

# Physical, Chemical and Engineering Properties of Chromium Contaminated and Harbor Dredged Soil

K.Jimreeves Donald, P.D.Arumairaj, Jeya Priya. J

**Abstract:** Soil contamination is caused by the presence of manmade chemicals in the natural soil environment. It is often caused by some form of industrial activity, agricultural chemicals or the improper disposal of waste. The most common chemicals involved in soil pollution are petroleum hydrocarbons, pesticides, lead and other heavy metals. Heavy metals are among the major environmental pollutants and the accumulation of these metals is a great concern in agricultural production due to the toxic effects it has on crop growth. Remediation of soil is a challenging process but if done perfectly it can yield very good results. The physical and chemical properties of the soil are tested. Test such as sieve analysis, liquid limit, plastic limit and specific gravity are done to understand the characteristics of the soil. The contaminants and their concentration in the soil is identified using SEM ANALYSIS and EDAX. Remediation of soil can be done using micro organism, chemicals, plants, high voltage current or by other physical means. Use of micro organisms is one of the advanced methods of remediation. Microbes, aerobes, anaerobes and facultative anaerobes have been contributing to soil improvement for billions of years. They help with nitrogen fixation, limiting growth of plant pathogens, and decomposition of heavy metals, pesticides and hydrocarbons in the soil. The remediated soil can even be used for construction purposes.

**Keywords:** soil properties, engineering properties, chromium contaminated, harbor dredged, remediation.

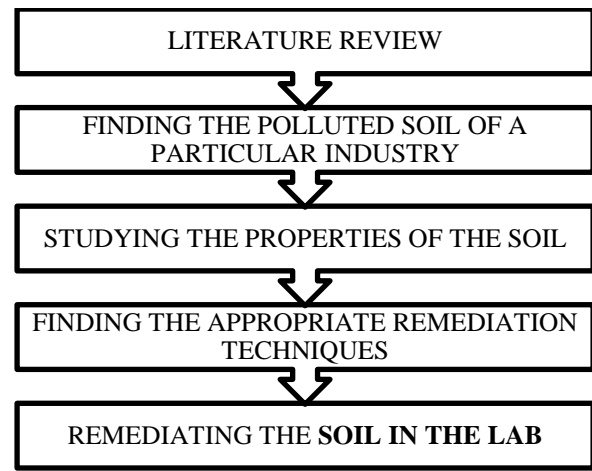
## I. INTRODUCTION

The process of removal of pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water is called remediation. Soil which is wealthy and free from any form of contamination gives growth to clean and natural trees and vegetation, as well as contributing to healthy air and groundwater. If there are heavy metal contents present in the soil then they can cause serious defects to life and also plants and properties. When the chromium content present in the soil gets in the food chain it can cause serious effects to life of both animals and humans. This can lead to serious deterioration to human life. Thus, it is very much important to remediate the heavy

metal content present in the soil. Contaminated soil samples are obtained from the following two locations.

1. Chromium Contaminated Soil, Ranipet.
2. Dredged Harbor Sea Soil, Thoothukudi

## II. METHODOLOGY



## III. RESULTS & DISCUSSION

1. Specific gravity test
2. Sieve analysis test
3. Liquid Limit Test
4. Plastic Limit Test

### SPECIFIC GRAVITY RESULTS

Chromium contaminated	G = 2.618
Dredged sea soil	G = 2.608

### SIEVE ANALYSIS OF DREDGED SEA SOIL

Sieve	Retained wt	Retained %	Cumulative %	Pass %
4.75	157	15.7	15.7	84.3
3.35	60	6	21.7	78.3
2.36	135	13.5	35.2	64.8
1.18	133	13.3	48.5	51.5
0.600	98	9.8	58.3	41.7
0.450	154	15.4	73.7	26.3
0.15	198	19.8	93.5	6.5
0.075	37	3.7	97.2	2.8
Pan	26	2.6	99.8	0.2

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- ✓  $C_u=11.76$
- ✓  $C_c=4.47$
- ✓  $D_{10}=0.17$
- ✓ Coarse Sand = 15.7%
- ✓ Medium Sand = 42.6 %
- ✓ Fine Sand = 38.9 %
- ✓ Silt & Clay = 2.6 %

**SIEVE ANALYSIS OF CHROMIUM CONTAMINATED SOIL**

Sieve	Retained Wt	Retained %	Cumulative %	Pass %
4.75	20	2	2	98
3.35	29	2.9	4.9	95.1
2.36	69	6.9	11.8	88.2
1.18	163	16.3	28.1	71.9
0.600	175	17.5	45.6	54.4
0.450	234	23.4	69	31
0.150	179	17.9	86.9	13.1
0.075	104	10.4	97.3	2.7
Pan	25	2.5	99.8	0.2

- ✓  $C_u = 6.41$
- ✓  $C_c = 1.56$
- ✓  $D_{10} = 0.12$
- ✓ Coarse Sand = 2 %
- ✓ Medium Sand = 43.6 %
- ✓ Fine Sand = 51.7 %
- ✓ Silt & Clay = 2.5 %

**LIQUID LIMIT TEST**

The Liquid Limit of both the Chromium Contaminated Soil and Dredged Sea Soil could not be determined because of the low clay content present in the soil.

