International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2585
Volume 4, Issue 4, April-2018

EFFECT OF PHOROUSPHROUS BASED INDUSTRY ON JHAGADIA GIDC AND NEAR BY SOIL PROPERTIES

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Abstract*—Industrial development is necessary for economic and social development for any country but due to rapid industrial growth some problems occur like soil resources and water resources contaminated by industrial pollutants and their properties degrade. Now a days soil contamination is a huge issue because due to contamination of soil some basic properties of soil have been changed and it causes a harmful effect on foundations which are supported by the contaminated soil and resulted in structural failure as well as structural damages. In this research comparative study of contaminated and non-contaminated soil had been carried out. Contaminated sample was collected from UPL company which is situated in the region of Jhagadia GIDC and non-contaminated soil sample was collected from Kapalsadi village which is situated nearbyjhagadia GIDC region. Physical properties as well as pH and Phosphorous contents had been found for both of the soil samples.Basicly UPL is a phosphorous based company so it released a large amount of Phosphorous waste.This wastehas beencontaminated with soil and water of nearby are. Soil content large amount of phosphorous content and results also shows that This contamination also effects on Geotechnical properties of soil and the properties has been changed.

***Keywords*— Soil contamination, Phosphorous, physical properties**

I. INTRODUCTION

This study describes the effect of various industrial pollutants on the basic properties of the soil. Two different soil samples which are contaminated and non- contaminated had been collected for the study. Contaminated samples were collected from

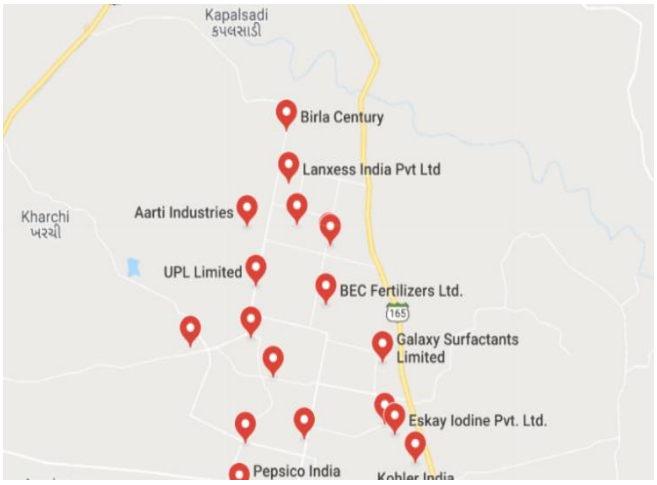

Fig. 1Major Industries in Jhagadia GIDC region

UPL company which situated injhagadiaGIDCregion, Bharuch, Gujarat, India. UPL produced phorousphrous based products and fertilizersand non-contaminated soil samples were collected from a village nearby this company whose name is Kapalsadi and for both of the soil samples Geotechnical properties had been find out. Many researchers had work on this topic. Abhilash and Tharaniadded alkali and dairy industrial effluents in clayed soil and found that various physical properties of soil like Liquid limit, Plastic Limit etc.

They concluded that amount of alkali effluents was increase Shearstrength of the soil goes to decreases [1]. Sivapullaiah had carried out many experiments on contaminates soil and concluded that rate of the swell is affected by minerals available in soil [2]. Shah and Shroff concluded that when various pollutants come in contact with the soil it effects on to the soil properties and that change in to the soil properties depends on clay particles present in soil as well as type of the pollutant [3]. Karkushatel et al. collected various disturb and un-disturb soil samples. They added different contaminants in to the soil samples and contaminated soils for 30 days and concluded that contaminants highly affected on the soil properties. Atterberg limits increases while all other properties decrease with increasing the contaminants [4].

II. ABOUT JHAGADIA GIDC:

Jhagadia GIDC is situated in Bharuch district of Gujarat state in India. There are around 96 large scale, middle scale and small-scale industries are situated there. And around 30 larger scale Chemical Industries are there which are famous for export dye intermediates, bulk drugs, pharmasuticatials, paint, fertilizers, pesticides and many more. Each year small scale industries increase at the 30% rate while large and medium scale industries increases at 10% rate.

III. SAMPLE COLLECTION:

Contaminated soil samples were collected from Jhagadia GIDC region near the UPL (United Phosphorus Limited) which export the fertilizers and expose large amount of the chemical waste. and for Non-contaminated soil samples were collected from Kapalsadi village which is situated around 10km distance from the UPL limited. Un disturb samples were collected by the use of the core cutter and various properties of soil were examined.

