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Impacts of Cement Industries Wastes, on Hydrogen Ion Activity of Soil, and Biodiversity: A Pilot Study

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Abstract. World over cement industries are one of the main pillars for the development of the economy and building the infrastructure. The present study which is carried out at the surrounding area of the one of Libyan cement industry (Soog Al khamis) located at a distance of 57.5 km, south of Tripoli, during 1977. It describes issues related to site selection, availability of raw materials and agricultural activity in the region.
Results show that after years of its production, the soil has lost its productivity which led to consequent decrease of biodiversity. The pollution from this industry has impacted the soil and vegetation. Measurements reflecting a change in the values of the pH of the soil around the factory clearly shows the production of two types of soils i.e. acidic soils and alkaline soils. The highest value of 12.42 pH shows that the soil is basic in character. Under this circumstance, _the proportion of Nitrogen, phosphorus, iron, manganese, is decreasing, and the organic matter in the soil are found to be soluble. Samples captured from the vicinity of the factory at a distance of 1 km to the north show that, the 9.27 PH value is low when compared to the one from the samples taken from inside the plant. The high pH value of the order of "9" leads to the production of poor conditions. It is found to be unsuitable for plant growth, since it increases sodium metal leading to the poisoning of plants in these soils. On the other hand, in the south of the factory, the highest value of samples is "7.68". With regards to the wind direction, samples collected at 10 km, from the factory, having PH of the order of 8.26, gives an indication of potatoes disease, in the region.
In summary, this study shows that, the alkaline nature of agricultural soil has led to disappearance of organic matter resulting in low permeability and aeration in the soil, with consequent negative impacts on soil productivity, plant growth, and biodiversity.

Keywords: Hydrogen ion (PH), Soil, Biodiversity, Waste

1. Introduction

The cement industries are one of the main pillars for the development of the economy and build the infrastructure of any country. However, the production, processing, and final manufacturing of the raw materials of cement, if not managed well produces huge environmental disasters. In addition, lack of planning, management, and follow up, causes not only, environmental problem, but also human health deterioration. The overall aim of this paper is to minimise the impact on the environment caused by cement industry wastes discharged from cleaning activities, trucks, pipes and other equipment. The goal is to help evolve a 'living document' that will need to be changed from time to time as our technology and experience change.

Ideally, the PH of any solution ranges between zero to 14. The neutral value of 7 shows that at this point, hydrogen ion and hydroxyl are equivalent. The change or fluctuation on hydrogen ion of the soil could damage soil micro flora, within this case the essential elements like Fe, Mn, and P, could not be available for plant easily, because most plants prefer neutral hydrogen ion of the soil [1]. However, microorganisms in soil can live in different environmental cultural, for instance fungi, able to adapt itself in acidic soil (i.e. PH from 1-5.5), also, in neutral soil (i.e.PH from 5.5-8.0), and in alkaline soil with in a PH from 8.5 to 11.5 [2].

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Natural systems are often subject to constantly changing in puts, and since some reactions occur very slowly, and equilibrium may never be established[3]. Further, the most important function of soil in supporting plant growth is to provide essential plant nutrients, i.e. macronutrients and micronutrients.[4] In an acidic soil condition, it will be an increase in Al, Fe, Mn, they are toxic to plants, and if soil is alkaline (PH above 9), there will be an increase in Na, which is most toxic to plants[5].Soil is an essential source and a vulnerable environmental system, two broad catagories of threats to soil are soil degradation and soil pollution.[6]

2. Case Study Methodology

The methodology adopted is based on the case study carried out at the surrounding area of the one of Libyan cement industry (Soog Alkhamis) that is representative of similar other industries in the country. The chosen case study industry established in 1977 is located at a distance of 57.5 km, south of Tripoli. It is situated on a site that is ideal due to the availability of raw materials. However, it is found to impact the agricultural activity in the region[7].

It is observed that years of cement production has resulted into not only the soil loss but also its productivity. In addition this has led to decrease of biodiversity too[8]. This prompted the authors to undertake a comprehensive study to investigate that how the pollution from this industry impacts the soil and vegetation. This is measured in terms of a change in the values of the pH of the soil around the factory. In addition a comprehensive questionnaire is designed to collect views, opinions and practices on items as listed below:

What is the quantity of cement wastes? What are the pumping requirements? What are the site conditions? Will the whole site be developed? Is the quantity of cement industry wastes such that a waste facility is required? Are the pumping requirements such that a waste facility is required for cement wastes? If not, are leak proof bins appropriate? Is a pit appropriate? Can bins and a pit be used together? If a collection treatment disposal facility is proposed, has the developer or architect provided enough details of the proposal? Will it adjust pH according to local authority standards? Is the sewer available? Is Planning secretariat approval required? Does the factory have a trade waste agreement with the local sewerage authority? Can the treated cement wastes be recycled or re-used off-site, for example, at a local batching plant? Can the treated wastes be recycled or re-used on-site? [9]

