ANALYSIS AND TREATMENT OF THE GROUND WATER AROUND KMML, CHAVARA

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ABSTRACT

Kerala Minerals and Metals Ltd Chavara, Kollam is located at $8^0$59'69.8"N latitude and $7^0$00'19.17"E longitude, is an integrated Titanium Dioxide manufacturing public sector undertaking at Kollam, Kerala, India. Its operations comprise mining, mineral separation, and pigment-production plants. It was reported that ground water and surface water around the study area was affected due to the effluents from the industry. Total 10 open well samples were collected covering a distance of 2.5 km in two directions. Then the main physio-chemical analysis of the parameters like, conductivity, turbidity, pH, TDS, iron, nitrate, sulphate, hardness etc. were done and found that the samples collected from places near KMML are polluted. A composite media filter prototype was made using cashew-nut shell & coconut shell activated carbon, gravel, coarse and fine sand and geotextiles for filtration purpose .The filtered water was again tested and concluded that the parameters like TDS, chloride content and hardness were reduced considerably within the permissible limit.

Key Words: Effluents, prototype, leaching

1. INTRODUCTION

Kerala Minerals and Metals Ltd. (KMML) located at Chavara, Kollam district is one of the major industries in Kerala. It is the only integrated plant with Mineral separation capability, Synthetic Rutile plant with acid regeneration facility and Titanium dioxide pigment production plant in a single complex. People around this industrial area mainly depend on ground water source, particularly the open wells for their domestic purposes. Quality of ground water is deteriorating at a faster pace due to industrial wastes being discharged into the surrounding areas and people in this area suffer from health hazards. So it is significant to check the ground water contamination. Kerala Minerals and Metals Ltd is one such public sector, sited at Chavara, Kollam District,

produces 40,000 MT waste products (sludge) per annum during the production of titanium dioxide pigment. Accidental leakage of this industrial effluent has led to the degradation of adjacent area of industry along with surrounding aquatic ecosystems. Water quality assessment involves evaluation of the physical, chemical, and biological nature of water.

2. METHODOLOGY

2.1 Location of regions

The investigation was carried out by selecting ten open well samples representing different localities around the KMML industrial area, Chavara.

2.2 Sample collection

Samples from different locations which were identified and listed before were collected for analysis. The samples thus collected are taken for physical and microbial test.

2.3Data collection

Data collection includes the topographical features of the sample locations, water quality features enquired from the residents. Latitude, longitude and elevation of the sample locations were obtained with the help of GPS.

2.4 Analysis of sample

Physical and chemical parameters like pH, total alkalinity, total hardness etc were tested in the laboratory.

2.5 Suggestion of remedies

From the obtained results and maps it was understood that some sample locations were polluted and a filtration method is suggested for treatment.

3. DETAILS OF THE STUDY AREA.

Open well samples were collected from areas around KMML. Total 10 samples are collected covering a distance of 2.5 km in two directions. Samples A, B, C, D and E are collected at 0.5 km interval in the direction of flow of waste effluents from KMML. And samples 1, 2, 3, 4 and 5 are collected at 0.5 km interval in the direction opposite to flow. Samples were collected and the latitude and longitude of sample stations were noted by using GPS as shown in table1 and table 2.

Table.1. Latitude and longitude of sample stations in flow direction.

Sample No.	Distance From Kmml (Km)	Latitude	Longitude
A	0.5	8º59‟ 36.17 ” N	76º31‟54.52 ” E
B	1.0	9º0‟ 32.4 4” N	76º32‟8.66” E
C	1.5	8º59‟ 33.11 ”N	76º31‟5.52” E
D	2.0	8º59‟ 33.11 ” N	76º31‟45.52 ” E
E	2.5	9º0‟ 25.8 1” N	76º31‟56.6” E

Table 2. Latitude and longitude of sample stations in opposite direction of flow.

