

# **Chapter – 7**

## **Re-Utilization of Sludge from Steel Industry**

## **7.0. Solid Waste Management:**

The main activities of the solid waste management of any steel industry are to Reduce, Reuse, Recycle & Restore the materials i.e. 4 Rs. To achieve the target of go clean, green & zero waste tools, principal to sustainable development of the steel industry; the reuse & recycling of the entire solid waste generated in the process of steel making is a practicable solution. Because of the competitive standards all over the world, input costs rise, raw material scarcity & solid waste generated there was a phase of uncertainty, volatility and speculation and that's why there is a huge importance of solid waste management in the steel industries. The big challenge of any steel industry facing today is to meet the necessity of a sustainable development by meeting the needs of our present generation without compromising the ability of future generations. In the manufacturing of the conventional products by utilizing the solid waste various different technologies have been developed and technologies are there for the conversion of the same into a completely new product.

From the scrap materials, using the various different furnaces like BF (Blast Furnace), BOF (Basic Oxygen Furnace) & EAF (Electric Arc Furnace), the steel is manufactured. In presence of coke the molten iron is produced in blast furnace and in presence of oxygen inside the basic oxygen furnace the molten steel is produced. The carbon reduction in blast furnace is through the smelting & refining process and there produces the molten iron and the process of decarburization of the molten iron to create molten steel. After that to produce billets and slabs; the molten steel is controlled to a target composition & temperature for the processing into continuous casting machine and at last, finally the castings are rolled to the requisite proportions in the rolling mill to acquire the finished steel products. The coke oven by-products, sinter plant, rolling mill, refractory materials,

blast furnace, basic oxygen furnace, steel melting shop are the various sources of the solid wastes generated in the steel industries. The coal & coke dust, blast furnace slag, steel melting shop slag, mill scale, scrap, oil sludge, fly ash, acid sludge, refractory wastes are the main classification of the solid wastes from the steel industries. Apart of the huge financial liability the dumping of the solid waste in open space & the excavated land creates environmental pollution in the form of dusts. With the alarming growth in human population, the available land is inadequate now-a-days for discarding the solid waste. A major drive is now very necessary to be given to find the way on the scope of reprocess of these solid wastes. In India, the creation of solid waste is approx. 1.6 ton for per ton of steel manufactured and in abroad it is around 0.53 ton, as we are using the inferior quality of raw material. Near about 65% of the total generated solid wastes from the steel plant are usually discarded & dumped in the nearby open space, which should to be recycled again in a very proper way and should be reused to achieve a zero waste target.

### **7.1. Sludge Treatment, Reuse and Disposal:**

The on-site treatment of wastewater from different processes of steel industry & the off-site i.e. activated sludge systems are the main producer of sludge from any steel industry. Removing of solids from the wastewater is essentially the first aim of the wastewater treatment system. The soluble organic substance is transformed to the bacterial cells & after that is removed from the wastewater, in addition of the treatment system. A less organic sludge is also produced from the storm of the water to the wastewater sludge.

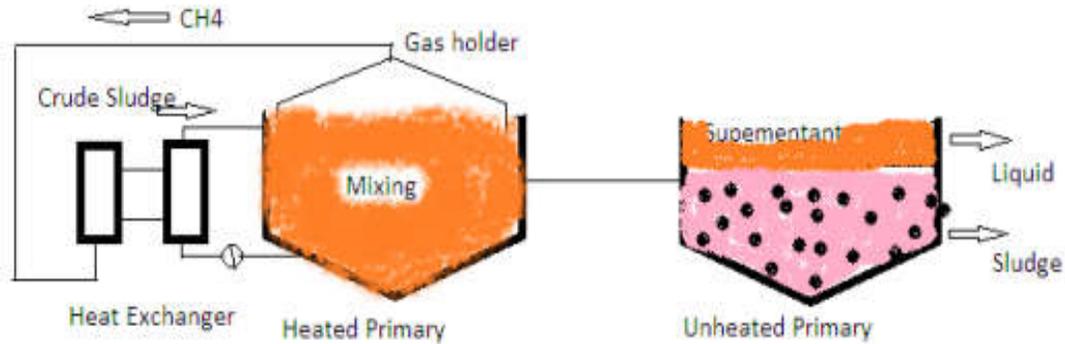
The characteristic of the sludge is the deciding criteria for the treatment required processes. The sludge should always be handling with extra care, to avoid the contact with pathogens. The Pre-

treatment of the industrial wastes is very essential before discharging to the sewer, as when industrial wastes are disposed into the sewer, the sludge may be contaminated with heavy metals and other pollutants. If the sludge is infected with high concentration of the heavy metals or poisonous chemicals, then the treatment of sludge becomes more difficult and the possibilities for the reuse of the same will also be limited. The processes of stabilization, thickening, dewatering, drying & incineration are the different processes for the sludge treatment.

