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# How wastes generated in Thermal Power Plant get treated? A Review

Shivani Mridula

M.SC. EVS. / UGC-NET, Banaras Hindu University

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**ABSTRACT**

*Although Thermal Power Plant has its great utility, though it releases huge amount of wastes in the environment. For the generation of electricity, our environment is kept at stake. For the training purpose, I visited Obra Thermal Power Plant, Uttar Pradesh where I have studied the operation and management and conducted experiments for its credibility. This paper consists of the results of the detailed study and experimentation conducted on the management of wastes during my training period. The major concern for the plant is of low graded coal supply which generates huge amount of ash and also the required proportion of ash doesn't get collected by the cement factories for some reasons. Concerning Environmental issues, harmful gases like Carbon Monoxide, Nitrous Oxide, Sulphur etc are changed into harmless gases before releasing into the chimneys through installation of Fly Gas Chamber and Electrostatic Precipitator.*

*The treated and untreated waste water have been compared and found positive results for various essential parameters. However, the problem is with the Effluent Treatment Plant which doesn't run frequently as per the need. The huge ash generation is also pumped to Ash Pond, 5 km away from the plant by making slurry and the water gets used up is recycled through Ash Water Recirculation System. If the height of embankment is not maintained properly then contaminated water gets drained into the Renu River, a tributary of river Ganga and pollute the river. The findings provide major concerns raised for the environment and the plant as well. These must be sorted out in order to ensure eco-friendly generation of electricity through Thermal Power Plant.*

*Keywords: Thermal Power Plant, Waste management, Fly Gas Chamber, Electrostatic Precipitator, Effluent Treatment Plant, Ash Pond, Ash Water Recirculation System, Embankment, Eco-friendly.*

## 1. Method & Materials Required:

***For Ash Handling:***

In Obra thermal power station, there are operating units of various capacities. In 200 MW unit, average coal consumption is 130 ton/hr. The Calorific value of recommended coal for the plant is 4700 kcal/hr. Ash content of this type of coal is approx. 40%. This rate of 40% ash generation is equivalent to about 52 ton/hr ash is generated in 200 MW unit i.e. only one unit.

***Collection of Ash:***

| Equipment | Amount of Collection |
|---|---|
| BOTTOM ASH HOPPER | 20% |
| ECONOMISER HOPPER | 5% |
| AIR PRE HEATER | 5% |
| ELECTROSTATIC PRECIPITATOR | 70-85% |

***Disposal of Ash:***

- Bottom Ash Hopper: 11 ton/hr of Ash is accumulated & dispersed in Ash slurry sump from which is dumped into Ash Pond.
- Economiser Hopper & Air pre Heater: to recover heat from flue gases and then send to Air as Fly Dry Ash.
- Electrostatic Precipitator- About 39 ton/hr collected in their hopper , evacuate to cement factories through conveying lines (30%) and remaining is sent to Ash Pond.

**For Waste Water treatment:**

The Civil Maintenance Division manages ETP (Effluent Treatment Plant) to treat the effluents generated. The treated & the untreated wastewater have been compared by testing the following parameters:

- pH
- Oil & Grease
- TDS
- TSS
- COD

## 2. Sampling and testing procedures of treated wastewater

***Sampling Procedure*:**

Samples are to be taken at regular intervals to check whether the plant is giving the desired output and any corrective measures are called for. It is essential that the collected samples be truly representative of the product. While collecting samples the following procedures are to be adhered to:

a) Samples are to be collected in dry, clean and stoppered bottles
b) The bottles are to be rinsed thoroughly before collection of samples
c) While collecting sample from channel, launder, sample is to be collected only from surface. Avoid the bottles touching or scraping the surface of the structure.

d) Stopper the bottles after collection of sample.
e) Attach a tag on the bottle indicating date, time and name of sample and tests to be carried out.
f) While collecting composite samples it is suggested that the samples be preserved in refrigerator to avoid any biological activity within the samples

***Test for pH Determination***

Procedure:

- Standard pH solutions of 4.7 and 9.2 pH using pH tablets were taken.
- It was standardized with the standard pH solutions.
- The pH of the sample of wastewater was determined.

Precaution: We should Standardize the pH meter every day.

***Test for Oil & Grease***

Procedure:

- 100 ml of silica or glass dish was weighed.
- 50 ml of sample in a separating funnel and add 2-3 ml of conc. HCl was taken.
- Then, 10 ml of $CCl_4$ was added, shaken well and allowed to stand for 5 minutes. The procedures were followed 3-4 times i.e. total of 30-40 ml of $CCl_4$ was added.
- Lower layer of sample through separating funnel was discarded and remaining $CCl_4$ part in weighed silica or glass dish was taken.
- Carbon tetrachloride was evaporated on a water bath and the final weight of dish after cooling in a dessicator was taken.