**PLASTIC LIMIT TEST**

The Plastic Limit of both the Chromium Contaminated Soil and Dredged Sea Soil could not be determined because of the low clay content present in the soil.

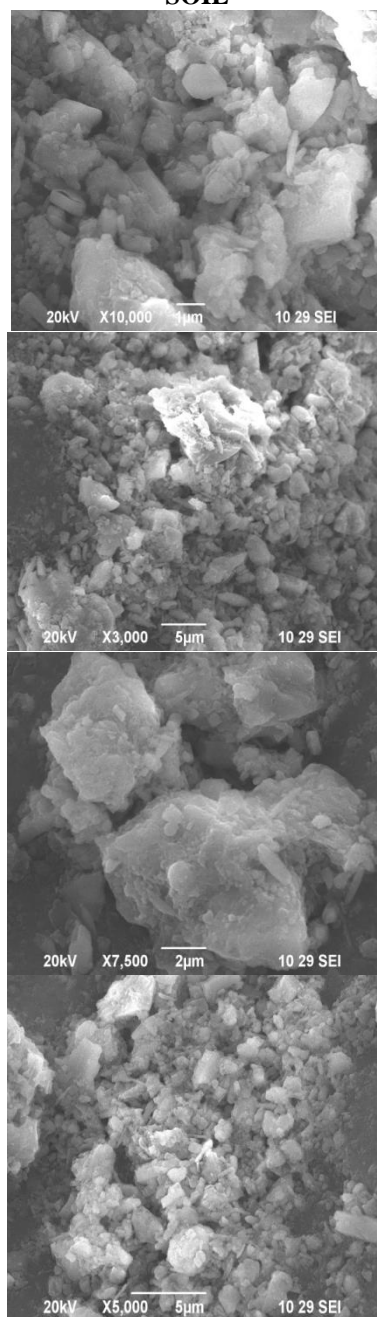
**TEST ON CHEMICAL PROPERTIES OF SOIL**

Parameters	Chromium contaminated	Dredged sea soil
Chloride	251.27 mg/l	5.0055 mg/l
Total hardness	150 mg/l	92 mg/l
Calcium hardness	70 mg/l	76 mg/l
Magnesium hardness	80 mg/l	16 mg/l
Calcium concentration	28 mg/l	30.4 mg/l
Magnesium concentration	19.2 mg/l	6.4 mg/l
Ph	10.316	9.347
Conductivity	727.9 $\mu$ S	2.224 $\mu$ S
TDS	379.7 ppm	108.1 ppm

**IDENTIFYING THE CONTAMINANTS IN THE SOIL SAMPLE**

The main soil pollutant present in the soil are heavy metals and arsenic; organic substances and organic compounds; residues of non-biodegradable pesticides, pharmaceuticals and radionuclide. The heavy metals present in the soil sample can be identified with the help of Scanning Electron Microscope (SEM) and Energy Dispersive X-Ray Analysis (EDAX).

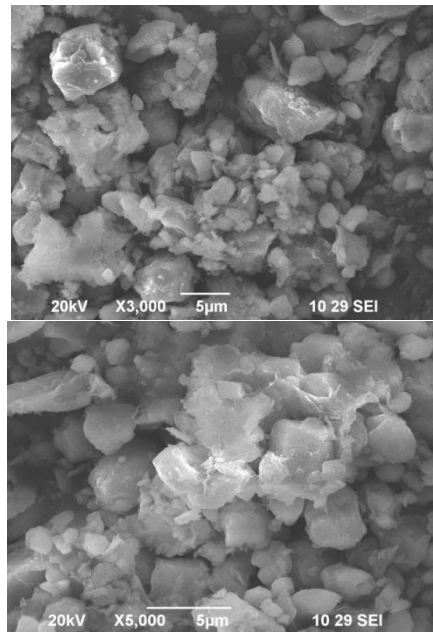
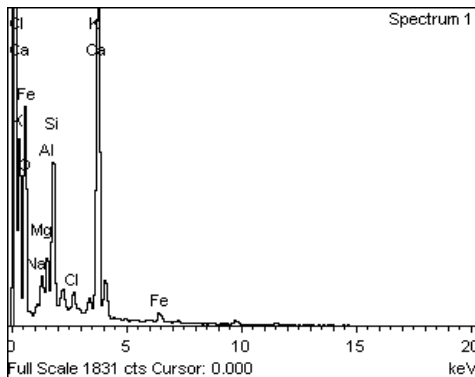
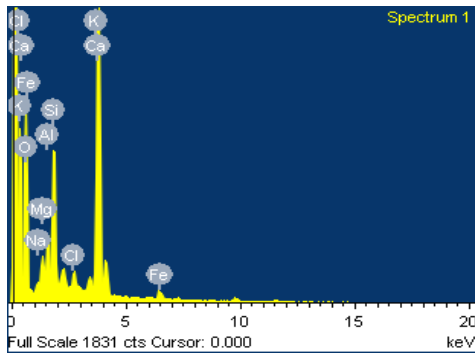
**SEM ANALYSIS OF CHROMIUM CONTAMINATED SOIL**



