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# Trace Elements in Groundwater of Chrompet Industrial area of Tamil Nadu

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## ABSTRACT

The concentrations of the trace elements Fe, Cu, Pb, Mn, Zn were studied in groundwater of Chrompet Industrial area of Tamil Nadu. The degree of trace element pollution and the suitability of groundwater for drinking purpose was assessed. The concentration of Pb found to be present above maximum permissible limit. More than permissible limit of Fe was found around the industrial area. The concentrations of Zn, Cu and Mn are well below the maximum permissible limit as recommended by ISI (1983) for drinking purpose.


**Key words:** Drinking purpose, Industrial area, Maximum permissible limit and Suitability of groundwater.

## 1. INTRODUCTION

The importance of groundwater for the existence of human society cannot be overemphasized. Groundwater is the major source of drinking water in both urban and rural area. Besides, it is an important source of water for the agricultural and industrial sector. Water utilization projections for 2000 put the groundwater usage at about 50%. Being an important and integral part of the hydrological cycle, it's availability depends on the rainfall and recharge conditions. Till recently it had been considered a dependable source of uncontaminated water. Groundwater crisis is not the result of natural factors. It has been caused by human actions. Much of ill health which affects humanity, especially in the developing countries can be traced to lack of safe and whole some water supply. There can be no state of positive health and wellbeing without water. Water is not only a vital environmental factor to all form of life, but it has also a great role to play in Socio-economic development of human population [1]. Groundwater is the cheapest and most practical means of providing water to small communities. It is subjected to less contamination and has high mineral content. Today the groundwater resource is contaminated by the constant addition of industrial, agricultural and domestic water. The extent of groundwater pollution depends on rainfall pattern, depth of water table distance from the sources of contamination, soil properties, such as permeability [2],[3]. Water pollution is a growing hazard in many developing countries owing to human activity. The present investigation was undertaken with a view to study the trace elements in the groundwater around Chrompet Industrial area of Tamil Nadu.

## 2. STUDY AREA

The southern suburbs of Chennai that are involved in the tanning processes involve areas of Chromepet. These areas include large scale, small scale and also cottage industries that promote tanning process. Both vegetable and mineral tanning processes are practiced. This study is to be carried out in Chromepet area, located in the southern part of Chennai city, which serves as a home town to a large number of tanning industries. The study area is 13 km away from Bay of Bengal and 20 kilometers from Chennai city. It is located in12°57'00''N to 12°59'00''N longitude and 80°6'00''E to 80°9'30''E latitude. In general, the climate of the area is with low humidity and high temperature. During winter the temperature is around 20°C. During the summer season the temperature increases up to a maximum of 44°C. The southwest monsoon from June to September contributes nearly 40% of the annual rainfall, which is about 1200 mm. The northeast monsoon is more important as it contributes to more than 60% of the annual rainfall from October to December. Topographically this region gently slopes towards west and east. The charnockite rocks of Archaean age occur as a basement rock in this area. Weathered charnockite rock occurs at the depth from 2 m to 4 m from the ground surface. The weathered rock is overlaid by soil of thickness ranging from 2 m to 4 m.

## 3. MATERIAL AND METHOD

In the present investigation 50 groundwater samples were collected from bore wells and open wells in and around the Industrial areas of Chrompet. Water samples collected in May'2020 in one litter plastic cans. Collected samples were analyzed for trace elements like Cr, Fe, Cu, Pb, Mn, and Zn by using Atomic Absorption Spectrophotometer following analytical methods prescribed by [4]).

## 4. RESULTS AND DISCUSSION

The concentrations of trace elements and minimum and maximum of the sampling point are given in Table-1.

