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ANALYSING THE CADMIUM CONTENT IN THE SOIL SAMPLES COLLECTED FROM SIPCOT REGION, CUDDALORE DISTRICT OF TAMIL NADU

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ABSTRACT

The present study was designed to determine the Cadmium (Cd) level in the soil samples collected from the industrial area-SIPCOT Cuddalore. Soil samples were collected from the different region in the vicinity of the industrial area, processed and the Cadmium content was analyzed using atomic absorption spectroscopy. Increased level of Cadmium was observed in the analyzed soil samples. Our study concludes that the soil in the industrial area-SIPCOT Cuddalore was polluted by the toxic metal cadmium.

Keywords: Cadmium, heavy metal, SIPCOT, Cuddalore

Abbreviations: Cd- Cadmium, AAS- Atomic Absorption Spectroscopy, SIPCOT - State Industrial promotion Corporation of Tamilnadu Limited

INTRODUCTION

Cadmium is a relatively abundant metal discovered by German scientist Friedrich Strohmeyer in 1817 as an impurity in zinc carbonate. Cadmium is a lustrous, silver-white, malleable and ductile metal. The divalent cadmium ion existing with other elements as oxide, carbonate, chloride, sulfide and sulfate (ATSDR, 1999). Specific ore and processing are not carried for cadmium, since is associated in small amounts with the ores of nonferrous metals such as zinc, lead and

copper and it is recovered as a byproduct in extraction, smelting and refining (Belyaeva EA, et al., 2012, Bernard A 2008).

Heavy metals are the class of elements that exhibit metallic properties with a density of at least five times higher than water. It mainly includes the transition metals, some metalloids, lanthanides and actinides. These elements constitute the major position in periodic table and varied in their physical and chemical properties and biological functions. Heavy metals are toxic elements and not having any biological role

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except few like Fe, Co, Ni, Cu and Zn. Similarly, metals like beryllium possess toxicity with lesser density (Hu H.2000). Hence, the alternative term toxic metal can also be used for heavy metals. Toxic metals placed under environmental pollutant category due to their ill effects on plants, animals and humans (Cook ME et al.,1995). They deranges the normal metabolism and casus various conditions like Hepatotoxicity, Enzyme denaturation, Cell membrane degradation, Cancer etc, (Valko et al., 2005).

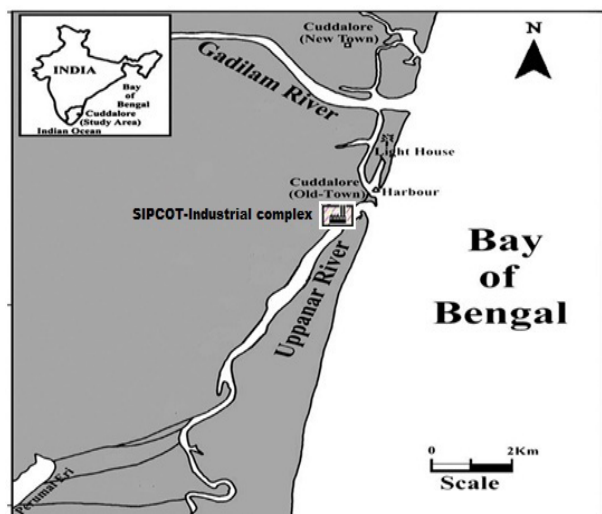
The main objective of our study is the collection of soil samples from the SIPCOT-Industrial complex, Cuddalore and analyzing the Cadmium level in the collected samples using AAS.

SIPCOT - CUDDALORE

The industrial estate SIPCOT (State Industrial promotion Corporation of Taminadu Limited) Cuddalore is situated in 8 km away from Cuddalore town, Tamilnadu, India with the set up of a 200 hectare estate in the coastal region of Bay of Bengal (Fig.1).

Fig.1:

Location of SIPCOT-Industrial complex - Cuddalore, India.



Industries located in the SIPCOT-Cuddalore region discharges the waste in the soil and water bodies slowly and continuously. Rapid exposure like explosions may threaten and collapse the life style of the residential peoples. Unused raw materials, solid waste and the transport packing materials are dumped in the nearby land area, raw and partially treated effluents directly drained in the water resources. The pervasive bad odour in this living place evident the continuous release

of gaseous materials in the atmosphere. Soil, water and air are the basic component of the environment which directly affected by the pollutants and impact on healthy life in humans.

SOIL SAMPLE COLLECTION POINTS

1. Effluent discharge point, Chemplast-Sanmar in river Uppanar
2. Cultivable land - Sangolikuppam.
3. Public tank soil - Sangolikuppam.
4. Pioneer-Jellice Effluent pumping point-Sangolikuppam.
5. GSR-Asian paint backyard tank soil.
6. TANFAC road side canal soil.

Soil samples (6 samples from each point in different locations) were collected from the industrial area SIPCOT - Cuddalore in every month for the period of 6 months were processed and used for Cd analysis.

