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Selective Characterisation and Microbial analysis of Industrial Hazardous Wastes in Kadapa District, Rayalaseema Region (A.P - INDIA)

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ABSTRACT

The present research investigation is mainly aimed at selective characterisation of industrial hazardous wastes specifically solid wastes in Kadapa district of Rayalaseema region, Andhra Pradesh. The hazardous wastes from specified industries of the region contaminate the water, soil and atmosphere in the vicinity of selected locations of industrial belt. The hazardous solid effluent samples were collected from industrial belt of Kadapa district by following standard procedures. The research study is focused on investigating Physico-Chemical parameters like pH, EC, TDS, SO_3^{2-}, Cl^-, SO_4^{-2}, PO_4^{-3}, Ca^{2+} and Mg^{2+}. The results indicate that quality parameters exceeding the permissible limits and posing challenge to environment protection. The collected solid effluent samples in contaminated soil were characterized for identification of bacteria.

Key words: *Total dissolved solids (TDS), Physico-Chemical parameters and Hazardous Wastes*

1. INTRODUCTION

The Rayalaseema region in Andhra Pradesh comprising of four districts viz., Anantapur, Chittoor, Kadapa and Kurnool. In every district there are some major industries like Cement, Sugar, Paper, Cotton, Mining, Dairy Products, Pig Iron and Alkali Chemicals etc., the effluents from these contaminate water and atmosphere, therefore the contaminated environment will have disastrous effects on human beings, plants and animals of the region. The extensive indiscriminate pollution caused by some industrial hazardous wastes may even impair the use of the river for irrigational purposes in this region. Indiscriminate discharge of untreated industrial effluents on land has irreversibly contaminated the ground water sources. The perusal of literature reveals that significant research work has been carried out on Physico-Chemical characterisation of industrial hazardous wastes (solid and liquid effluents) in addition to microbial analysis of contaminated soil samples **[2,3,4,5,6,7,8,11,13,14].** The analysis of hazardous waste is of paramount importance. Sampling of hazardous wastes include collection of different physical forms of wastes like solids, semi-solids, sludges, slurries, liquids etc., The reported studies also indicates that solid effluent samples becoming increasingly contaminated due to domestic and industrial wastes.

Further more, Identification/Characterisation of industrial hazardous wastes and proper management of hazardous in techno-economic manner by following statutory mandate of Environment Protection Agency (EPA) in the Rayalaseema region is considerable significant area of research interest from the environmental protection point of view. The Cement industry in the district of Kadapa, Rayalaseema region, Andhra Pradesh.India having important in the rural economy of the state. The solid effluents discharged by these industries have posed the threat to the ecological balance of rural area around. Keeping this fact in a view, the author in present research investigation mainly focused on studying Physico-Chemical parameters of collected solid effluents from respective industries and microbial analysis of hazardous wastes.

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2. MATERIALS AND METHODS

The details of sampling code and the sampling locations are presented in Table - 1. Containers made of polyethene were employed for sampling of industrial solid effluent samples for analysis as per the standard procedures **[12].** The solid effluent samples were analyzed for Physico-Chemical parameters which include pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Ca, Mg, Chloride, Sulphate , Phosphate, Na and Potassium ratio. Industrial Hazardous waste solid samples were analysed by pH meter (Global-DPH 505, India-Model) and conductivity measured by the digital conductivity meter (Global-DCM-900-Model), TDS determined from the relation TDS = Electrical conductivity (EC) x 0.64. Total Hardness, Chloride was estimated by Titrimetry. Sulphate measured by Spectrophotometer (Vissican 167, Systronics), Na and K by Flame photometry (Systronics). The solid effluent samples were analyzed for physico-chemical parameters and the analytical data is presented in Table 2 respectively.

