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Research Article

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Study of Oil and Grease pollution near Thermal power plant, Tuticorin, Tamil Nadu, India

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ABSTRACT

The oil pollution of seawater is an important problem especially for its toxicity on marine organisms and being a cover on surface water preventing the penetration of oxygen into sea water. In this paper oil pollution levels were determined in sea water and sediment samples of Tuticorin Bay near Thermal power plant. Three stations were fixed and oil concentrations were varied in examined area. The highest level found in station 1 near thermal power plant. Oil concentration was recorded maximum of 130.8 mg/L in surface water and sediment showed 86 mg/g in station 1. The studies revealed that the oil concentrations mainly depend on earlier ash dumpsite and water out fall from Thermal power plant.

Key words: Oil pollution, water and sediment samples, Tuticorin Bay, Thermal power plant, ash dumpsite

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INTRODUCTION

Industrial effluent characteristics provide basic information about the integrity of the aquatic habitat within such rivers and streams into which they are discharged and most of industries discharged their wastes directly to the river, canal or sea which are characterized by their abnormal turbidity, conductivity, chemical oxygen demand, total suspended solids and total hardness [1, 2, 3]. The main components of any thermal power plant are: furnace, boiler, turbine, generator, condenser, chimney and other auxiliaries such as forced draft pump, air heaters, de-aerators, economizer, and boiler drum. In its operation, the combustion of fuels (coal, gas, crude oil) in furnace supplies heat to produce steam inside the boilers, which is used to generate mechanical energy in a turbine; this energy is subsequently converted by a generator to electricity [4, 5, 6]. The source and pollution from TTPS is the discharge of waste water. The waste water consists mainly of acidic and alkaline chemical solutions used in cleaning power plant equipments, acidic water drainage from coal storage and waste water contaminated with petroleum products such as oil and grease [7]. In this present investigation the study area was near thermal power plant. Much chance for oil and grease pollution in this coastal area. So studying the pollution of oil and grease was useful for taking necessary steps.

1.1 Description of study area

TTPS (Tuticorin Thermal Power Plant) is a coal – fired thermal power station and hence large amount of fly ash (6,000 Metric Tonnes per day) is generated during the process. The hot water effluent generated by cooling the condenser is pumped directly into the Bay. Earlier until 1991 the fly ash was dumped into sea by power plant. In this present investigation, the study area is located near the earlier fly ash dumpsite in Tuticorin and presently the hot water effluent generated by cooling the condenser has pumped directly into this area.

Station 1 : 500 meters away from water outfall of power plant (Earlier ash dumpsite) (N 08° 46' 48.3" & E 078° 10' 76.3"). This area does not contain any biological system due to the water with high temperature from outfall of thermal power plant and the presence of fly ash.

Station 2 : 2 km away from the water outfall of power plant (N 08° 47’ 32.0” & E 078° 10’ 80.3”). This area does not contain any biological system. The impact of outfall water from power plant and fly ash extents over in this area too.

Station 3 (Control site) : 3 km away from the station 2 (N 08° 47’ 85.5” & E 078° 10’ 65.3”). This area contains biological system like coral reef and sea grass bed, and considered as control site.

Fig 1: Map showing the study area (Tuticorin Bay) with 3 stations

1.2 Collection of samples

Water and sediment samples were collected at one time during May 2015 from three stations fixed in and around 5 km from earlier ash dumpsite. The surface water samples were collected in a pre-cleaned plastic containers using nitric acid, bottom water samples were collected using Meyer’s water sampler, and samples were transferred into pre-cleaned plastic containers and analyzed oil and grease using standard procedures. Sediment samples were collected by grab and transferred to polythene bags, dried and stored in plastic containers.

