

Experimental Study on the Impact of TiO₂ on Groundwater Near KMML

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Abstract—In this project, the impact of TiO₂ on groundwater was the subject of interest. For this we have chosen the near by site of KMML. Groundwater samples from places near KMML are collected and analyzed for the presence of TiO₂. Spectrophotometer is used to give the absorbance of various TiO₂ solution in order to generate the calibration curve.

Keywords:- Groundwater; TiO₂ content; infiltration; KMML;

I. INTRODUCTION

Kerala Minerals and Metals Ltd is an integrated titanium dioxide manufacturing public sector undertaking in Kollam, Kerala, India. Its operations comprise mining, mineral separation, synthetic rutile and pigment -production plants. Effluents from KMML (Kerala Metals and Minerals Ltd), are polluting water sources, degrading the environment, and posing a public health hazard. The plant manufacturing titanium dioxide was responsible for the deterioration in the quality of groundwater sources.. KMML, one of the few profit-making public sector units in Kerala, uses the chloride route technology to recover titanium dioxide from ilmenite ore, which is abundant along the Kerala coast. Titanium is the ninth most common element on the earth's crust, and thus it is being used for many purposes. Titanium dioxide, also known as Titanium (IV) oxide or Titania, is the naturally occurring ore of Titanium, chemical formula TiO₂. Generally it is sourced from ilmenite, rutile and anatase. It has a wide range of applications from paint to sunscreen to food colouring. The production method depends on the feedstock. Titanium dioxide is compatible with strong reducing agents and strong acids. Violent or incandescent reactions occur with molten metal that are very electropositive. Titanium dioxide dust when inhaled has been classified by the international agency for research on cancer (IARC) as an IARC group 2B carcinogen, meaning it is possibly carcinogenic to humans. The findings of the IARC are based on the discovery that high concentration of pigment grade and ultrafine titanium dioxide dust caused respiratory tract cancer in rats exposed by inhalation and intra tracheal installations.

II. COLLECTION OF SAMPLES

For the collection of samples we had surveyed the sites of around 2 km radius distance from KMML.. The water in the wells as well as in tube wells are found to be very contaminated. There are many residential areas nearby the

factory. They are mainly depending upon public water supplies.



Fig 1: Places from where groundwater samples are collected. We took 8 samples from the sites. 4 of which is taken from the north direction of the factory at 500 meter intervals. North direction of the factory is majorly composed of residential areas. 3 samples were taken from the south direction at 500 meters interval and 1 sample is taken from the west direction at 500 meter distance from the factory.

III. TEST CONDUCTED

For the determination of quality of groundwater we have done several tests including pH, acidity test, turbidity test, specific conductivity test and for the determination of wave length of the particles we have conducted spectrophotometer test.

A. pH

pH determines how much is the liquid solution is acidic or basic. Test for pH is conducted on digital pH meter which contains a pH electrode and a reference electrode. The pH of 8 samples are measured.

TABLE 1

Sample number	pH
1	6.51
2	6.30
3	6.40
4	6.49
5	6.45
6	6.35
7	6.42
8	6.45

B. Turbidity

It is the measure with which water loses its transparency due to the presence of total suspended particles. Turbidity is measured in a Turbid meter. Turbid meter is used to measure the obstruction due to chemical substances present in the water solution. It is measured in NTU.

TABLE 2

Sample number	Turbidity
1	20
2	20
3	19
4	19
5	19
6	21
7	19
8	24

C. Acidity

It is the measure of the capacity of water to neutralize bases. We used both Methyl orange and phenolphthalein as indicator to find the acidity. The dissolved CO₂ is mainly the reason for the acidity component of unpolluted water. For standard determination of acidity of wastewater and natural water, methyl orange acidity (pH 3.7) and phenolphthalein acidity (pH 8.3) are used.

TABLE 3

Sample Number	Initial Reading	Final Reading	Volume (v1)
1	28.4	28.4	0
2	28.5	28.5	0
3	28.6	28.6	0
4	28.7	28.7	0
5	28.8	28.8	0
6	29	29	0
7	29.3	29.3	0
8	29.6	29.6	0

TABLE 4

Sample Number	Initial Reading	Final Reading	Volume (v2)
1	28.4	28.5	0.1
2	28.5	28.6	0.1
3	28.6	28.7	0.1
4	28.7	28.8	0.1
5	28.8	29	0.2
6	29	29.3	0.3
7	29.3	29.6	0.3
8	29.6	29.7	0.1

D. Specific Conductivity

Specific conductivity is the ability of liquid solution to conduct or transmit electricity. In water the electrical conductivity is mainly due to the presence of ions like sodium, chloride, calcium, magnesium etc. Electrical conductivity is determined by electrical conductivity meter. For a typical drinking water the electrical conductivity should be between the range of 5-50 ms/m. For a distilled water it ranges from 0.5 to 3 micro Siemens per meter.

TABLE 5

Sample Number	Specific Conductivity
1	0.03
2	1.4
3	2
4	1.2
5	1.9
6	0.2
7	0.1
8	0.1

E Spectrophotometer

Spectrophotometer techniques are used to measure the concentration of solutes in solution. It measures the intensity of light relative to wavelength. Spectrophotometer must be calibrated by a procedure known as 'zeroing'. The absorbency of a reference substance is set as a baseline value, so the absorbencies of all other substances are recorded relative to the initial 'zeroed' substance.



Fig 1 :Spectrophotometer

TABLE 6

Sample Number	Wavelength
1	248
2	256
3	246
4	261
5	254
6	265
7	255
8	296

IV RESULTS

The pH of the water sample ranges from 6-6.5. The turbidity of the sample ranges from 19-24NTU. The characteristic wavelength of TiO₂ sample was found to be 315-400nm. Water samples collected from the study area on spectrophotometer analysis showed wavelength in the range 240-295nm. This implies that TiO₂ is not present in the sample.

V CONCLUSIONS

In this project studies were conducted on soil and water samples collected from areas nearby KMML, Chavara, in Kollam district. The groundwater samples for analysis were collected from open wells. These open wells were situated at about 1-2km from the titanium sponge factory. The collected water samples were analysed using UV spectrophotometer in the laboratory. The pH and wavelength of the samples were

determined, wavelength using spectrophotometer. For groundwater samples collected from 1km distance, pH was observed to be 6.3 and 6.5, wavelength as 245 and 260nm, for sample 1 and sample 2 respectively. For samples collected from 2km circumference pH was observed to be 6 and 6.45, wavelength to be 296 and 246, for sample 1 and 2 respectively. The results shows that till now the groundwater is not affected by the titanium contents discharged from KMML since the water is neutral and is used for drinking purposes. TiO₂ in nanoparticle form is detrimental to human beings when inhaled or consumed but till now the discharge from KMML is not adversely affect the surroundings.

VI REFERNCES

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