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Assessment of quality parameters of industrial effluent from Khetri copper complex (Jhunjhunu, Rajasthan, India)

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Industrial wastewater entering a water body represents a heavy source of environmental pollution. A study was conducted on industrial effluent at different sites of Khetri Copper Complex, (Jhunjhunu Rajasthan, India) to determine the physico-chemical parameters, important in assessing the variations in water quality. Various parameters included in the present study are pH, dissolved oxygen(DO), biological oxygen demand(BOD), acidity, alkalinity, total hardness(TH), total dissolved solids(TDS), and levels of chloride, fluoride, nitrate and heavy metals viz copper, zinc, cadmium and mercury. The study was made to check suitability of effluent water for irrigation purpose. A comparative study with World Health Organization standard shows that the water of this region requires suitable treatment before use.

Keyword: Physico-chemical parameters, Industrial effluent, heavy metals, Water pollution, Irrigation purpose.

1. Introduction

With the exploding population, increasing industrialization and urbanization, water pollution has become a major concern for the welfare of humankind. Surface water and lakes are most vulnerable to pollution due to their easy accessibility for disposal of waste ^[1, 2]. The lakes have complex and fragile ecosystem, as they do not have a self cleaning ability and therefore readily accumulate pollutants ^[3].

In India, every year, approximately 50,000 million liters of waste water, is generated in urban areas which incorporate hazardous pollutants in ground water ^[4]. There is a risk of toxic heavy metals associated with waste water and sludge that may accumulate in the soil, contaminate the ground water and affect marine life, subsequently human being ^[5]. Number of studies have been undertaken to assess the physico chemical parameters of water from different parts of India such as Amalher town in Jalgaon District, Maharashtra ^[6]; Patancheru, Medak District, Andhra Pradesh ^[7]; City of Nablus ^[8]; Anila Neziri *et al.* studied to determination of heavy metals (Cr, Ni) in Buna river, they found water of Buna river polluted by heavy metal with high concentration ^[9]; Heavy metals are environmentally stable and non-

biodegradable, toxic to the living beings and tend to accumulate in plants and animals causing chronic adverse effects on human health. Heavy metals are introduced to the environment through a variety of sources such as combustion, extraction, agricultural runoff, transportation etc ^[10]; and are priority toxic pollutants that severely limit the beneficial use of water for agricultural and industrial application. Frequent use of heavy metal contaminated water in the agricultural fields leads to soil pollution and gradually enriched the soil with heavy metals. Different studies have revealed that the presence of toxic heavy metals like Fe, Pb, Hg reduce soil fertility and agricultural output.

Copper is a trace element for plant grown and development. Both Cu- deficiency and Cu excess will resulted in plant growth abnormalities ^[11]. In the present studies, most plants grow better in the medium containing 2 micro Mthann in a plain medium. All plants cultured in medium over this concentration did show the symptoms of copper toxicity.

2. Materials and Methods

Sampling Sites- Khetri Copper Complex (fig 1) is located Khetri (Jhunjhunu District, Rajasthan) about

190 kms south-west of Delhi. Khetri Copper Complex is at the northern end of a large copper belt extending for a length of 76 kms, from Singhana to Raghunathgarh of Aravali range there two major mines, one at Khetri and another at Kolihan, having a concentrator, a smelter, an electrolytic refinery and an acid-cum-fertilizer plant along with all ancillary facilities. Present study includes three different sites of Khetri Copper Complex:

Site 1 Water Lagoon; Site 2 Slag Area and; Site 3 Refinery Wire Bore Casting Plant.

Analytical method ^[12] used for determination of different physicochemical parameters for Industrial effluent are listed in Table 1. The water samples were collected from different sites in clean plastic bottles and transported to the laboratory in an icebox to avoid unpredictable changes in different physicochemical parameters.



Fig 1: Khetri Copper Complex

Table 1: water quality parameters and analytical methods used in analysis of water samples.