Fig 2: Photos showing the collection of water and sediment samples near thermal power plant

EXPERIMENTAL SECTION

2.1 Determination of oil and grease in water

Oil and grease in water sample was analyzed by [8]. 250 ml water sample was collected and 10 ml of sulphuric acid was added, 50 ml of petroleum ether and approximately 3 ml of ethyl alcohol in a separating funnel and shaken well. Allowed to stand until the two layers, upper of petroleum ether and lower of water become distinct. The water layer was discarded and drained in the petroleum ether through filter paper into the pre weighed beaker. Placed the beaker in the hot water bath and allowed the petroleum ether to evaporate. From the weight of the beaker, found the amount of oil and grease in the water samples.

2.2 Determination of oil and grease in sediment

About 10 g of surface sediments was dried in the oven at 105°C for 2 hours to determine the moisture content analysis. Sediment samples containing known amounts were analyzed by using a modified form of the oil and grease extraction method for sludge samples [9].

RESULTS AND DISCUSSION

3.1 Oil and grease in water

Water samples were collected from both surface and bottom of the sea and found out oil and grease and shown in Fig 1. The results are shown in Table 1. Station 1 surface water showed the highest value of 130.8 mg/L and bottom water showed the oil and grease value of 75.6 mg/L. Station 3 showed the lowest value of 10.8 mg/L and bottom water showed the oil and grease value of 1.8 mg/L.

3.2 Oil and grease in sediments

Sediment samples were collected and found out oil and grease and shown in Table 1. The results are shown in Fig 2. Station 1 recorded the highest value of 86 mg/g, station 2 recorded the value of 71 mg/g and station 3 recorded the lowest value of 62 mg/g.

Table 1. Oil and Grease in water and sediment

Types of water	Water (mg/L)			Sediment (mg/g)		
	S1	S2	S3	S1	S2	S3
Surface	130.8	23.2	10.8	86	71	62
Bottom	75.6	2.4	1.8			