Sample No.	Distance From Kmml (Km)	Latitude	Longitude
1	0.5	9º0‟2.7 4” N	76º32‟28.21” E
2	1.0	9º0‟3.1 3” N	76º32‟45.24” E
3	1.5	9º0‟5.8 3” N	76º33‟3.02” E
4	2.0	9º0‟1 4” N	76º33‟21.82” E
5	2.5	9º0‟2.7 4” N	76º33‟2.59” E

4. ANALYSIS OF DATA

Table 3. Results of the samples collected in the direction of flow of waste

Si no:	Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
1	pH	8.3	8.2	8.1	8.1	8
2	Electrical conductivity	2000	2220	390	280	158
3	Total Dissolved solids (mg/L)	1200	1332	234	168	95
4	Turbidity (NTU)	0	0	1	22	1
5	Total Hardness (mg CaCo3)/l	790	795	135	105	65
6	Calcium (mg/L)	252	316	54	38	22
7	Magnesium (mg/L)	39	1.2	0	2.4	2.4
8	Sodium (mg/L)	110	120	35.9	22.6	12.3
9	Potassium (mg/L)	6.2	15	3.8	3.9	0.6
10	Total Alkalinity (mg CaCO3)/l	130	84	84	46	42
11	Carbonate (mg/L)	5.4	0	0	0	0
12	Bicarbonate (mg/L)	93	56.1	119.5	102.5	51.2
13	Sulphate (mg/L)	10	22	32	54	5
14	Chloride (mg/L)	741	684	70	28.5	20
15	Fluoride (mg/L)	-	-	-	-	-
16	Iron (mg/L)	0.06	0.03	0.12	8.2	0.1
17	Nitrate-N (mg/L)	0.36	0.3	0	0.9	0.16

Table 4. Results of the samples taken in the opposite direction of flow of waste

Si no:	Parameter	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	pH	8.2	8	7.4	7.1	7
2	Electrical conductivity	380	265	213	238	202
3	Total Dissolved solids (mg/L)	228	159	128	143	121
4	Turbidity (NTU)	0	1	3	0	2
5	Total Hardness (mg CaCo3)/l	140	120	30	25	80
6	Calcium (mg/L)	2.8	44	8	8	28
7	Magnesium (mg/L)	0	2.4	2.4	1.2	2.4
8	Sodium (mg/L)	31.9	15.6	39	40.5	14.4
9	Potassium (mg/L)	3.5	1.2	0.8	4.8	1.1
10	Total Alkalinity (mg CaCO3)/l	98	64	44	6	6
11	Carbonate (mg/L)	0	0	0	0	0
12	Bicarbonate (mg/L)	158.6	78	7.3	7.3	53.6
13	Sulphate (mg/L)	45	43	8	22	43
14	Chloride (mg/L)	45	39	70	57	29
15	Fluoride (mg/L)	-	-	-	-	-
16	Iron (mg/L)	0.46	0.55	2.7	0.08	1.2
17	Nitrate-N (mg/L)	0.13	0.4	0.13	5	0.2

5. RESULT AND DISCUSSION

The Physiochemical parameters were tested and the results are analysed, it is found that as the distance is increasing the parameters are also changing, the samples A, B, C, D and E collected in the direction of flow of waste effluents from KMML are having high variation from their acceptable limits compared to the other samples 1,2,3,4 and 5 collected in the opposite direction of flow of waste from KMML

5.1 VARIATION OF pH

The graph shows the trend that as the distance from the KMML increases, the pH of the water sample decreases.

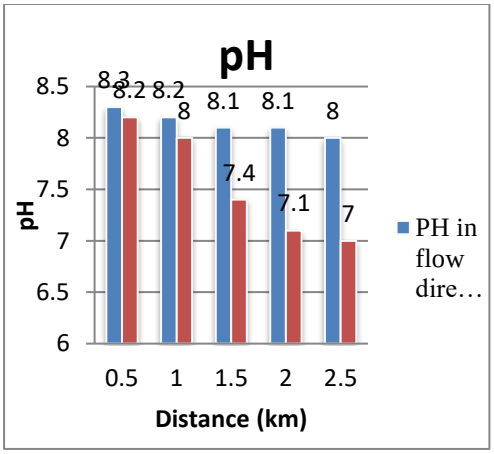

Fig 1: Variation pH With Distance

5.2 TOTAL DISSOLVED SOLIDS

In the present investigation the TDS of the samples ranged from 95 to 1332 mg/l. The maximum value of TDS is presented in sample B with value of 1332 mg/l. The high TDS values indicate the leaching of pollutants into the groundwater.