| S.No | Cr | Cu | Fe | Mn | Pb | Zn |
|---|---|---|---|---|---|---|
| 1 | 0.105 | 0.025 | 0.000 | 0.034 | 0.032 | 0.000 |
| 2 | 0.046 | 0.009 | 0.037 | 0.000 | 0.000 | 0.000 |
| 3 | 0.079 | 0.016 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 0.065 | 0.035 | 1.134 | 0.094 | 0.057 | 0.175 |
| 5 | 0.073 | 0.003 | 0.557 | 0.042 | 0.020 | 0.005 |
| 6 | 0.043 | 0.574 | 1.468 | 0.043 | 0.014 | 0.074 |
| 7 | 0.070 | 0.027 | 0.392 | 0.179 | 0.000 | 0.016 |
| 8 | 0.044 | 0.009 | 0.457 | 0.000 | 0.013 | 0.033 |
| 9 | 0.032 | 0.034 | 1.233 | 0.000 | 0.016 | 0.172 |
| 10 | 0.018 | 0.017 | 0.329 | 0.000 | 0.006 | 0.040 |
| 11 | 0.019 | 0.004 | 1.761 | 0.040 | 0.093 | 0.028 |
| 12 | 0.030 | 0.016 | 0.789 | 0.013 | 0.064 | 0.019 |
| 13 | 0.046 | 0.046 | 0.969 | 0.014 | 0.010 | 0.163 |
| 14 | 0.045 | 0.015 | 0.674 | 0.037 | 0.076 | 0.018 |
| 15 | 0.042 | 0.017 | 0.762 | 0.017 | 0.083 | 0.024 |
| 16 | 0.012 | 0.022 | 0.608 | 0.035 | 0.084 | 0.105 |
| 17 | 0.080 | 0.001 | 0.960 | 0.000 | 0.060 | 0.058 |
| 18 | 0.013 | 0.036 | 0.930 | 0.029 | 0.045 | 0.177 |
| 19 | 0.022 | 0.006 | 0.317 | 0.070 | 0.032 | 0.041 |
| 20 | 0.030 | 0.006 | 0.711 | 0.022 | 0.003 | 0.017 |
| 21 | 0.012 | 0.013 | 0.508 | 0.000 | 0.000 | 0.018 |
| 22 | 0.045 | 0.000 | 0.417 | 0.045 | 0.067 | 0.282 |
| 23 | 0.072 | 0.008 | 0.495 | 0.043 | 0.033 | 0.030 |
| 24 | 0.003 | 0.007 | 0.112 | 0.029 | 0.037 | 0.026 |
| 25 | 0.012 | 0.000 | 0.650 | 0.007 | 0.032 | 0.019 |
| 26 | 0.023 | 0.033 | 1.039 | 0.000 | 0.000 | 0.021 |
| 27 | 0.011 | 0.000 | 0.935 | 0.000 | 0.025 | 0.024 |
| 28 | 0.021 | 0.007 | 0.720 | 0.000 | 0.053 | 0.021 |
| 29 | 0.023 | 0.011 | 0.547 | 0.026 | 0.022 | 0.017 |
| 30 | 0.047 | 0.020 | 0.543 | 0.047 | 0.026 | 0.196 |
| 31 | 0.063 | 0.005 | 0.499 | 0.079 | 0.034 | 0.031 |
| 32 | 0.071 | 0.016 | 1.113 | 0.000 | 0.034 | 0.029 |
| 33 | 0.052 | 0.000 | 1.150 | 0.022 | 0.055 | 0.039 |
| 34 | 0.012 | 0.000 | 0.933 | 0.000 | 0.210 | 0.023 |
| 35 | 0.045 | 0.008 | 0.552 | 0.000 | 0.036 | 0.631 |
| 36 | 0.034 | 0.000 | 1.785 | 0.000 | 0.026 | 0.073 |
| 37 | 0.042 | 0.019 | 1.469 | 0.023 | 0.044 | 0.062 |
| 38 | 0.011 | 0.016 | 0.801 | 0.020 | 0.095 | 0.022 |
| 39 | 0.018 | 0.002 | 2.161 | 0.000 | 0.023 | 0.035 |
| 40 | 0.054 | 0.013 | 2.278 | 0.000 | 0.013 | 0.012 |
| 41 | 0.008 | 0.026 | 1.889 | 0.000 | 0.033 | 0.009 |
| 42 | 0.056 | 0.046 | 0.664 | 0.017 | 0.082 | 0.013 |
| 43 | 0.042 | 0.011 | 1.122 | 0.005 | 0.022 | 0.018 |
| 44 | 0.022 | 0.000 | 1.684 | 0.023 | 0.021 | 0.121 |
| 45 | 0.002 | 0.050 | 0.855 | 0.010 | 0.055 | 0.061 |
| 46 | 0.048 | 0.025 | 1.121 | 0.000 | 0.000 | 0.017 |
| 47 | 0.028 | 0.031 | 0.442 | 0.037 | 0.074 | 0.018 |
| 48 | 0.058 | 0.011 | 0.735 | 0.013 | 0.062 | 0.017 |
| 49 | 0.002 | 0.010 | 1.127 | 0.000 | 0.046 | 0.074 |
| 50 | 0.031 | 0.000 | 0.896 | 0.023 | 0.011 | 0.025 |
| **Minimum** | **0.002** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** |
| **Maximum** | **0.105** | **0.574** | **2.278** | **0.179** | **0.210** | **0.631** |
| **Average** | **0.038** | **0.036** | **0.877** | **0.025** | **0.042** | **0.073** |