**EDAX ELEMENTAL ANALYSIS & RESULTS OF CHROMIUM CONTAMINATED SOIL**

Element	App Conc.	Intensity Corr.	Weight %	Weight % Sigma	Atomic %
O K	35.27	0.7715	56.47	0.82	74.67
Na K	0.58	0.6231	1.16	0.22	1.07
Mg K	1.57	0.6069	3.19	0.20	2.77
Al K	2.12	0.6994	3.74	0.19	2.93
Si K	4.36	0.7744	6.96	0.23	5.24
K K	0.33	1.0888	0.38	0.11	0.21
Ca K	12.97	1.0133	15.82	0.36	8.35
Cr K	2.51	0.8362	3.71	0.21	1.51
Fe K	5.73	0.8244	8.58	0.34	3.25

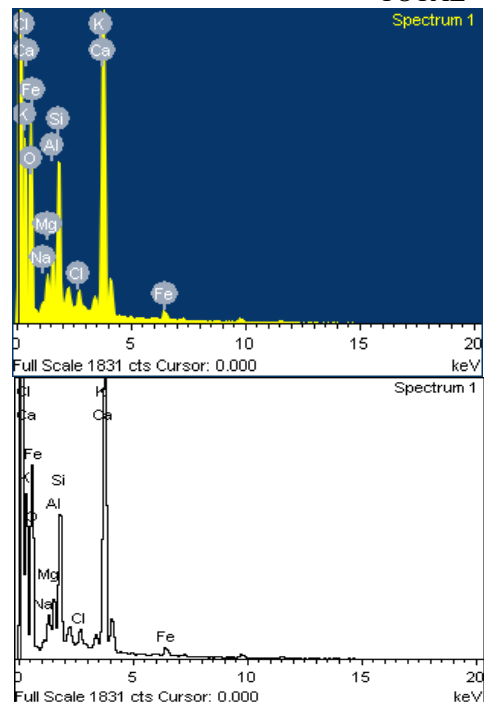
TOTAL 100



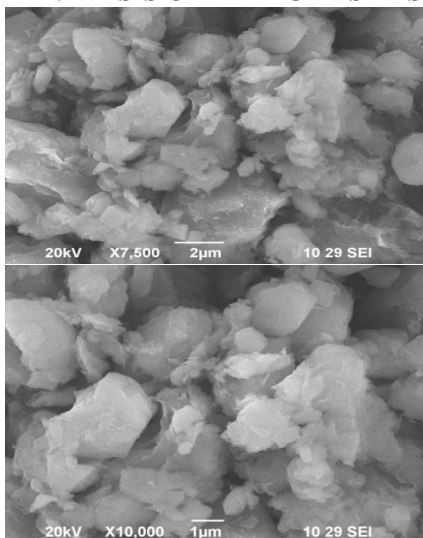
**EDAX ANALYSIS OF DREDGED SEA SOIL**

Element	App Conc.	Intensity Corr.	Weight %	Weight% Sigma	Atomic %
O K	31.96	0.6067	61.64	0.68	77.66
Na K	0.40	0.6663	0.71	0.22	0.62
Mg K	1.22	0.6466	2.21	0.19	1.84
Al K	1.53	0.7444	2.41	0.18	1.80
Si K	5.32	0.8233	7.57	0.24	5.43
Cl K	0.71	0.8019	1.04	0.14	0.59
K K	0.87	1.0926	0.93	0.13	0.48
Ca K	18.62	0.9961	21.87	0.43	11.00
Fe K	1.12	0.8108	1.62	0.22	0.58

TOTAL 100



**SEM ANALYSIS OF DREDGED SEA SOIL**



## IV. CONCLUSION

The soil samples were collected and then the soil properties were studied. Various soil tests such as sieve analysis test, plastic limit test, liquid limit test and specific gravity test were done to understand the engineering characteristics of the soil. Chemical tests such as pH test, conductivity test, total dissolved solids test, chloride tests and hardness test were also done to understand the chemical properties of the soil. The in-depth analysis of soil structures was understood with the help of Scanning Electron Microscope (SEM) and the concentration of chemical elements present in the soil sample were determined with the help of Energy Dispersive X-Ray Analysis (EDAX). With this knowledge on the soil, there is further scope for the remediation or reuse of the soil.

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