Calculation:

Oil and Grease, mg/l = (A-B) x 1000/V

Where, A= Final weight of dish in mg
B= Initial weight of dish in mg
V= Volume of sample in ml

***Total Dissolved Solids***

Procedure:

- 100 ml of silica dish was weighed.
- the sample was centrifuged and 20 ml was taken in the silica dish.
- the sample was evaporated at 80-100 deg. C
- the final weight was taken after cooling in a dessicator

Calculation:

Total dissolved Solids, mg/l = (A-B) x 1000/V ml of sample

Where,
A= Final weight of the dish in mg
B= Initial weight of dish in mg

***Total Suspended Solids***

Procedure:

- About 100 ml of distilled water was passed through filter and filtered was dry to constant weight (for about 15-30 minutes) in oven at 103 deg. C. Cool the filter to room temperature in dessicator and initial weight of filtered was measured.
- Carefully, the filter in the filtration setup was placed and passed as much volume of the sample as would pass through it easily.
- The volume of the sample that has been poured on the filter was recorded.
- the filter in oven was placed and dried to constant weight (for at least 1 hour) at 103 deg.C
- the filter was cooled in a dessicator and measured filtered weight.

Calculation:

Total Suspended Solids (mg/l) = (a-b-c)*1000*1000/Sample Volume (l)

Where, a= weight of filter with solids (in mg)
b = weight of filter alone (in mg)
c = blank correction (in mg)

***Test for Chemical Oxygen Demand (COD)***

Procedure:

- 0.4 g HgSO4 in a COD flask was used and 20 ml sample added.
- glass beads were followed by 10 ml $K_2Cr_2O_7$ solution
- slowly 30 ml $H_2SO_4$ reagent was added and mixed well. If colour turned green more $K_2Cr_2O_7$ and $H_2SO_4$ were added.
- It was Refluxed for 2 hrs cooled and then washed down condenser with D/W
- It was Diluted for minimum 150 ml cool and titrated with 0.1 N Fe(NH4)SO4 using ferric indicator till wine red and paint
- It was Refluxed blank in the same manner using D/W instead of sample

Calculation:

COD mg/l = (a-b) x 8000 x N/ml. sample

Where, a = ml $Fe(NH_4)_2(SO_4)_2$ for blank
b= ml $Fe(NH_4)_2(SO_4)_2$ for sample
N= normality of $Fe(NH_4)_2(SO_4)_2$

**Table 2: List of Lab Equipment & Chemicals Required for the above performed test:**

| S.No. | Test | Apparatus | Chemicals |
|---|---|---|---|
| **1.** | pH | pH meter | pH tablets of 4.7 and 9.2 |
| **2.** | TSS | Silica Dish, Hot Air Oven | - |
| **3.** | Oil & Grease | Separatory funnely, water bath, filter paper, silica dish | CCl4, conc. HCl |
| **4.** | Chemical Oxygen Demand | Reflux apparatus, Hot plate with temperature regulator | Dry K2Cr2O7, H2SO4, Ag2SO4, Fe(NH4)2(SO4)2.6H2O, HgSO4 crystal analytical grade, 1,10-phenonthroline monohydrate, FeSO4.7H2O |

### 3. Result & Discussions:

**Table 3: The results of the above experiments have been mentioned below:**

| Serial NO. | Parameters | Ash pond effluent | ETP inlet | ETP outlet | Standard Tolerance limit: |
|---|---|---|---|---|---|
| **1.** | pH | 7.79 | 7.52 | 7.30 | 5.5-9.0 |
| **2.** | TSS (mg/l) | 141.0 | 95.7 | 63.2 | 100.0 |
| **3.** | TDS (mg/l) | 120.4 | 98.5 | 49.8 | NA |
| **4.** | Oil & Grease (mg/l) | 4.2 | 3.3 | 2.4 | 10 |
| **5.** | COD (mg/l) | 25.3 | 27.5 | 25.6 | 250 |

The above results indicate the proper functioning of the ETP and the waste water gets treated efficiently. All the values of the common parameters which have been examined are found to be within the prescribed standard limits. Therefore, this treated water is safe to discharge into the river Renu, a tributary of river Ganga. There should be monitoring from time to time at fixed interval to check the efficiency of the ETP.

***(a) (b) (c)***

***Fig.: (a) & (b) the Ash Pond at the Chakari village of Obra where all the ash mixture get dumped into. Fig. (c): shows the Decantation well which leads to the entering of upper layer water through it.***

***Fig.: the rapid mixing tank, the settling tank and the storage tank of ETP respectively.***

### 4. Conclusion

The primary aim is to share experiences of the study and experiment conducted for the waste treatment and management of the ash handling division at Thermal Power Plant and also to highlight the major concerns associated with it.

It is ensured that the generation process does not affect any environmental parameters like air, water, soil and surroundings. However, the low graded coal supply affects this process. All requisite machineries have been installed in the plant premises for the waste treatment and minimizing environmental pollution. Trained personnel have been employed to operate all this machinery and ensure proper waste disposal. But, most of these machineries are not operating as per need.

The Ash Handling Division & the Civil Maintenance Division are actively involved in regularly monitoring and awareness program like afforestation, waste disposal, and awareness program through digital board and so on. However, more greeneries are required near the surrounding in order to control Air pollution.

The treated wastewater monitories show that all the parameters evaluated are within the prescribed limits. Monitoring is done without fail on a monthly basis and in case any parameter is found to exceed the present limit, cause for the same is corrected and detected. However, the Effluent Treatment Plant is not operated frequently. It means from environmental point of view this plant is well maintained, impressive and disciplined if all the problems would be sort out cautiously.

 

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