Thus the methodology is designed to find that how this change using the cement polluted water may damage or kill the vegetation. Objective is to find reasons of Loss of vegetation, soil erosion and possible pollution of the environment in the surrounding area. For the purpose of exact estimate 20 Samples are taken from the soil (50 cm in depth) and collected in plastic bags, and stored in the laboratory. Next day the samples are well crushed and screened to remove any impurities. The samples are diluted in distilled water. Using PH meter, the pH of all samples is measured.[10]

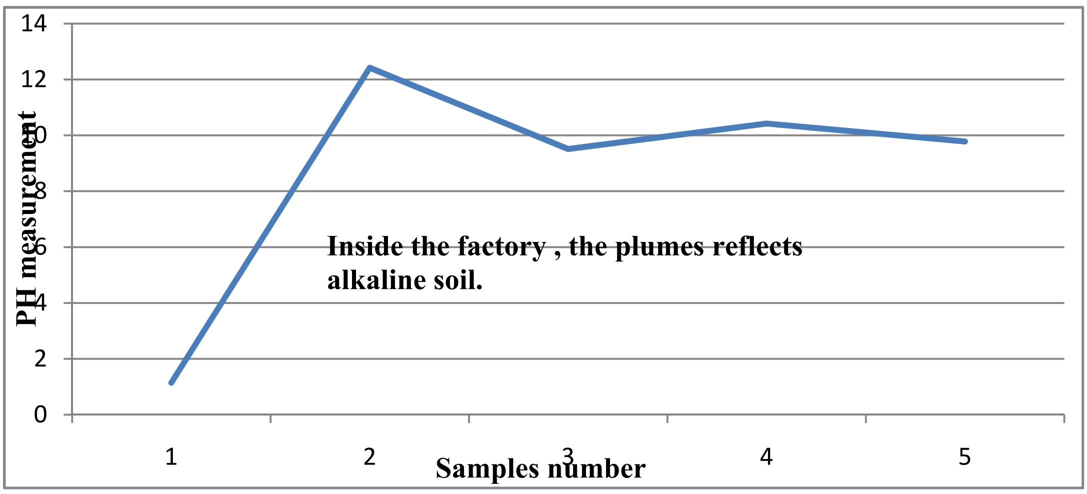

Fig. 1: PH measurement of the soil inside the cement factory.

3. Results and Discussion

Results plotted in figures 1 show that the samples collected from inside of the factory, have the highest value of the PH which of the order of 12.42. The median value is 10.6, and standard deviation 1.15. It indicates that, the plumes from the industry at the nearest point have the alkaline nature of soil.

Fig. 2: Shows that away from the factory, about 1 km, from the northern site, the, arithmetic mean of PH value of the samples is 8.4, and the standard deviation 0.545. Also in this cultivated soil, the organic matter is soluble. The minerals are limited. Therefore, the soil has lost gradually its fertility.

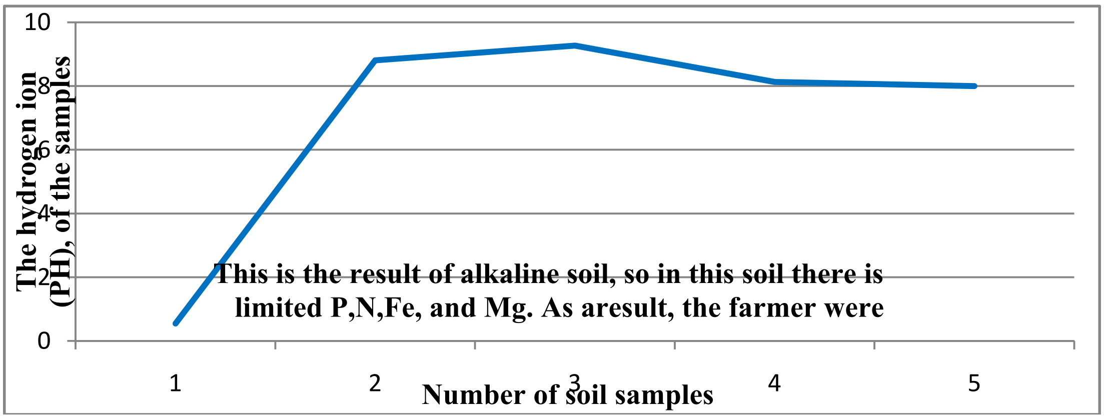

Fig. 2: Shows the measurement of hydrogen ion (PH) of the soil,at one kilometer away from the factory (Northern site).

Fig. 3: Presents results from the situation wherein samples taken from the southern site of the factory have PH values with the arithmetic mean of 8.37, and the standard deviation as 0.443.