IV. EFFECT OF PHOSPHORUS ON SOIL:

UPL is a Fertilizer company which produced waste in the form of phosphoric waste in the form of solid as well as liquid waste. Solid waste disposal nearby landfill site while liquid waste disposal in Kaveri river which is near by the area. But both of the waste contaminated with soil and as the result Phosphorus content is increasing in that particular area. Many researchers have studies on effect of Phosphorus contamination with soil. Horta had concluded that increase the amount of Phosphorus decreases permeability of soil because it allow the salt crystallization between soil particles [5]. Barbour & Yang concluded that Due to excess amount of phosphorous plasticity of clay soil decreases and shear strength increases [6]. Sinha et al. had been concluded that Soil bearing capacity decreases up till 30% as compared to Non-contaminated soil. Sivapullai et al. had researched on structural distortion due to the Phosphorus effect and suggest geomembrane bellow footing for protect the soil from contamination [7]. Sridharan et al. studied near the fertilizer plant where Phosphoric acis leaked below foundation soil and damage open drains in joints and he recommended closed conduits and drains with filter [8]. Schguiling& van Gaanshad been studied on sulphuric acid waste generated by Phosphate fertilizer plant at Ukraine, disposal in to the nearby lake and who act as a sealant and constrained seepage [9].

V. EXPERIMENTAL WORK (IS: 2720):

Following tests were conducted on both of the contaminated and non-contaminated soils as per IS. For Atterberg limits (L.L, P.L, S.L), grain size distribution, specific gravity, specific gravity, standard proctor test, direct shear test, free swell, soil pH.
For determining Atterberg limits the soil sample have to first sieved through a 0.425 mm sieve (#40 mesh).
It is advisable L.L test first.

TABLE I
LIST OF EXPARIMENTS

Sr. No	Experiment	IS Code
1.	Atterberg limits	IS: 2720- Part 5
2.	Grain size distribution	IS: 2720- Part 4
3.	Specific gravity	IS: 2720- Part 3
5.	Standard proctor test	IS: 2720 – Part 7
6.	Direct Shear test	IS: 2720- Part 13
7.	Permeability	IS: 2720- Part 17
8.	Free swell	IS: 2720- Part 40
9.	Soil pH	IS: 2720- Part 26
10.	Phosphorus	

Liquid Limit is a soil water content at which soil changes from a plastic to liquid state. Liquid limit is determined using the Casagrande cup. It contains finding a soil water content which corresponds to the 25 number of blows required to bring together a 13 mm slices of a groove cut into the soil sample. It is difficult to get accurate count so by plotting the graph [Fig-1] get the L.L at 25 blows.

Plastic Limit is a soil water content at the border amid the semi-solid and plastic state. It is obtained as the water content at which a soil should be rolled by palm in to the thread of around 3.2 mm diameter without failure.

Plasticity Index (Ip) is difference between the liquid limit and the plastic limit (Ip = L.L-P.L)

Grain size distribution test had been carried out for finding the percentage of clay and silt contents present in soil samples. Sieve analysis test was ne performed on both of the soil samples.

Specific gravity of a soil is an important parameter for finding the other parameters like compaction curve, void ratio, hydrometer.

Standard Proctor test is a test by which we can find out the Optimum Moisture Content and Maximum Dry Density of the soil samples. Soil compaction parameters can be determinate by this test. It is also required for the various strength and settlement criteria of the foundation.

Direct Shear test is useful for finding out the Shear strength, angle of friction and cohesive strength of the soil sample. Many researchers had concluded that if the cohesion content increasing the frictional angle decreasing.

Soil Permeability test had been carried out for finding the permeability of contaminated as well as non-contaminated soil. Constant head permeability test was used for both of the soil samples. Soil permeability is effect on the Bearing capacity of the soil it is an inverse relation between permeability and bearing capacity. If the permeability is more than less bearing capacity of the soil.

Free Swell test is useful for finding out the swelling potential for the soil which is useful for constructing the foundation.

Soil pH is the Concentration of Hydrogen ion and it is useful parameter for finding out the acidity of the soil. Due to the present of acid content steel which used in foundation goes to corrode and due to that strength of the structure goes to decrease.

VI. RESULT AND DISCUSSION

Following results had been obtained from various tests on contaminated as well as Non-contaminated soils. Jorbenadze at el. Soil colour indicates the composition of soil particle in both of the cases the soil colour remain same and it is Yellow and the reason is presence of ferric hydroxide [10]. From Grain size distribution it had been concluded that in both of the cases around 80% particles are finer than 0.002mm IS sieve so, soil is classified as silty clay but from the results of Atterberg limits both of the soil samples are classified as High cohesive clay (CH). From the results of Specific gravity test it had been concluded that specific gravity for contaminated soil is greater than the specific gravity of the non - contaminated soil. From the results of permeability test ae can see that permeability decreases as effluents increase and that is because effluents fill gap between the soil particles therefore porosity decreases and due to that permeability also decreases.As shown in graph (Fig. 1) for contaminated L.L increases as compared to Non-contaminated soil for Noncontaminated soil L.L was 60.08% but for contaminates soil goes to decrease up till 52.3%. Both of the Liquid limit and plastic limits increases for contaminated area. As the Plasticity index is difference of L.L and P.L so, (Ip) is also goes to decrease.Standard proctor test had been carried out on both of the soil samples contaminated and non-contaminated and results shows (Fig-2) as compared to non-contaminated soil contaminated soil have more Maximum dry density and less Optimum moisture content.For finding out the strength parameters like cohesion, frictional angle and shear strength Direct shear test were performed on contaminated and non-contaminated soil samples and as shown in (Table:1) cohesion is increasing in contaminated sample while frictional angle and shear strength decreases.