In polluted water which cause health hazard, concentration of particular elements is more than the permissible limit for drinking water standard prescribed by ISI (1983) [5]. The sampling points 1,5,23,32,35,40 and 46 in the well were around the stream carrying industrial effluent. Iron may be present in ground water in varying quantities from 0.5 to l00 mg/L (Ernest, 1991). ISI (1983) [5] and WHO (1984) [10] have set a desirable limit of 0.3 mg/L and maximum permissible limit of l.0 mg/L for drinking purpose. In the present study the iron content in sample was found to in the range of 0 to 2.278 mg/L, most of groundwater samples concentrations shows above desirable limit and the location numbers 4,6,9,11,26,32,33,36,3739,40,41, 46 and 49 fallsabove the permissible limit, due to the location of the well in the vicinity of the stream carrying industrial effluent (Fig.1).

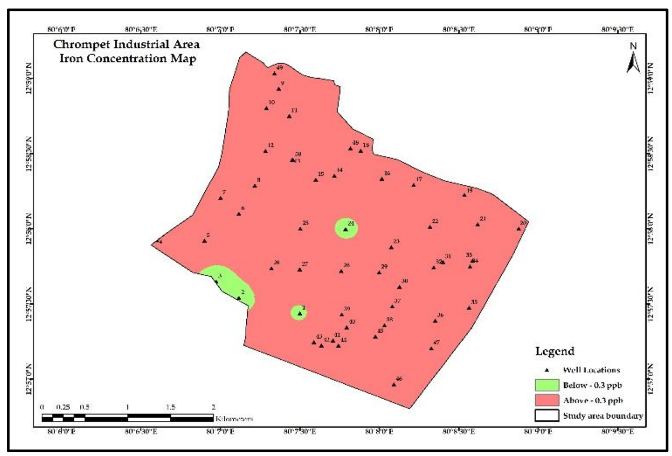


Fig.1. Spatial distribution of Iron concentration

Copper is ubiquitous in the environment and hence frequently present in water. Since copper is both an essential and potentially toxic element there may be risks to living being if there is too little or too much of copper in the environment. Large doses of copper irritate the stomach (Ross,1995). ISI has set a desirable limit of 0.05mg/L for copper. Copper when present in excess of 1 mg/L imparts an undesirable taste to drinking water, so maximum permissible limit of 1 mg/L is recommended by IS I (1983) and WHO (1984). In the sampling point copper concentration varied from 0 to 0.574 mg/L which is below the maximum permissible limit recommended by ISI (1983) and WHO(1984) (Fig.2).