Table – 1 Details of collected Industrial Hazardous Wastes

Sample Description Code	Name of the Industry	Address of the Industry	Sample Type
Sample – 1	India Cement Pvt. Ltd.	Yerraguntla, Kadapa District	Solid
Sample – 2	India Cement Pvt. Ltd.	Yerraguntla, Kadapa District	Solid
Sample – 3	India Cement Pvt. Ltd.	Chilamkur,Yerraguntla, Kadapa District	Solid
Sample – 4	India Cement Pvt. Ltd.	Chilamkur, Yerraguntla, Kadapa District	Solid

Table – 2

Solid Samples (Cement Industry)

S.No	Parameters	Cement Industry			
		S1	S2	S3	S4
1	pH (5% aqueous solution)	9.19	9.66	9.40	9.17
2	Colour	Gray	Gray	Gray	Gray
3	Conductivity (µ mhos/cm) (5% aqueous solution)	97	368	106	118
4	TDS at 105^0C (mg/kg)	1,241.6	4,710.4	1,356.8	1,510.4
5	Chlorides (mg/kg)	3,545	10,635	3,545	4,993
6	Fluorides (mg/kg)	25.6	31.2	22.4	48.2
7	Sulphate (mg/kg)	1964	3394	2724	5137
8	Ca^{2+}(mg/kg)	4,000	7,200	2,400	1,600
9	Mg^{2+}(mg/kg)	976	976	1,464	976
10	Na (mg/lit)	29.79	24.06	21.15	23.82
11	K (mg/lit)	4.76	6.97	4.04	1.77
12	Phosphate (mg/kg)	80	100	80	82
13	Nitrate (mg/kg)	5.4	7.6	9.8	6.2

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3. Results and Discussion

pH: pH levels of the Industrial Hazardous Waste solid samples range from 9.17 – 9.66 indicating slight alkaline nature. Though the pH levels are within the permissible limits (6.5-8.5) of IS: 10500-1992, the solid samples are found to be with slight to moderate alkaline nature.

Electrical Conductivity (EC): Electrical Conductivity values of Industrial Hazardous Waste samples range from 97- 368 µmhos/cm.

Total Dissolved Solids (TDS): The Total dissolved Solid levels of Industrial Hazardous Waste solid samples range from 1241.6 – 4,710.4 mg/kg of IS: 10500-1992 and the levels of three industrial solid samples are within the permissible limit while the sample 2 exceeded the permissible limits. Due to higher levels of TDS, the industrial solid sample loses palatability and may cause gastro intentional irritation.

Ca^{2+} and Mg^{2+}: The Industrial Hazardous Waste solid samples calcium ion concentration ranging from 1600-7200 mg/kg. The Calcium ion levels exceeded the permissible limit (75 mg/kg) of IS: 10500-1991. Magnesium levels in industrial hazardous waste solid samples range from 976 – 1464 mg/kg, the magnesium ion levels exceeded the permissible limits (30 mg/kg) of IS: 10500-1992. The higher levels of Ca and Mg may be due to the seepage of industrial and domestic water or due to cationic exchange with Sodium.

Chloride: Chloride level in Industrial Hazardous Waste solid samples range from 3545-10635 mg/kg. Chloride levels of hazardous wastes is exceeded the permissible limit (250 mg/kg) of IS:10500-1992.

Sulphate: Sulphate levels of Industrial Hazardous Waste solid samples range from 1964-5137 mg/kg. Sulphate levels of industrial hazardous waste are exceeded the permissible limits (200 mg/kg) of IS: 10500-1992.

Phosphate: Industrial Hazardous Waste solid samples Phosphate values are observed at 80-100 mg/kg.

Fluorides: Fluoride ion concentration in Industrial Hazardous Waste solid samples collected range from 22.4 – 48.2 mg/kg. It is well known that the excess fluoride intake is responsible for dental and skeletal fluorosis.

Nitrate: Nitrate ion concentration in Industrial Hazardous Waste solid samples collected range from 5.4 – 9.8 mg/kg.