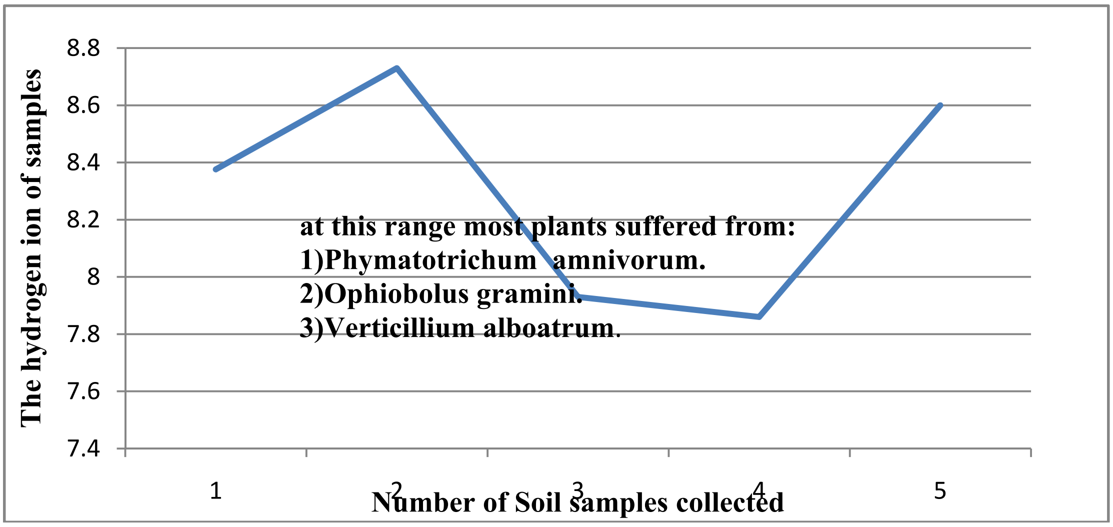

Fig. 3: Shows the result of PH measurement at one kilometer away from the south of the factory

On comparison of results obtained from sites at location about 10 Km, away from the factory show that the collected samples PH values have an arithmetic mean and standard deviation, of the order of 8.19, and 0.080, respectively. This shows that the cement industry plum, reaches as for as 10 Km away. As evident in Fig 4, alkaline nature of soil is dominated with Na, Ca, Mg, K. It further shows that the organic matters are dissociated.

4. Conclusion

After years of processing and production of cement in case study it is evident that the soil has lost its productivity which in turn has led to decrease of biodiversity. Thus the pollution from cement industry has significant impacts to not only in reducing in the soil productivity but also vegetation distribution. It is found that the change or fluctuation on hydrogen ion of the soil does cause damage to soil micro flora. In case study the essential elements like Fe, Mn, and P, could not be available for plant easily, because most plants prefer neutral hydrogen ion of the soil. In addition, in an acidic soil condition, it results in to an increase in Al,Fe,Mn, which, is toxic to plants. In situation of alkaline soil (PH above 9), there is an increase in Na. This is most toxic to plants.

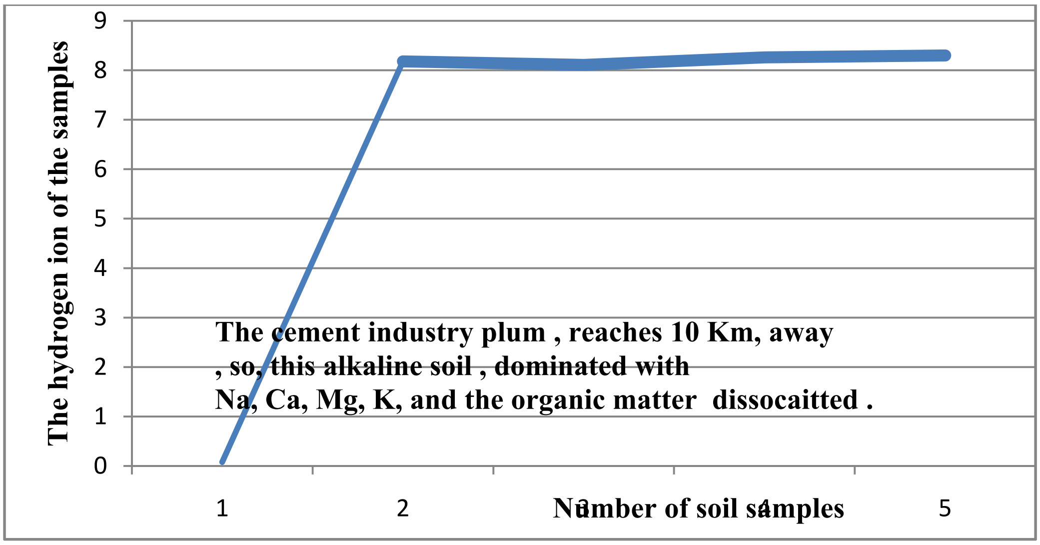

Fig. 4: The hydrogen ion of the soil at ten kilometer away from the factory.

Finally the paper highlights the need and role of planning, management and good follow-up for enhanced safety of the environment and human health. The findings of case study have implication for its potential application in other locations in Libya as well as other developing countries scenario that results from similar situations like an alkaline soil around this factory.

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