Parameters	Analytical method
pH	pH meter
Conductivity	Conductivity meter
TH	EDTA Titrimetric Method
Alkalinity	Titrimetric Method
Chloride	Titrimetric Method
Fluoride	Colorimetric method
Nitrate	Colorimetric method
TDSs	Through conductivity
DO	Titrimetric Method
BOD	Titrimetric Method
COD	Titrimetric Method
Copper	AAS
Zinc	AAS
Cadmium	AAS
Mercury	AAS

TH: Total Hardness, TDS: Total Dissolve Solid DO: Dissolve Oxygen, BOD: Biological Oxygen Demand „COD: Chemical Oxygen Demand AAS: Atomic Absorption spectrophotometer

3. Result and Discussion

The result of Assessment of quality parameters of Industrial effluent from Khetri Copper Complex (Jhunjhunu, Rajasthan, India) from different sites of Khetri Copper Complex and comparing them with permissible limit following inferences can be made

Table 2: comparative study of water of different site of Khetri

Sites	pH	Cond.	TH	Cl ⁻	NO ₃ ⁻	F ⁻	Cu ⁺²	Zn ⁺²	Cd	Hg
H.P. Near Old Court	7.87	1.20	140	25	34	0.3	0.51	7.0	0.01	0.001
Aajad Market	7.84	0.93	150	30	30	0.2	0.52	7.5	0.00	0.0
New Market	8.12	0.89	120	50	16	0.3	0.6	8.5	0.00	0.0
Subhash Chock	7.84	1.16	380	70	10	0.3	0.53	6.5	0.00	0.00
H.P. near Govt. Hospital	7.85	2.12	410	100	04	1.04	0.0	7.5	0.01	0.00
H.P. Near Shyam Guest House	7.74	0.92	190	300	02	0.4	0.0	8.5	0.00	0.00
S.R.A. En-Office PHED	7.84	0.86	100	150	02	0.5	0.0	8.0	0.00	0.00
H.P. near govt. sec. School	8.06	0.97	110	140	04	0.8	0.0	6.0	0.00	0.00
Sanjay Nagar, Khetri	7.04	0.99	320	310	19	0.9	0.0	7.0	0.00	0.00
Sector 1 nd , Khetri	7.62	0.86	450	140	22	0.4	0.2	6.5	0.00	0.00
Sector 2 nd , Khetri	7.02	0.83	410	50	02	0.4	0.3	6.0	0.00	0.00
Sector 3 rd , Khetri	7.15	0.77	380	360	02	0.6	0.6	7.0	0.00	0.00

Govt. Colony, Khetri	7.54	0.85	380	410	40	0.6	0.1	8.0	0.00	0.00
Water Works Colony, Khetri	7.68	0.91	320	100	12	0.5	0.2	9.0	0.00	0.00
Ali Colony, Khetri	7.39	0.80	280	230	24	0.6	0.1	5.5	0.00	0.00

Conductivity is in mmhos cm^{-1}
and TH, Cl⁻, NO³⁻, F⁻, Cu⁺², Zn⁺², Cd and Hg are taken in mg/l

Table 3: Measurement of different quality parameters

Parameter	Site 1	Site 2	Site 3	Permissible limit
pH	8.1	7.94	7.98	6.5-8.5
Conductivity (mmhos/cm)	3.97	3.94	4.12	1.51-3
TH (mg/L)	540	570	550	600
Chloride (mg/L)	250	168	164	141-350
Fluoride (mg/L)	2.4	2.9	3.0	1.0-15
Nitrate (mg/L)	34	12	15	45
Copper (mg/L)	1.0	1.5	1.2	0.2-5
Zinc (mg/L)	11	13	13.7	2-10
Cadmium (mg/L)	0.7	1.0	1.5	0.01-0.05
Mercury (mg/L)	0.003	0.005	0.006	0.002

All the three sites have pH, conductivity, TH values within the permissible limit and standards. The anionic components like fluoride, chloride and nitrate are also under the permissible limit. Where the metal concentration of the effluent at all the three sites appears to show high concentrations of heavy metals like zinc, cadmium, copper and mercury, which deposit on the soil and shows harmful effects on animals and plants both.

4. Conclusion

From the study it has been found that effluent of Khetri copper complex is discharged into the soil, making the ground water of Khetri become polluted to some extent even toxic metal, copper, mercury, zinc, and cadmium have reported in effluent and also in ground water. Industrial effluent of KCC is not fit for irrigation purpose and it needs treatment to minimize the concentration of toxic metal.

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