S1-Station 1 S2- Station 2 S3- Station 3

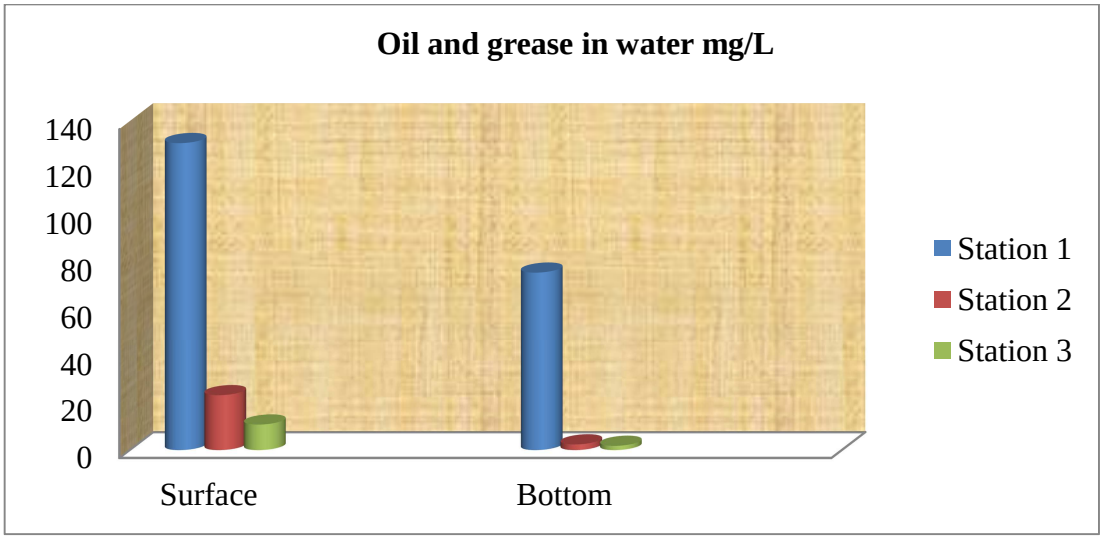

Fig 3: Oil and grease in water

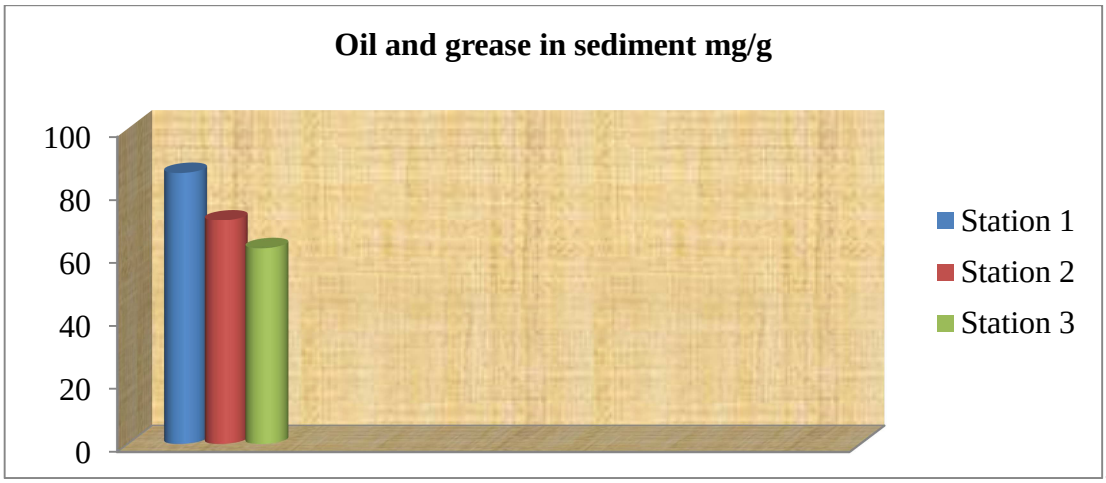

Fig 4: Oil and grease in sediment

The results of oil and grease in station 1 showed highest value of 130.8 and 75.6 mg/L (Table 1) in surface and bottom water respectively. Marine sediments showed the highest value of 86 mg/g. Station 1 is located near the water outfall of thermal power plant and showed the high value. The main component of equipment used by power plants to produce electricity is the turbine; if it does not run, the plant does not produce electricity. In simple terms, a power turbine is a device that converts rotational energy into electrical energy. So, it needs lubricating oil to minimize wear by lubricating the moving parts in the steam turbine. Besides providing wear-reducing properties, oils have secondary purposes, such as cooling, corrosion protection and transportation of contaminants (cleaning) [2].

Organic substances in power plant effluents originated from several sources where some lubricating oils contain organic compounds as an additive material for improving oil performance such as phenolic and aromatic amines [10, 11]. Environmental protection rules, 1986 has given the minimum limit of oil and grease effluents for thermal power plant to be 20 mg/L. But the station 1 exceeds the limit. These increasing oil and grease activities gradually polluting marine water and other water bodies which have serious implications for marine organism and human being. [12] pointed out that project could be the death knell for the already polluted Gulf of Mannar. Almost all the sediment samples showed presence of oil and grease. Environmental Impact Assessment, 2005 mentioned that there will be attendant development all along coast in the form but now where are the cumulative impacts of these on the environment of Gulf of Mannar. In thermal power plant the oil system is an auxiliary oil system pump is used to supply oil at the start-up of the steam turbine generator. It supplies the hydraulic oil system required for steam turbines main inlet steam stop valve, the governing control valves, the bearing and seal oil systems, the relevant hydraulic relays and other mechanisms. At a preset speed of the turbine during start-ups, a pump driven by the turbine main shaft takes over the functions of the auxiliary system. The extra has ejected as an effluent.

Station 1 is located near the water outfall of thermal power plant, and showed high content of oil and grease value than other two stations.

CONCLUSION

Present study infers that the oil and grease values maximum in ash dumpsite near power plant. At the same time, the values measured in this area decrease from ash dumpsite to control site. The impact of ash extends to few kilometers. Accordingly, it reveals that earlier fly ash dumping and outfall from power plant significantly affect the study area. Monitoring of the seawater quality of sampling sites should be done at regular interval.

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