The waste treatment process which involves the combustion of organic substances contained in waste materials are the process of incineration. The high temperature waste treatment system like incineration and some other processes are described as the 'Thermal Treatment' process. The waste materials are converted into ash, flue gases & heat by the process of incineration and this process mainly used when the sludge is greatly infected with the heavy metals & other unwanted pollutant. The contamination of the sludge by the industrial wastes is preferable prevented by the process of incineration. For removing the sludge from the waste water & for the treatment of the waste water the cost is almost same.

## **7.2 Stabilization:**

The process of reducing the biological oxygen demand [BOD] is the stabilization. The process of stabilization is generally processed under the condition of anaerobic & aerobic. Like an activated sludge process, the aerobic stabilization of primary & secondary sludge can also be carried out in an aeration tank. When the aerobic stabilization is used for composting process, it requires less energy. To be handled as a solid, its contents should be more than 15% in the process of composting. To achieve the required solids content, the processes of thickening and dewatering of primary & secondary sludge is requisite.



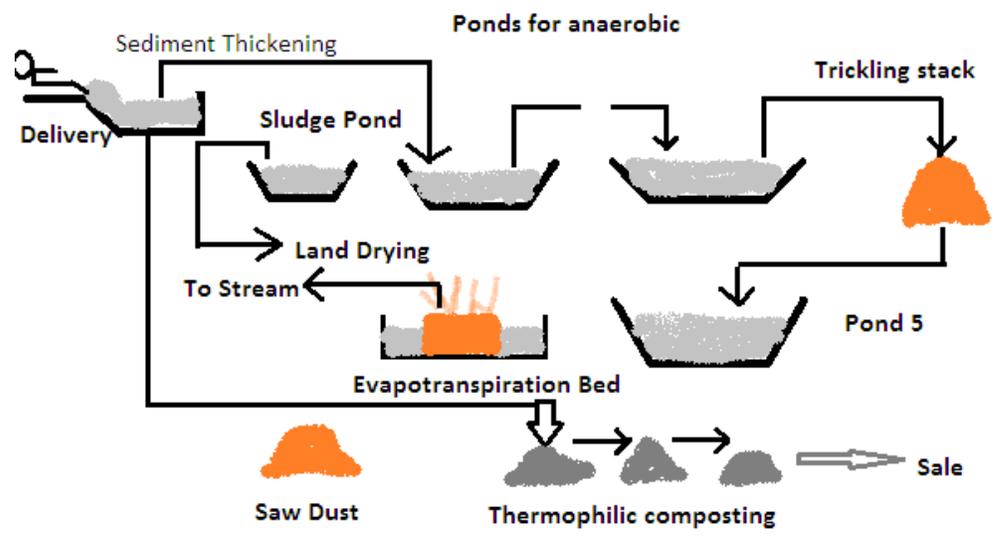
**Figure: 7.1 Simple Anaerobic Digestion Process**

The bacterial decaying process used to stabilize the organic wastes and produce a mixture of methane & carbon dioxide gas or bio-gas, is the anaerobic digestion process. For heat value the gas methane is considered same as the usual petroleum gas and the biogas is also a very precious efficient source of energy. In a specially built digester the content is mixed in the anaerobic digestion process and the temperature of the digester is generally maintained at 36°C, and in this process after combustion the biogas is produced. After the digestion process, the sludge is passed to a sedimentation tank for it to be thickened, and further to this, the thickened sludge requires treatment proceeding to reuse or removal.

**7.3 Thermophilic Composting:**

An aerobic process of decaying the bacteria to stabilize the organic wastes & produce the compost (humus) is the process of composting. The compost mostly contains nutrients & natural carbon and these are exceptionally excellent soil conditioners. The most favorable setting & composition for composting are the moisture content of about 50 percent, a carbon to nitrogen ratio of about 30 to 35 and the temperature of about 60 °C. The carbon to nitrogen ratio of wastewater sludge is very low and is generally of approx 6 to 12 and is rich in nutrients and it is also very high in the moisture content. The dry sawdust is very high in carbon to nitrogen ratio

i.e. of about 500 and the adding together of this can regulate both the moisture & also the carbon to nitrogen ratio. The temperature of sludge from the various different processes like the blast furnaces, hot rolling mills, coke oven in steel industry is generally very high and this temperature of sludge can utilize for the composting process of Thermophilic. This is an important heating phase in the process of Thermophilic composting. The microbial metabolism is the main source of the heat and is dependent on the size of the stack. Often the temperatures from the various processes of the steel industries are generally higher or lower, but ideal temperature during the heating stage is in the range of 60°C. The 'batch' model is generally followed by this type of composting processes; that means all the materials are piled up at one time in a heap and further no more is added during the first phase of the process. A critical mass of materials is required in order to establish a continuous heating phase. Assuming adequate Carbon & Nitrogen ratio, a pile needs to be at least one (01) cubic meter in size. The hot composting can be achieved with a material in the pile of a carbon to nitrogen ratio in between 20:1 to 40:1, but preferably it should be in between 25:1 to 30:1.



**Figure: 7.2. Thermophilic composting of sludge using sawdust**