4. Bacterial Analysis

MATERIALS AND METHODS

1 gm each solid sample was taken separately and diluted in the 10 ml of distilled water, 01 ml of sample was inoculated separately into nutrient agar media, and incubated at 37ºC for 24 hours. After incubation colonies are formed. Bacterial isolated form colonies, and identified following bacteria. The industrial solid effluent samples were collected in sterilized containers **[1]** and immediately transported to the laboratory for the bacterial analysis. The Most Probable Number (MPN) technique was employed for the Coliform count in industrial solid effluent samples **[9,10].**

Further the industrial solid effluent samples were analyzed for microbial analysis and the details of the analytical data is presented in Table 4 and the identified bacteria are presented in photographs.

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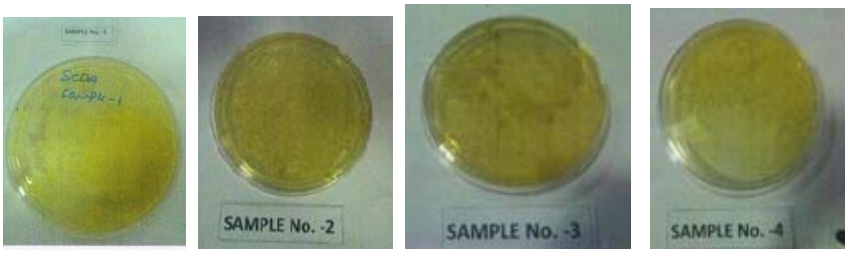
Bacterial Colonies photographs



Sample 1 Sample 2 Sample 3 Sample 4

Table – 4 Characterization of Industrial solid effluent Samples for Bacteria

Sample No	Bacterial species identified
1	*Bacillus circulans*
2	*Bacillus licheniformis*
3	*Bacillus coagulans*
4	*Bacillus circulans*

Industrial Hazardous Wastes Samples – Microbial Studies

Sample:1

Bacillus circulans identified in sample 1(India Cement Pvt. Ltd. Yerraguntla, Kadapa), which is gram positive, motile, rod shape. White cream color colonies were formed on Soybean-Casein Digest Agar media after 24 hours of incubation at 32.5^0C. The colonies were small with rough edges. The bacteria positive for Catalase test. *Bacillus circulans found in wound infections, and cause bacteremia, septicemia and abscesses reported clinically.*

Sample: 2

Bacillus licheniformis identified in sample 2 (India Cement Pvt. Ltd. Yerraguntla, Kadapa). This is gram positive, motile rod shape. White cream color colonies were formed Soybean-Casein Digest Agar media after 24 hours of incubation at 32.5^0C. The colonies were moderate with rough edges. *Bacillus licheniformis* positive for Catalase test. The bacteria produce antibiotic such as bacitracin. It causes *bacteremia* or *septicemia* and food poisoning. The *bacteria* resistant to clindamycin and susceptible to *penicillin.*

Sample: 3

Bacillus coagulans was identified in sample-3 (India Cement Pvt. Ltd. Yerraguntla, Kadapa). Which is gram positive, motile, rod shape.White cream color colonies were formed on Soybean-Casein Digest Agar media after 24 hours of incubation at 32.5^0C. The colonies were moderate with rough edges. *Bacillus coagulans*positive for Catalase test. It causes bacteremia or septicemia reported clinically.

Sample: 4

Bacillus circulans identified in sample 1(India Cement Pvt. Ltd. Yerraguntla, Kadapa), which is gram positive, motile, rod shape. White cream color colonies were formed on Soybean-Casein Digest Agar media after 24 hours of incubation at 32.5^0C. The colonies were small with rough edges. The bacteria positive for Catalase test. *Bacillus circulans found in wound infections, and cause bacteremia, septicemia and abscesses reported clinically.*

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5. CONCLUSIONS

The selective characterisation of industrial effluents in the study region with respect to important parameters has been investigated by employing standard procedures. The obtained results indicate that quality parameters exceeding the permissible limits and posing threat to environmental protection. The identification and characterization of industrial hazardous wastes (solid effluents) by following statutory mandate of Environment Protection Agency (EPA) in the Rayalaseema region is considerable significant area of research interest from the environmental protection point of view. Effective monitoring of equality parameters is frequently suggested to safe guard the health of the public residing in the surroundings of the polluted site.

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