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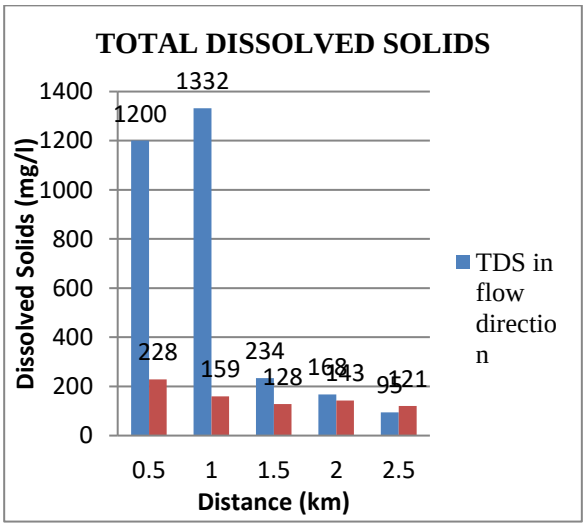


Fig 2: Variation of TDS with Distance

5.3 TURBIDITY

It is evident from the graph that sample D has the highest value of turbidity with 22 NTU as the sample station was located very close to paddy field. The sample was also tardy and clayey having lot of colloidal and suspended particles.

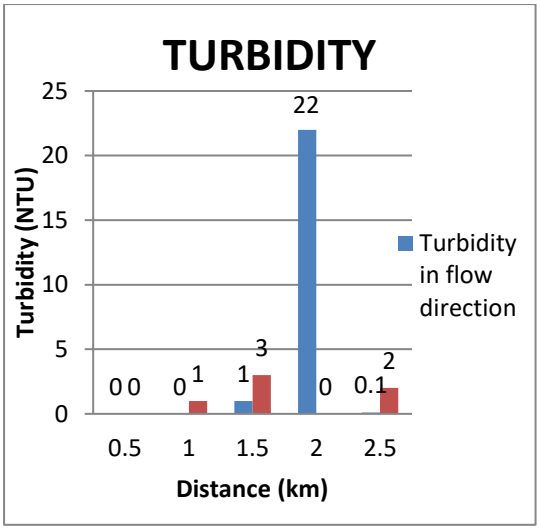


Fig 3: Variation of Turbidity with Distance

5.4 TOTAL HARDNESS

Sample B is having the highest average value for hardness of 795 mg/l. It is clear that the hardness for the sample near the KMML is beyond the limit and as distance from KMML increases hardness value decreases. The variation of Hardness with distance is shown in this graph .

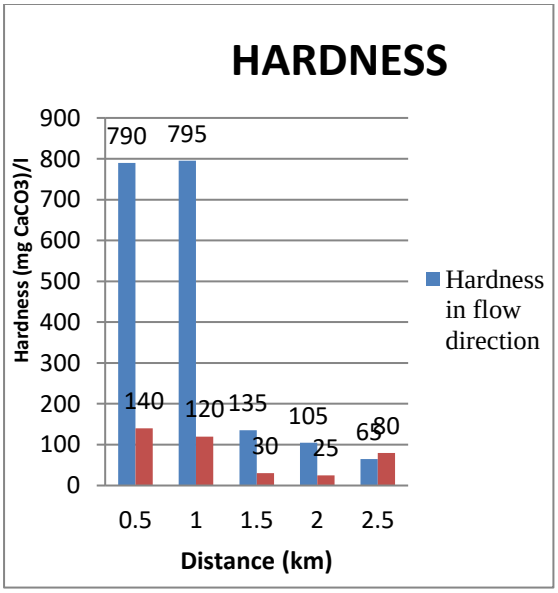


Fig 4: Variation of Hardness with Distance

5.5 CALCIUM AND MAGNESIUM

The variation of calcium with distance is shown in graph 5. The Ca content is highest in sample B with a value of 316mg/l. The variation of magnesium with distance is shown in this graph .

