International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072

COMPARATIVE STUDY ON HEAVY METAL CONCENTRATION IN GROUND WATER AND SOIL SAMPLES IN AND AROUND SIPCOT INDUSTRIAL COMPLEX, CUDDALORE DISTRICT

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Abstract: *The heavy metals are carcinogenic, mutagenic and they are Persistent, Bio-accumulative and Toxic (PBT) – move among air, water and soil and cross human boundaries. The mixing of toxic heavy metals into the water bodies deteriorates the quality of water, sediment and aquatic organisms. It is a threat to the several endemic fish species due to the heavy metal pollution of groundwater and soils. Further, the heavy metals could also pass to human beings through the food chain and create various health hazards. These heavy metals have been discharged into the ecosystems by means of various industrial and other anthropogenic activities. In order to study the industrial pollution, groundwater and soil which were found very close to the SIPCOT industrial area of Cuddalore district of Tamilnadu, India has been chosen to assess the concentration of heavy metals. About 12 samples were totally collected from around sipcot industrial complex and analyzed for the heavy metals concentrations. The study revealed that both of the ground water and soil samples show the comparative of heavy metals like Cu, Ni, Zn, Pb and Cd at an alarming rate. There is an urgent need to control the industrial pollution and future generations.*

Keywords: *Samples, Heavy metals, Contamination, Concentration and Industries.*

1. Introduction

Pollution of heavy metals in an aquatic eco-system is growing at an alarming rate and has become an important worldwide problem, [1]. As heavy metals cannot be degraded – they are deposited, assimilated or incorporated in water, sediment and aquatic animals and thus, causing heavy metal pollution in the water bodies, [2]. Heavy metals are potentially toxic to crops, animals and humans when contaminated soils used for crop production. Heavy metal pollution in an aquatic environment has become a serious problem and also an important factor responsible for the decline of ground water quality.

The '**Heavy metals**' are chemical elements with a specific gravity at least 5 times that of water. The specific gravity of water is 1 at 4°C, [3]. Environmental Protection Agency list out the eight most common heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn) discharged by the industries like metallurgy, chemical, alloys, paint, pulp and paper, leather, textiles, fertilizers, petroleum refining, coal burning etc. These metals are released into the eco-system by various industrial activities and they bio-accumulate in the living organisms. For example, lead bio-accumulate in bones and teeth, cadmium build up in kidneys and mercury attaches itself to protein especially in the liver, [4].

A comparative study on heavy metal concentration in ground water and soil samples which were found very close to the SIPCOT industrial area of the Cuddalore district of Tamilnadu, India has been carried out by taking into consideration of the industrial pollution and the toxic effect of the heavy metals.

The present study is carried out with a view to find out whether the heavy metal concentration level in the ground water and soil samples was within the permissible limit or above the Permissible limit. The study also aimed to know the effect of the industrial activities on the nearby aquatic environment.

1.1 STUDY AREA

Cuddalore is the heart land of Tamilnadu, located 200km south of Chennai and less than 25km south of Pondicherry is a developing industrial city lying between latitude 11° 43" north and longitude 79° 49" east. It is the port town from ancient times with historical trades SIPCOT (State industrial promotion corporation of Tamilnadu) was setup in 1982, with a setup at an extend of 518.79 Acers. It is located 8 km from cuddalore to Chidambaram road stretching from pachaiyankuppam in the north to semmankuppam in south. Phase II will cover 88 hectares (200 acers) currently between 26 and 29 functional units are lying with phase 1 of the industrial estate on the western bank of the river uppanar. These companies manufacture pesticides and

pharmaceuticals and Intermediate chemicals, plastics and plastics additives, dyes and intermediates and textiles. At least 10 villages lies with in the industrial complex. At least 2000 peoples are estimated to be lying in the potential impact of SIPCOT. Taken from SIPCOT area community environmental monitors. The village pachaiyankuppam is located at the north of the SIPCOT complex behind Tagro's chemicals. Kudikadu lies on the eastern side of vanavil dyes and Shasun chemicals towards back of uppanar behind Asian paint. Echankadu is located near the south of pioneer chemicals. Semmankuppam lies immediate south of pioneer miyagi chemicals. The study area receives about an annual rainfall of 1,162 mm. ground water in this area is over exploited for agriculture and industrial purposes are predominant. Land use which includes sailing in the coastal aquifer.

