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Metals and organic components of sewage and sludges

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Abstract: *Sewage and sludge samples were collected from rural areas of Vellore district. The metals like Cu, Zn, Cd, Pb, Fe, Ca and Mg were determined by Inductively coupled plasma atomic emission spectrophotometry (ICP–AES). For this determination HCl – HNO_3 and 4N HNO_3 extracts were used. The total organic carbon (TOC), chemical oxygen demand (COD) and organic matter (OM) have also been determined to evaluate the presence of organic and metallic contents in sewage and sludge environment.*

Key words: *Metals, ICP – AES, Organic matter, Sewage, Sludge.*

Introduction

Vellore district is conspicuous by the absence of perennial rivers and frequent susceptibility to recurring droughts.

The total geographical extent is 5, 92, 018 hectares and is sandwiched between latitude 12^0 15' 23" – 13^o 12' 32" and longitude 78^o 24' 16"–79^o 54' 56". This district can be classified as hilly terrains and plain regions. The landscape particularly on the western part of the district is flanked by the easternghats and the continuity of the baramahal range of Andhra pradesh is often broken. The absence of any structural control of the drainage is striking as the major seasonal river Palar flows east wards running parallel to ridges and valleys. In this area many small and large scale industries like chemical, sugar, distilleries, pulp and paper, soaps, oils and refineries etc. are located without treatment and care against environmental pollution (Shrivastava, 1992; 1995). In some areas the effluents of these industries get mixed with city sewage and flows through city drains and finally ponded to rivers and open places. The effluent of these industries contains a variety of organic chemicals and metals (Shrivastava, 1995; Dissanayake, 1983). These metals percolate through soil strata and pollute underground water resources of the area.

The domestic sewage is disposed either on ground through soak pits or in surface waters in an untreated form. The sewage setting on river beds is immediately acted upon by bacteria which help in decomposition and nutrient release and reduces the dissolved oxygen to the levels at which many desired organisms like fish die.

Materials and Methods

Water samples were collected from both sewage and sludge sources, during October 2003. Selected chemical parameters of the samples were determined by standard methods (APHA, 2000; Trivedy and Goel, 1984). A total of 10 sampling locations were fixed, out of which 5 are sludge and 5 are sewage samples.

Results and Discussion

The results obtained during the course of present investigation are given in (Table 1). The concentration of copper in sewage samples was found to be in the range of 0.8 to 1.05 μg/ml. The copper concentration in all the sludge sites was found 1.20 to 1.50μg/g. The high concentration of copper in sludge is due to the adsorption of copper containing matrices in the soil particles. Copper have tendency to form complexes with organic moieties (Disassanayke, 1983). This fact is also supported by the detection of COD and OM of sludge sample.

The concentration of zinc in all sewage sample was between 0.58 to 1.30μg/ml, while in sludge samples the concentration of Zn was determined 0.55 to 0.75 μg/g. The higher concentration of Zn is due to discharge from industries like jewellery, soaps, galvanised electroplating, pharmaceutical pigments, insecticides, cosmetic, etc. (Cook, 1976). The Zn ions are also adsorbed on the soil surfaces. The concentration of Cd in all the sewage sites was detected in the range of 0.25 to 0.5μg/ml but in the sludge samples it was in the range of 0.30 to 0.50μg/g. Cd in both the sewage and sludge samples is more or less similar which clearly indicates that Cd is adsorbed by the soil particles (Sastry *et al.,* 1992).

The concentration of Pb in sewage was in the range of 0.48 to 0.59μg/ml while in the sludge samples it was found to be 9.0 to 12.0μg/g respectively. The higher concentration of Pb in sludge sample is due to the adsorption Pb species on soil surface. The concentration of Fe in sewage samples was found to be in the range of 3.98 to 2.64μg/ml, while it was found to be much higher (155μg/g) in all the sludge samples and trend was more or less similar. This concentration of iron in all sludge samples clearly indicates the adsorption of Fe containing species from the sewage water and finally on the soil particles. Mg was in the range of 45.0 to 63.0μg/ml is sewage sample but it's concentration in sludge was detected to be high (268.6 s to 300.00μg/g). The concentration of Ca was found to be in the range of 25.00 to 115.00μg/ml in all the sewage sites while it was 125 to 175.00 μg/g in sludge samples. The high

Table – 1: Metals in sewage and sludges of Vellore town.

S.No	Sites of sample collection*	Cu	Zn	Cd	Pb	Fe	Mg	Ca
	A. Sludge sample							
1	CMC back	1.44	0.60	0.30	8.3	136	270.2	134
2	Near National theatre	1.32	0.58	0.31	9.0	148	268.6	158
3	Near collectrate	1.16	0.75	0.41	11.6	152	275.3	175
4	Velapady	1.50	0.68	0.50	12.0	155	294.9	148
5	Arni road	1.20	0.55	0.33	10.6	124	300.0	125
	B. Sewage sample							
6	Municipal supply	0.86	0.64	0.34	0.36	3.61	52	33
7	Old Town	0.93	0.58	0.25	0.48	3.98	63	84
8	Dinesh hospital	0.80	0.83	0.43	0.53	2.64	45	76
9	Poonthottam	1.05	1.30	0.50	0.59	3.15	56	25
10	Bore well	0.96	1.22	0.29	0.40	3.52	50	115

* unit for sewage sample μg/ml, unit for sludge sample μg/g.

Table – 2: T.O.C, O.M and C.O.D in sewage and sludges of Vellore town.

S. No.	Sites of sample collection*	TOC	COD	OM
	A. Sludge sample			
1	CMC back	2340	2880	190
2	Near National theatre	1220	2225	240
3	Near collectrate	2312	3648	400
4	Velapady	2045	4000	320
5	Arni Road	2350	3860	380
	B. Sewage sample			
6	Municipal supply	1200	2200	190
7	Old town	840	1684	170
8	Dinesh hospital	1351	1500	240
9	Poonthottam	1734	1800	310
10	Bore well	1900	3200	290

* unit for sewage sample μg/ml, unit for sludge sample μg/g.

concentration of Ca in the sludge samples is due to the high adsorption of Ca species on the sludge particles (Aggarwal *et al.,* 2000).

The content of total organic carbon (TOC) organic matter (OM) and chemical oxygen demand (COD) are given in (Table 2). In all the sewage sites TOC, COD and OM rangeD from 840 – 1900, 1500 – 3200, 170 – 310μg/ml respectively. However the concentration of these parameters in sludge samples range from 1220 – 2350 μg/g, 2225 – 4000μg/g, 190 – 400μg/g respectively, the concentration of these parameters is based on dried sludge sample. OM and COD data clearly indicate the presence of organic and metallic species in sewage and sludges.

The quantity of nutrient in sewage varies at different regions (Vollenwider, 1968). The quantity of heavy metals depend upon the type of domestic sewage and mixing of varieties of wastes in to it, such as human faeces, effluent from small scale industrial like automobile repairing, soaps, electroplating units, utensil manufacturing and maintenance units, jewellary and washing in the areas in and around the Vellore town. Domestic waste contains fuels, pesticides, inks, lubricants, paints, pigments and many toxic heavy metals such as Cu, Zn, Pb, Al and Fe. The presence of Zn, Cu, Pb, Ni and Cd in faeces has been reported (Spector, 1956; Davis and Copper, 1980). Metals in sewage percolate through the soil strata and ultimately pollute underground water resources (Sharpley and Menzel*.,* 1987).

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