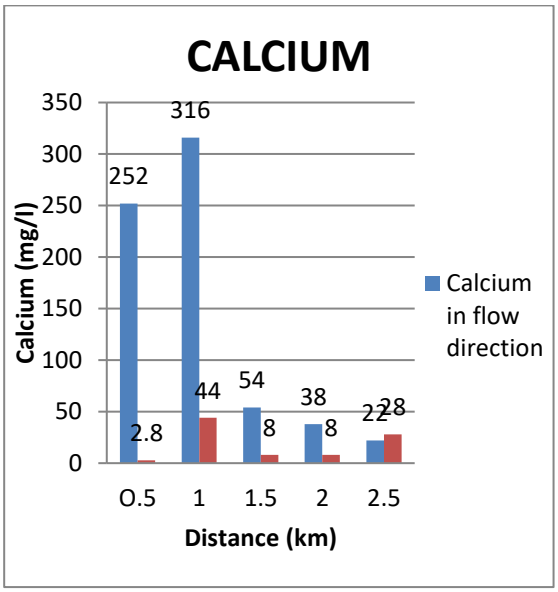


Fig 5: Variation of Calcium with Distance

The variation of magnesium with distance is shown in this graph . The magnesium content in the SAMPLE A is the highest with 39 mg/l. This is due to presence of magnesium limestone in that region.

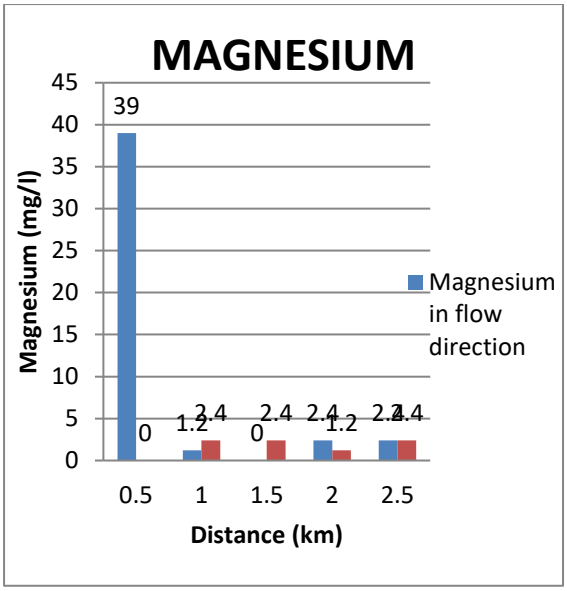


Fig 6: Variation of Magnesium with Distance

5.6 ALKALINITY.

A variation map for alkalinity has been shown in this graph. The highest alkalinity was for sample A with a value of 130 mg/l. The graph shows the trend that as the distance from the KMML increases the total alkalinity of the water sample decreases.

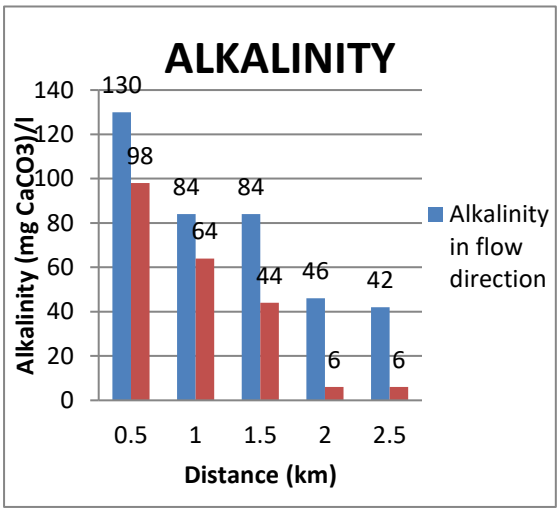


Fig 7: Variation of Alkalinity with Distance

5.7 SULPHATE

The variation of sulphate is shown in the below graph . The highest value of sulphate is noted in SAMPLE D. The graph doesn't show a continuous trend, it depends upon the percolation and seepage rate of sulphate ions near the sample station.