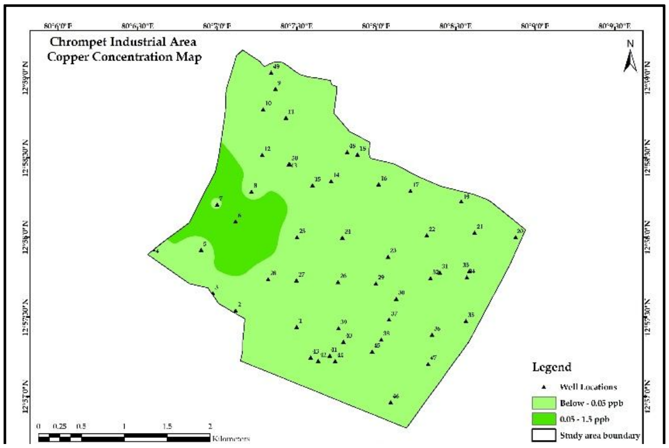


Fig.2. Spatial distribution of Copper concentration

Lead is also a toxic element. The major fraction of lead in groundwater results from the seepage of industrial effluent and from lead containing dust fall out, which is thrown into the atmosphere by vehicles, then ultimately percolates down in the groundwater. Approximately 75% of lead in the gasoline burned by the vehicle are emitted as particles and the remainder of lead consumed in gasoline combustion is deposited in the engine and exhaust system. These particles which are thrown into the atmosphere can travel for long distances before getting into the water system. Thus, lead in groundwater could be attributable to the seepage of industrial effluent and combustion of gasoline on highways[6]. Generally, concentration of lead is too low and most of the time, it is below the detectable concentration in groundwater [7]. In the present study the lead concentration varied from 0 to 0.210 mg/L. Most of the sample lead concentration exceeds the desirable limit (0.01 mg/l) as recommended by ISI (1983) (Fig.3). Lead in high doses has been recognized as cumulative metabolic poison for some of the symptoms of acute poisoning such as tiredness, slight abdominal discomforts, irritability, anemia and in the case of children, behavioral changes (Ramteke et al., 1988).

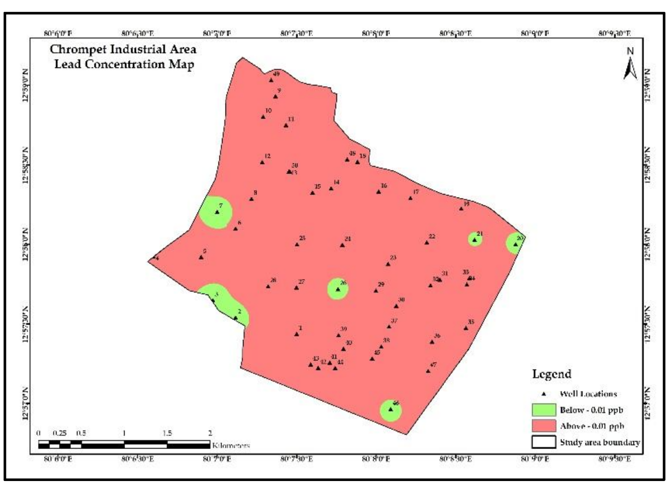


Fig.3. Spatial distribution of Lead concentration

Manganese is a mineral that naturally occurs in rocks and soil and is a normal constituent of the human diet. It exists in well water in Connecticut as a groundwater mineral, but may also be present due to underground pollution sources. Manganese may become noticeable in tap water at concentrations greater than 0.05mg/L of water by imparting a colour, odour, or test of the water. However, health effects from manganese are not a concern until concentrations are approximately 10 times higher. The Department of public health recently set a drinking water action level for manganese of 0.5mg/L to ensure protection against manganese toxicity. This action level is consistent with the World Health Organization guidance level for manganese in drinking water. Exposure to high concentrations of manganese over the years has been associated with toxicity to the nervous system, producing a syndrome that resembles parkinsonism. This type of effect may be more likely to occur in elderly people. Manganese is unlikely to produce other type of toxicity such as Cancer or reproductive damage. In the present study manganese concentrations varied from 0 to 0.179 mg/L. In sample point 7 and 31 the manganese concentration exceeds the maximum permissible limit (0.5 mg/L) of ISI (1983), which could be due to seepage of industrial effluent (Fig.4).