1.2 Study Area Map

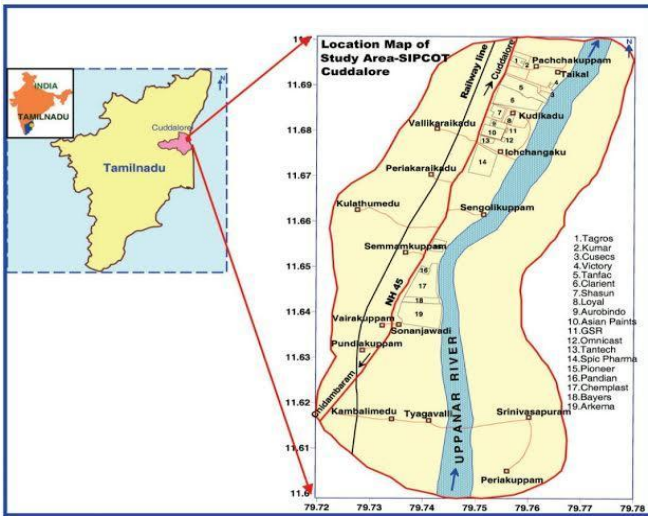

Table -1: Sampling stations

S.NO	Sampling Station	S.NO	Sampling Station
1	Champlast industry	7	Clarinet Chemical
2	Sangolikuppam	8	Tanfac industry
3	Eachankadu	9	Tagros industry
4	Shasun Chemical	10	Pachayankuppam
5	Kudikadu	11	Sothikuppam
6	Asianpaints industry	12	Rasapettai

2. MATERIALS AND METHODS

2.1 Collection of samples

Samples collection was done randomly from the area of around SIPCOT industrial complex Cuddalore. 12 water samples were collected at random from the ground water reservoir and were collected in plastic bottles. Soil samples were collected from around SIPCOT industrial complex Cuddalore collection was done randomly. Only 12 surface soils were collected and packed in polythene bags.

2.2 Heavy metal analysis

Standard procedure for the comparative study on heavy metal concentration in ground water and soil samples were followed by the different authors in their research works. The methods used are atomic absorption spectrophotometer. All the collected ground water samples are preserved at 4°c by using thermo coal box with ice packs (O. Venkata Subba Raju et al). The samples were filtered using whattman 42 filter paper and analysis (Mushtaq Hussain et al). Soil samples were also oven dried at 110ºC. 2gram of each sample was acid digested using 12 ml of nitric acid and 36 ml Con HCL. Samples were kept on hot plate. After removing from hot plate sample was filtered in 100 ml graduated cylinder up to 35 ml so that 35 ml of each sample was prepared.

2.3 Sample analysis

Samples of ground water and soil were subjected to atomic absorption spectrometer (Perkin Elmer) for being analyzed for heavy metals like Zn, Cu, Ni, Pb and Cd. The instrument setting and operational conditions were done in accordance with the manufacturers' specifications.

3. RESULTS AND DISCUSSIONS

Nickel (Ni): Nickel has been considered to be an essential trace element for human and animal health. [Zigham Hassan et al 2012]. The maximum permissible limit for Ni in ground water is 0.2 mg/l recommended by WHO.[Zigham Hassan et al 2012] Concentration of nickel in ground water samples ranged between 0.01 to 0.04mg/l which is below the permissible limit. In the collected soil samples concentration of nickel ranged between 0.01 to 0.06mg/l. In soil samples concentration of nickel was recorded with in the permissible limit set by WHO.

Cadmium (Cd): The maximum permissible limit for Cd in ground water is 0.01 mg/l recommended by WHO. Concentration of cadmium in ground water samples ranged between 0.01 to 0.05mg/l. In almost all the ground water samples concentration of cadmium was recorded above the permissible limit [Zigham Hassan et al 2012]. Concentration of cadmium in all the collected soil samples ranged between 0.02 to 0.04mg/kg. In all the collected soil samples concentration of cadmium was recorded above the maximum permissible limit set by WHO.

Copper (Cu): The maximum permissible limit for Cu in ground water is 2 mg/l recommended by WHO. In ground water samples concentration of copper ranged between 0.02 to 0.10mg/l. In all the collected water samples concentration of copper was recorded below the permissible limit. Copper accumulates in liver and brain. Copper toxicity is a fundamental cause of Wilson's disease [Samuel Zerabruk et al 2011]. Concentration of copper in all the soil samples was

above the maximum permissible limit set by WHO. Concentration of copper ranged between 0.05 to 1.00mg/kg.

Lead (Pb): According to WHO standards permissible limit of lead in water is 0.05mg/l. In all the collected ground water samples concentration of lead was above the permissible limit. Concentration of lead in all the collected water samples ranged between 0.07 to 0.52mg/l. Concentration of lead in soil samples was recorded to be ranged between 0.28 to 0.78mg/kg. In almost all the collected soil samples concentration of lead was recorded above the permissible limit set by WHO. Lead as a soil contaminant is a widespread issue; It accumulates with age in bones aorta, and kidney, liver and spleen.