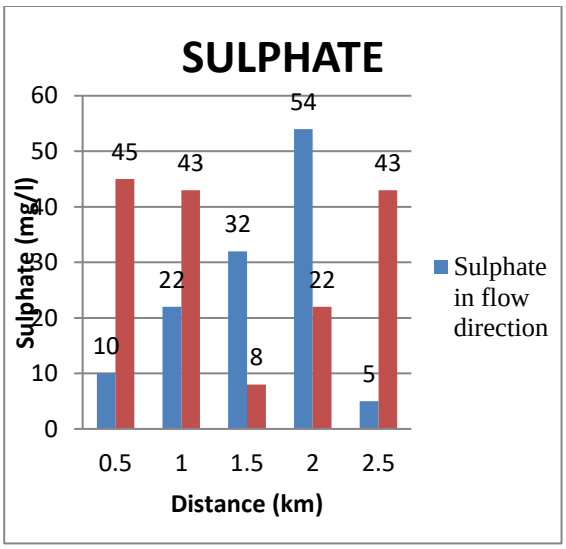


Fig 8: Variation of Sulphate with Distance

5.8 CHLORIDE

The variation of chloride (mg/l) is shown in this graph . The maximum value of chloride is in sample A with a range of 741 mg/l. The chloride content present in the water depends upon the percolation rate of chloride ions from the effluents to that region and its proximity to the sea.

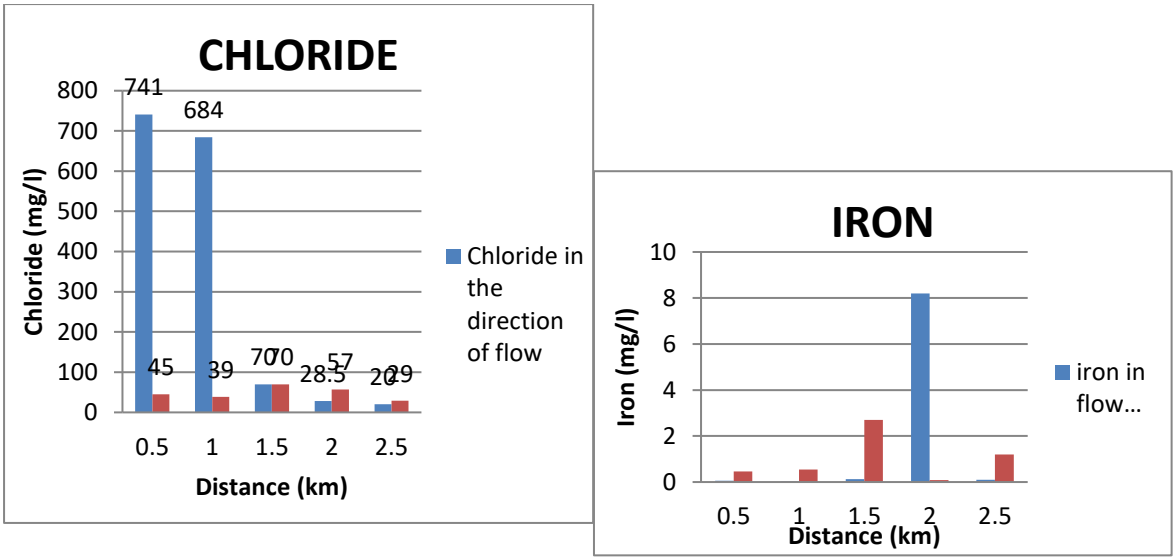


Fig 9: Variation of Chloride with Distance

5.9 IRON

The variation of iron is shown in the below graph .The maximum value for iron is present in sample D with a range of 8.2 mg/l

Table 5: Results of filtrated samples

Parameters	Sample C			Sample 3		
	Before Filtration	After Filtration	Removal Efficiency	Before Filtration	After Filtration	Removal Efficiency
pH	8.1	7	14%	7.4	7	5.40 %
TDS	234	125	46.58%	128	100	21.87 %
TURBIDITY	1	0	100%	3	0	100%
HARDNESS	135	62	54.07%	30	10	66.66 %
CHLORIDE	70	18	74.28%	70	18	74.28 %

