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Detecting of heavy metal pollution in steel factory environment health of the North of Iran

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ABSTRACT

Heavy metals like cadmium, lead and mercury are inessential and toxic elements which are created by various urban, industrial and agricultural activities and cause resources pollution. In this study, the soil sample was derived from the environment within the steel factory and from the leaves and roots of poplar trees existed inside of the steel factory and also the samples of soil, leaves and roots of poplar trees were provided outside of the factory. Sampling was random and after that, the amount of heavy metals, cadmium, lead and mercury, was calculated by atomic absorption spectrometer and then studied by Kolmogorov–Smirnov test, ANOVA, T-test, Levin test and Tukey test. The results suggest that there is a significant difference between existing mercury inside and outside of factory environment. The minimum stored density is related to mercury which has been observed in the leaf and root more than the others and less than the others in aerial organs of leaves.

1. Introduction

The importance of heavy metals, cadmium, lead and mercury among other toxic metals is that these metals could be accumulated highly in plant organs which are toxic for human beings and at the same time there would be no toxicity symptoms in the plant [1,2]. These metals are absorbed by the roots and leaves and are transferred to livestock and human body and cause emerging some metabolic disorders and do not follow any useful biologic goal [3]. Therefore, preventing absorption of these metals by plant roots could be a strategy in minimizing adverse biological effects of these elements. One of the reasons of toxicity provided by cadmium, lead and mercury in soil is their interaction with essential nutrients [4]. The effect of these elements on the absorption and distribution of nutrients in the plants could be the reason of some lacks in the plants and causes a disturbance in nutrients exchange and reduction of plant fertilization and also is among effective elements on the absorption of cadmium, lead and mercury, emerging their toxicity elements in the plant's, nutritional status, specially about inessential elements [5]. The heavy metals are absorbed initially by phytoplankton, bacteria, fungi and microorganisms, then are eaten by larger creatures and enter into human body. When heavy metals are consumed by human being have adverse and strong effects [6]. The density of accumulated toxic materials is increased continuously and it is possible to have the highest frequency in a particular context. Accumulation of toxic materials in food chain may increase concentration in high levels of animals in food chain [7]. Over enhancement of these heavy metals could be harmful for organisms. The inessential heavy metals are cadmium, lead and mercury which are so important about soil and surface water pollution and are considered by plant pollution science [8]. The heavy metals are important due to non-degradability and their physiological effect on living creatures in low density. One of the heavy metals' effects on the soil is that in high and sudden densities, the plant leaves are disturbed and their color is changed and are dried. In low densities, there are some stains on the leaves which are like stains caused by Sulfur dioxide and neurological disorders (Parkinson, Alzheimer, depression, schizophrenia), various kinds of cancers, lack of nutrients, disturbing hormones balance, overweight, abortion, respiratory and cardio-vascular disorder, damaging liver, kidneys and brain, Allergy and asthma, endocrine disorders, chronic viral infections, reduction of body tolerance, disorder in enzyme function, change in metabolism, infertility, anemia, fatigue, nausea and vomiting, headache and dizziness, irritability for encountering by mercury existed in the food and sterile environment are among their side effects [9]. Infertility in females emerges as hormonal disorder which prevents impregnation. While in males, it causes motor deficits or sperm survival. For example, mixing of heavy metals like copper and cadmium, zinc and nickel, increase their toxicity [2]. There are several studies in the field of refining soils contaminated by heavy metals by using the plants and thus green refining of the soils polluted by heavy metals and using hyper accumulator plants for refining polluted plants could be referred to [10,11]. There are few researches conducted in this field in Iran and present information in scientific centers about heavy metal absorption and other contaminators by plants is very little. Therefore, conducting some researches in this field aiming to introduce novel methods of refining and selecting appropriate plant species is essential. The goal of this

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research is studying the health of steel factory of Gilan contaminated by heavy metals.

2. Methods and materials

Ferro Gilan Complex is an industry which has been activated (Fig. 1). This complex is located in the south of Rasht with 9.7 m above sea level in the range of RIC (Rasht industrialized city). It is adjacent to Gilan flat from the north and to natural and planted forests of Saravan 18 from the south and to natural park of Saravan from eastern south.

This study required:

- referring to academic centers, libraries and related organizations and providing picture, slide and map and also statistics and standards
- visiting considered industry and sampling from the soil and plant components like leaves and roots in the range of established industry and collecting filed information from deployed industrial units
- analysis and conclusion and introducing the methods, approaches and suggestions
- applied materials include computer, camera, knife, shovel, lab tools and ….

The present research aims to evaluate the environment of Ferro Gilan Complex in accordance with related standards.