Zinc (Zn): The permissible limit of zinc in groundwater according to WHO standards is 5mg/l. Concentration of zinc in groundwater samples ranged between 0.01 to 0.10 mg/l. In all the collected ground water samples concentration of zinc was recorded below the permissible limit. Concentration of zinc in soil samples ranged between 0.01 to 0.58mg/kg. In all the soil samples concentration of zinc was recorded below the permissible limit set by WHO. Zinc is one of the important trace elements that play a vital role in the physiological and metabolic process of many organisms. Nevertheless, higher concentrations of zinc can be toxic to the organism.

Table –2: Heavy metal concentration of ground water samples

Heavy metals	Cu	Zn	Pb	Ni	Cd
Maximum	0.10	0.10	0.52	0.04	0.05
Minimum	0.02	0.01	0.07	0.01	0.01
Average	0.06	0.05	0.29	0.02	0.03

Table -3: Heavy metal concentration of Soil samples

Heavy metals	Cu	Zn	Pb	Ni	Cd
Maximum	1.00	0.58	0.78	0.06	0.04
Minimum	0.05	0.01	0.28	0.01	0.02
Average	0.52	0.29	0.53	0.03	0.03

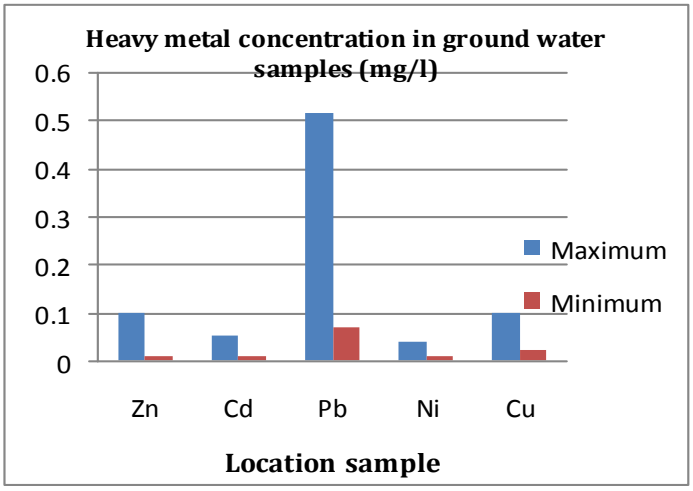

Chart -1: Heavy metal concentration of ground water samples for maximum and minimum

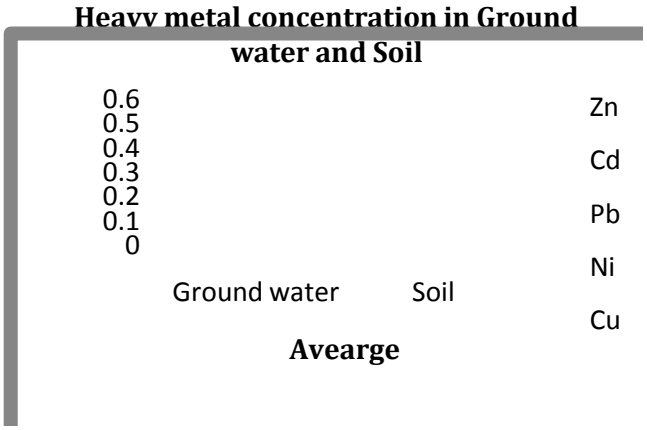

Chart -2: Heavy metal concentration of ground water and soil in average

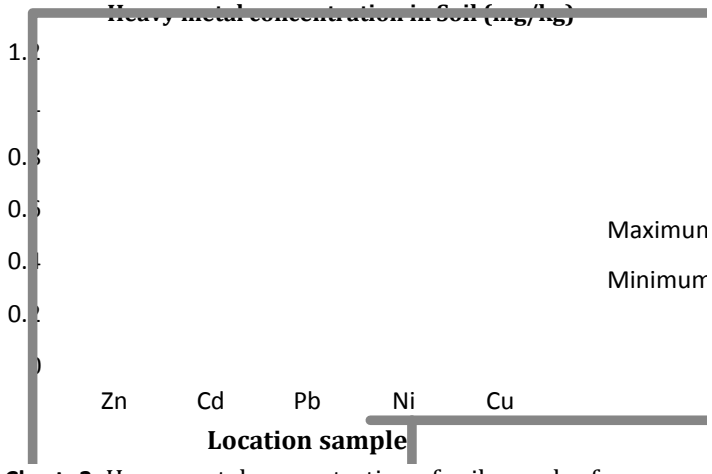

Chart -3: Heavy metal concentration of soil samples for maximum and minimum

4. CONCLUSIONS

The main goal of this research work was to assess the concentration of some toxic heavy metals of ground water and soil samples were collected from around SIPCOT industrial area. A total of 12 ground water and soil samples were collected and were analysed for five heavy metals (Zn, Cd, Pb, Cu and Ni) using standard procedures. The results show that all the ground water and soil samples were within the permissible limits set by WHO.

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