6. TREATMENT METHOD

Fig 10: Variation of Iron with Distance

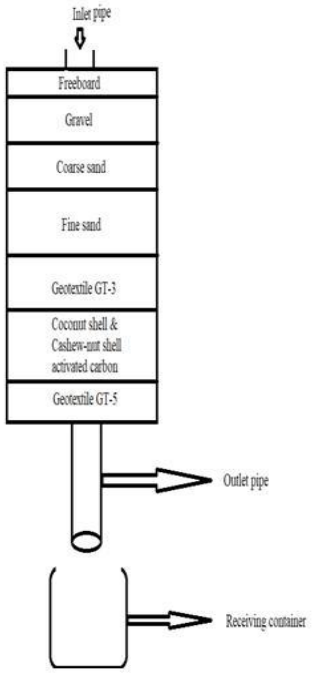


Fig. 11: Schematic diagram of composite media filter

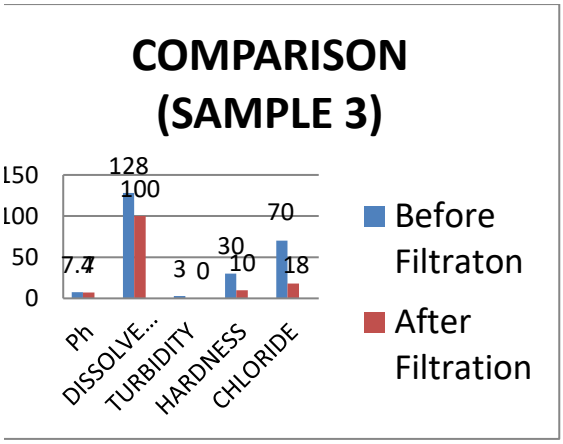
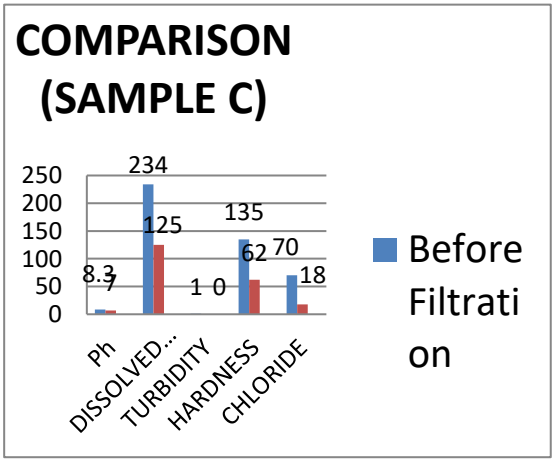


Fig 13. Comparison of samples before and after filtration

Fig 12. Comparison of samples before and after filtration.



CONCLUSION

The physio-chemical analysis of water samples collected from the area around KMML gives the results, sample A (2km), TDS, hardness, calcium, chloride contents are above the permissible limits, the sample B (1.5km) and sample D (2.5km) all contents in the samples are within the permissible limit, the sample C (0.5km), TDS, hardness, calcium, chloride contents are above the permissible limit, the sample E (2km), turbidity and iron content of the sample are above the permissible limit, the sample 1 (2km), iron content is above the permissible limit, the sample 2 (1.5km), all contents are within the permissible limit, the sample 3 (0.5km), 4 (2.5km) and 5 (1km) iron content is above the permissible limit. The high values of various parameters in the physio-chemical analysis shows that there is leaching of pollutants

from the KMML and the variations in this values may be due to the type of lithology and small scale industries present in that region. From the physio-chemical analysis of collected water samples after filtration sample 3 and sample C following conclusions were made, in sample C, 54.07% of hardness, 74.28% of chloride content, 14% of pH and 46.58 % of TDS is removed after filtration, in sample 3, 66.66% of hardness, 74.28% of chloride, 5.40% of pH and 21.87% of TDS is removed after filtration. Therefore the filtration mechanism is effective in removing the pollutants.

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