SOIL SAMPLE PROCESSING AND CADMIUM QUANTIZATION

Cd present in soil samples collected from SIPCOT-Cuddalore was extracted by following the procedure recommended by the International Organization for Standardization (1995). 3g of soil sample was mixed with 28 mL of acid mixture (3:1 ratio of 37% HCl and 65% HNO₃) and kept in room temperature (RT) for 16 hours then digested at 130°C for 2 hours. Refluxed samples were filtered through Whatmann 40 filter paper, made up to 100 mL using 0.5 M HNO₃ and the processed samples were used for cadmium analysis.

Cadmium present in the samples was analyzed by Flame Atomic Absorption Spectrophotometer. A Perkin-Elmer 5000 atomic absorption spectrometer furnished with a Cd hollow- cathode lamp (lamp current 4 mA) was used to determine the Cd concentration. The instrument was set at 228.8 nm with a slit width of 0.5 nm. The acetylene flow rate was 2.0 L/min and an airflow rate of 17.0 L/min was employed to ensure an oxidizing flame.

RESULTS

Cadmium present in soil samples collected from the different areas in and around SIPCOT - Cuddalore were

shown in table 1. This study shows the elevated levels of Cd in the industrial area and distribution of Cd in the soil samples were near and above the permissible threshold level of Cd in soil. Samples collected from Effluent discharge point Chemplast-Sanmar in river Uppanar and GSR-Asian paint backyard soil shows higher concentration of Cd in soil samples.

Table 1:
Cadmium levels in soil samples collected from different points in SIPCOT - Cuddalore

Area of Sample Collection	Cadmium level (ppm)
Effluent discharge point, Chemplast-Sanmar in river Uppanar	2.49 ± 0.19
Cultivable land soil- Sangolikuppam	1.72 ± 0.13
Public tank Soil – Sangolikuppam	1.47 ± 0.11
Pioneer-Jellice Effluent pumping point- Sangolikuppam	1.86 ± 0.14
GSR-Asian paint backyard tank soil	2.40 ± 0.18
TANFAC road side canal soil	2.11 ± 0.16

Values are given as mean ± SD.

The permissible limit of Cadmium in Soil is 1.5 ppm

DISCUSSION

SIPCOT - Cuddalore is generating employment and increasing the economic development to the country but causing health problems to humans. National Environmental Engineering Research Institute study report stated that ongoing industrial pollution has worsened the environmental, public health and economic crisis of local farmers, fishers and other residents in the industrial area SIPCOT - Cuddalore (NEERI, 1999). Atmosphere quality in this area is strenuously affected by the industrial smoke and fog. Around 25 toxic chemicals were found in the air including 8 carcinogens in SIPCOT air. Some of these chemicals were 20,000 times above the safe levels prescribed by the US Environment Protection Agency (SACEM 2006; NEERI 1999). State Human Rights Commission headed by Retd. Justice Nainar Sundram investigated and reported that the SIPCOT-

Cuddalore is over polluted and the people living condition in SIPCOT area is not suitable for healthy living. The report also quotes that Industrial discharges from the companies are environment-related human rights violations. Moreover, the existing environment in Cuddalore cannot withstand the burden of any new chemical industries (SACEM 2006). In this critical situation, latest addition of three new industrial units such as PVC plant Textile Park and Oil Refinery company threaten the SIPCOT area which were already refused by the fisher men, farmers and public by other state. Entry of these units may further worsen the environment by releasing pollutants.

Environmental condition and the well-being of communities in the SIPCOT- industrial estate was analysed by a panel of neutral experts (Reports of public hearing, 2006) and their assessment stated that the major part of the soil, ground water and the ecology of river Uppanar were severely affected by the industrial discharges. During the assessment period, team members suffered by various health problems like pain and irritation in the throat, mild breathlessness with wheeze and watering of the eyes. In our study period, we have also faced similar problems. People living in that area have complained the problems related to Cadmium toxicity includes cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain (Andujar P et al., 2010). During the period of sample collection, we have also experienced these kind of problems. Disposal of solid and raw waste materials drastically affects the quality of soil and the fertility of the soil was drastically reduced by the past two decades. Farmers in this region were pointed out that the reason for the sterility of the soil is because of the increase in the sanity intrusion due to the industrial aquifers and disposal of solid and liquid waste by the companies. previous studies also substantiates that farmers used to get crops three times in a year until 1995, but have to struggle to get one time nowadays and the paddy yield have dropped from 3000 kg to 1500 kg bags per acre and the quality of the product was below the normal (Mathivanan et al., 2010; Prabavathi et al., 2011; Velsamy et al., 2013).

In our study, we found that the soil samples were contaminated with Cd and the levels are above the permissible threshold limits. Cadmium and its compounds are widely used as a fantastic colorant in

paint companies, as a stabiliser in the PVC and plastic productions, major part in the battery production and handlings etc., in SIPCOT-Cuddalore.

CONCLUSION

In conclusion, elevated level of Cd was found in the soil samples collected from the different region in SIPCOT Cuddalore. Environmental accumulation of the toxic heavy metal Cd in this industrial complex has exacerbated the living situation for humans and the aquatic organisms in the ecosystem of the surrounding area. If the situation continues by the existing companies and the new plant entry, the released toxic metal cadmium may worsen the quality of the soil and living condition in the SIPCOT surroundings in Cuddalore.

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