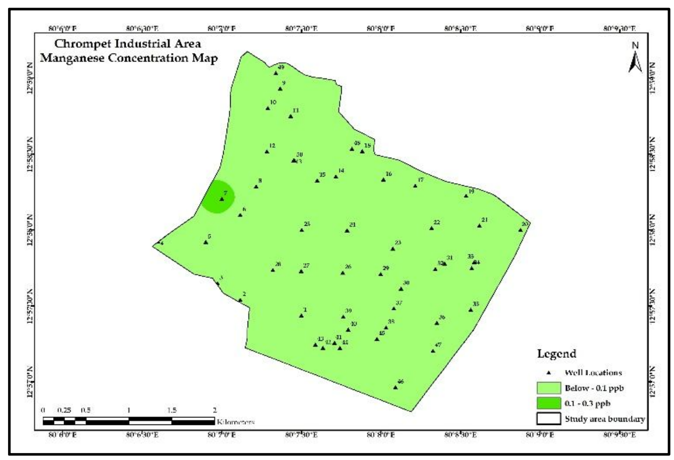


Fig.4. Spatial distribution of Manganese concentration

The toxicity of Zinc is generally low. Nevertheless, industrial and household affluent sometimes contain zinc concentration which can be harmful to the environment. Drinking water usually contains zinc levels below 0.2 mg/L [8]. Resident water in galvanized water pipes can contain considerable higher amount up to 2-5mg/L, depending on the age of the pipes and Physico-chemical properties of the drinking water. Therefore ISI (1983) and EEC (1980) [9] have set a maximum permissible limit of 5 mg/L for zinc, above which aesthetic quality of drinking water is impaired. Disorders of zinc metabolism are usually due to a deficiency rather than a surplus of zinc. In humanbeing the oral administration of high zinc does usually do not cause any side effect with exception of mild gastrointestinal complaints [6]. The zinc content is below the toxic limit in the groundwater samples collected under the present investigation (Fig.5).

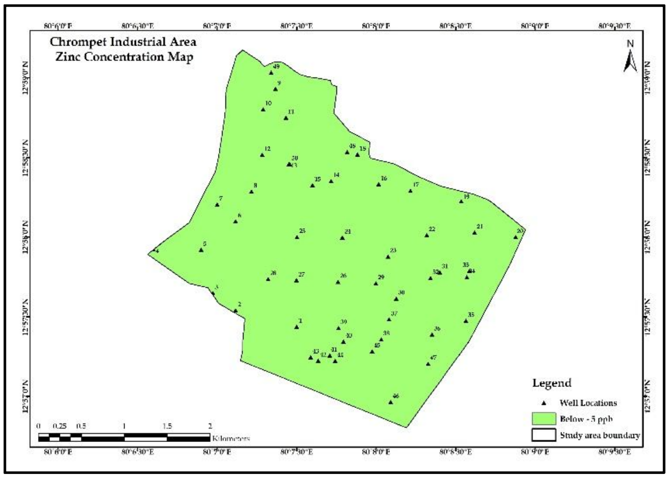


Fig.5. Spatial distribution of Zinc concentration

The concentration of groundwater by heavy metals has received great significance during recent years due to their toxicity and accumulative behaviors. The tanning process using Cr- is applied to 90% of leather produced in the world [11]. These metals are toxic and even in small concentrations cause diseases in humans and animals. The Cr- is highly toxic to humans even in low concentrations. The major sources of heavy metals in groundwater are the discharge of waste effluent and sewage on land. A concentration of 0.05 mg/l has been recommended as a desirable limit for drinking water [11]. In pre monsoon groundwater samples ranges from 0.002 to 0.105 mg/l. Studies of groundwater in this area western and northern part have high concentrations of Cr-, which is much more than the permissible limit in drinking water (Fig.6). The standard gives no relaxation for concentration in drinking water. The tanneries are polluting the groundwater causing ecological degradation and health hazards.

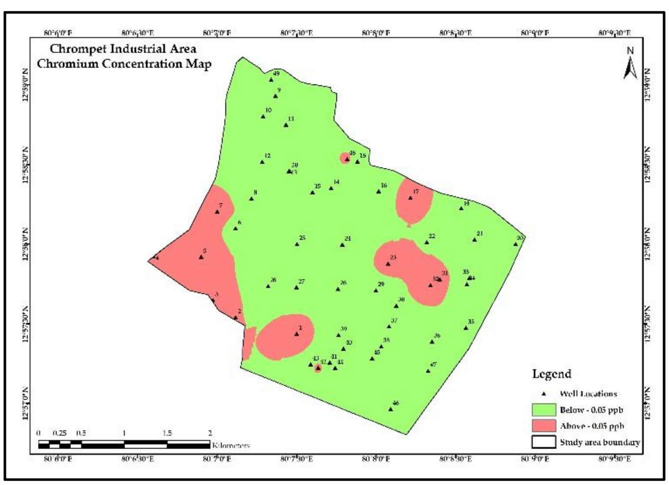


Fig.6. Spatial distribution of Chromium concentration

## 5. CONCLUSION

Concentration of Zinc in groundwater of the study area is well below the toxic limit. Concentration of Iron is observed to be more in the groundwater from the wells which are situated close to industries. Concentration of Cu and Mn are found below the maximum permissible limit and concentration of Pb is found above the maximum permissible limit, which could be attributable to seepage of industrial effluent.The western and northern part have high concentrations of Cr-, which is much more than the permissible limit in drinking water

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