Sampling was done from internal environment of the factory which includes soil and plant samples (leaf and root). The applied natural soil in this test was provided from 0 to 30 cm height and transferred to laboratory and processed in the lab temperature including washing — drying and grinding the plant. The sample is washed initially with mineral water and then with hydrochloride acid of 0.1 ml or washing liquid 1% and again with ordinary water and distilled water which this operation should be done as quickly as possible and after that the samples are placed in the oven with 70 °C during 48 h in order to be dried. Afterward, the samples are grinded to be powdered and passed from a 2 mm bolter and the powdered sample is kept in the shadow. Then 400 ml Nitric acid is mixed with 40 ml perchloric acid and 10 ml sulfuric acid is added. For initializing the test, 2 g from the sample with 0.001 g accuracy was transferred into a 100 ml flask and then 30 ml from provided solution was added to that and kept for one night. The next day, it was warmed for 40 min in order to remove nitric acid and the temperature increased gradually for distilling the remained acid and water. During this operation the flask contents are darkened gradually. After ending the distillation, the temperature is increased until boiling point of perchloric acid (205 °C) in which dense perchloric acid oxidizes remained organic materials and a white smoke is produced. After losing the color of the extract or having little color, the digestion is continued one more hour. After cooling, 20 ml of water and 2 ml of Sodium nitrate solution were added to the flask and warmed for 10 min, afterward the added content is reached to 100 ml volumetric flask and is passed from a fine-texture filter paper. For measuring the mentioned elements' density in the soil and plants samples, the atomic absorption device is used. The goal of data analysis is their reduction and to make the data interpretable, in order to analyze the research variables. The obtained data from analyzed samples were studied for determining the amount of heavy metal accumulation in aerial and ground organs and the soil from variance analysis by Kolmogorov–Smirnov test, T-test, Levin-test and Tukey test. Statistical quantitative characteristics and frequency accumulation diagram of lead in aerial and ground organs were presented by tables and diagrams.

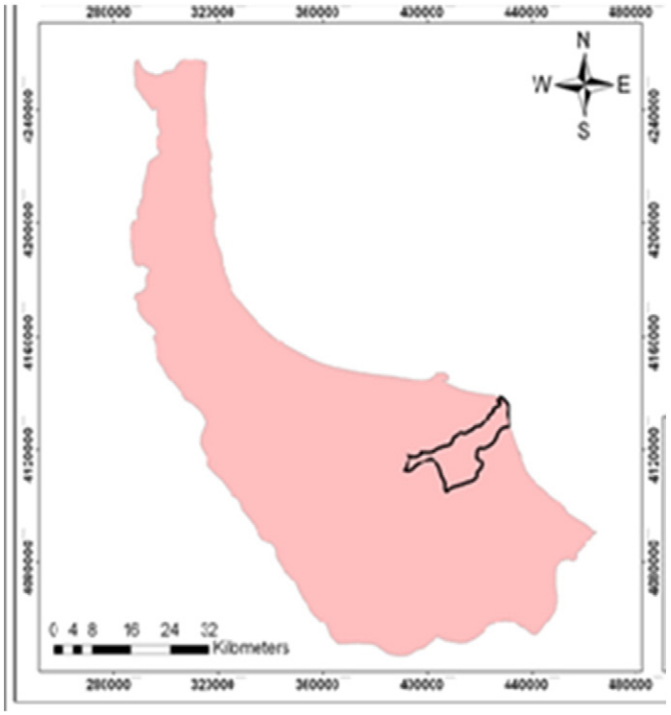

Fig. 1. The study area in Guilan province.

3. Results

According to the diagram and group statistics, it is observed that the mean of heavy metal accumulation cadmium in the soil is 0.71 and 0.68, inside and outside of the factory, respectively which apparently the mean of heavy metal accumulation level mean inside of the factory is slightly higher, however it is observed that this difference is not significant statistically (Fig. 2).

3.1. The studies of heavy metal accumulation mean cadmium between inside and outside of the factory

Considering the significance level of variance equality in Levin-test, it is observed that the significance level is 0.61 which is higher than 0.05. Thus, there is no reason for rejecting H0 (the variances are equal). As a result the variances are equal and variance equality is used for analyzing T-test. According to the significance level of independent T-test which is 0.05 and is higher than 5%, there is no reason for rejecting H0 (non-difference of means). There is no significant difference in heavy metal accumulation mean of cadmium between the samples of inside and outside of the factory (Fig. 2).

3.2. The study of heavy metal accumulation mean of lead of inside and outside of the factory

According the above diagram and the group statistics in the following, it is observed that the heavy metal accumulation mean of lead in the root is 1.05 and 0.99, inside and outside of the factory, respectively which it seems that heavy metal accumulation lead is slightly higher inside of the factory, however it is seen as follows that this difference is not significant statistically (Fig. 3). Considering significance level of variance equality Levin-test, it is observed that the significance level is 0.76 which is higher than 0.05, thus there is no reason for rejecting H0 (the variances are equal). Thus, the variances are equal and variance equality level is used to analyze T-test. According to the significance level of independent T-test which is higher than 5%, there is no reason for rejecting H0 (non-difference of means). There is no significant difference between the samples of inside and outside of the factory in the terms of heavy metal accumulation mean in the root (Fig. 3).