TABLE 2 RESULTS OF EXPARIMENTS

Properties	Non-contaminated	Contaminated
Color	Yellow	Yellow
Specific gravity	2.597	2.676
Finer than 0.002mm IS sieve	80.423%	82.897%
Liquid limit (%)	52.3	60.08
Plastic limit (%)	21.51	23.2
Plasticity Index (Ip)(%)	30.79	36 .88
Permeability (cm/sec)	$4.2*10^{-6}$	$1.25*10^{-7}$
Maximum dry density (gm/cc)	1.43	1.63
Optimum moisture content (%)	16.6	18
Frictional Angle	24°	21°
Cohesive Strength (kPa)	19.987	23.560
Shear Strength (kPa)	224.480	210.963
Free Swell index (%)	62.48	103.41
Phosphorus (ppm)	40	1240
Soil pH	8.34	9.72

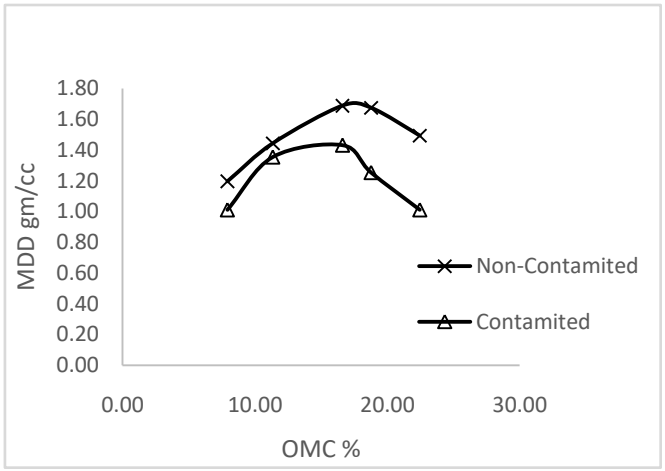

Fig. 2 Compaction Curve

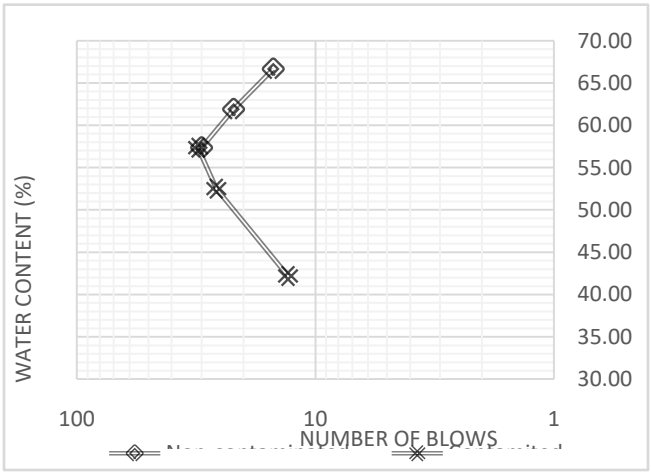

Fig. 3 Liquid limit graph

Free swell index test had been carried out to find the swell pressure of both of the samples and result shows (tab. 2) forcontaminates soil sample Swell pressure is more than the non-contaminated soil samples. In contaminated soil samplephosphorus amount is more as compare to the non-contaminated samples and reason is UPL is a phosphorous based company hence, in waste also the amount of phosphorous is more.

IIV. CONCLUSIONS:

1. Amount of the Phosphorous contents is so much high in sample of the industrial region soil and reason is phosphorous has been present in solid and liquid waste of that region. Grater amount of phosphorous cause harmful effect on human health and also on the agricultural soil.
2. For contaminated soil sample soil parameters like Specific gravity, Atterberg limits, Maximum dry density, Cohesion, Free swell index are increasing. Results shows in a [Tab-2].
3. Also the Geotechnical parameters like Permeability, Water content, Frictional angle and Shear strength are decreasing.
4. From the above results we can concluded that Contamination soil sample of the Jhagadia GIDC region contain large amount of the phosphorous material and that occurs a drastic change in geotechnical soil properties also soil strength.
5. Shear strength of the soil is decreasing and Soil bearing capacity if effected by that so also the soil bearing capacity decreasing that is not good for any building construction.

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