sulphuric acid. For every ton of phosphorus pentoxide produced, nearly 5 tons of Phosphogypsum are produced containing F (0.8%), P$_2$O$_5$ (1-0%), CaO (30-32%). Presently they are mostly stored in lagoons or discharged into sea. Phosphogypsum can be used for

(i) Soil amendment to check infiltration and run off in arable soils in arid and Semi arid zones
(ii) Reclamation of saline/alkaline soil by bringing down the Sodium level
(iii) Conversion into slow release fertilizer.

**Red mud from Aluminum Plant:**

Red mud is the undissolved material after the digestion of bauxite with alkali to recover alumina in Baeyer's process. Approximately one ton of red mud is generated for every ton of aluminium. NALCO, Orissa generates about a million tons of red mud annually.
The major components of red mud are silica, and heavy metals like iron, titanium and aluminium. The minor components are phosphorus, gallium, sodium and vanadium [4].

Due to lack of appropriate technology red mud is being discharged as useless waste in specially constructed ponds consuming vast areas of land and posing potential environmental hazard. Since there is always the risk of break or spillage under adverse natural conditions, generation and disposal of red mud have become a matter of global concern, leading to extensive studies in many alumina producing countries to find economical use of red mud.

These efforts include use of red mud,

(i) as a source for production of iron, aluminium, titanium
(ii) recovery of strategically important elements like vanadium, zirconium, thorium, gallium, scandium etc.
(iii) production of cement and other building materials.
(iv) source of inorganic chemicals.
(v) as a material for treatment of gaseous and liquid effluents.
(vi) as a catalyst and catalyst support.
(vii) ceramics and tiles filler in rubber.
(viii) recovery of alkali.
FLY ASH AND COAL CHAR: ORIGIN, DISPOSAL AND COMPOSITION

FLY ASH

Fly ash which is also known as “Pulverized Fuel ash” is obtained as a fine particulate mineral residue left behind after all the combustibles in the Coal or any pulverized fuel are burnt out. In modern thermal power stations, pulverized coal is used and fly ash is obtained as waste product in large quantities. The ash is recovered with the help of cyclones and electrostatic precipitator from the flue gases and collected in hoppers. The most common mode of disposal is to carry it in the form of slurry to an ash pond and then let out the supernatant liquid to a stream or to simply bury them.

In India the annual production of fly ash from different coal based thermal power units is nearly 30 million tons. The figure is likely to reach 90 million tons by the turn of this century. In Orissa the coal available has ash content as high as 40%. So the daily generation of fly ash from its large and medium sized thermal power plant is of the order of 4000 – 5000 tons. The land required for ash pond is about 4000-5000 square meter, with about 10 meter deep for megawatt capacity of power generation to last for about 20 years. The existing Power Plants in Angul – Talcher require about 2000 acres for ash-pond. To save the precious land and to avoid its after effect due to the accumulation, fly ash needs massive utilization programmes. While countries like
UK, Germany, France, China utilize 60% of the fly ash in their building and road making. In India the utilization of fly ash is about 5%.

The Chemical Composition of fly ash is given in Table-2.1. The minerals during combustion transform to mullite, magnetite, tridymite etc. forming composite fly ash. The Chemical analysis indicates that Silica and Alumina are the two major components in the fly ash. Silica contains oxygen bridges between the silicon atoms. The central ion of Silicates ($\text{Si}^{4+}$) has a very strong affinity for electrons, therefore the oxygen atoms bound to the silicon ion have a low basicity causing the silica surface to act as a weak acid. The alumina content in fly ash plays the major role in the removal of anion. The anions are probably adsorbed on the alumina surface because of the strong tendency for chemical bonding between the anionic group and alumina. Being of clay origin, heat-treated and aided by properties like porosity, high specific surface and chemical inertness to water and dilute acids, fly ash is well suited for adsorption purposes in aqueous medium [5].

**COAL CHAR**

Coal char, a solid waste is generated by sponge iron industry. In sponge iron industry coal char is used for the reduction of iron ore. Iron ore is subjected to smelting on mixing with coal and limestone. The unburnt coal left out in the blast furnace is called coal char. Due to rapid growth of sponge iron industry in Orissa, large quantities of coal char is produced annually. Presently this solid waste is not utilized
for any specific purposes except for road building. Studies are on for use of this solid waste.

The chemical composition of coal char (char) given in Table-2.2 indicates that carbon, silica and alumina are the major components. Silica contains oxygen bridges among the silicon atoms. The central ion of silicates (Si$^{4+}$) has a very strong affinity for electrons, and therefore the silica surface acts as a weak acid. The alumina content in coal char plays the major role in the removal of anion. The anions are probably adsorbed on the alumina surface because of the strong tendency for chemical bonding between the anionic group and alumina. Carbon content makes the coal char a well suited substrate for adsorption in aqueous medium[5].

**Table-2.21** Composition of Fly ash in %

<table>
<thead>
<tr>
<th>Component</th>
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<th>Component</th>
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<tbody>
<tr>
<td>Silica</td>
<td>48.20</td>
<td>Na$_2$O</td>
<td>1.74</td>
</tr>
<tr>
<td>Alumina (Al$_2$O$_3$)</td>
<td>30.22</td>
<td>MnO</td>
<td>0.024</td>
</tr>
<tr>
<td>Calcium as CaO</td>
<td>1.36</td>
<td>SrO</td>
<td>0.03</td>
</tr>
<tr>
<td>MgO</td>
<td>0.46</td>
<td>V$_2$O$_5$</td>
<td>0.056</td>
</tr>
<tr>
<td>Fe$_2$O$_3$</td>
<td>3.70</td>
<td>Moisture</td>
<td>1-2</td>
</tr>
<tr>
<td>Loss in Ignition</td>
<td>8.20</td>
<td>UO$_2$</td>
<td>2.2x10$^{-4}$</td>
</tr>
<tr>
<td>TiO$_2$</td>
<td>1.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table -2.22 Composition of Coal char in %

<table>
<thead>
<tr>
<th>Components</th>
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<th>Components</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Matter</td>
<td>2 to 3%</td>
<td>Fe$_2$O$_3$</td>
<td>6 to 7%</td>
</tr>
<tr>
<td>Fixed Carbon</td>
<td>27%</td>
<td>MgO, TiO$_2$</td>
<td>2 to 3%</td>
</tr>
<tr>
<td>SiO$_2$</td>
<td>45 to 47%</td>
<td>Alkali Metals (Na, K)</td>
<td>1 to 2%</td>
</tr>
<tr>
<td>Alumina as Al$_2$O$_3$</td>
<td>10 to 12%</td>
<td></td>
<td></td>
</tr>
</tbody>
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