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Studies on the Seed Germination Changes after Thermal Decontamination of Crude Oil Polluted Soils

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Abstract

Given that the world population will reach nearly 10 billion by 2050, removing all the causes that result in reduced yields of cereals and technical plants is vital. It is known that soil affects plants through its physical (texture, structure, density), chemical (nutrients content, pH) and biological characteristics (microbiological activity, soil fertility).

Soils are the key environmental tank to pollutants, storage and persistence of pollutants in soil being dependent on a number of factors: the exchange of air, the burying of pollutants and their biodegradability. This paper aims to emphasize the germination of plants after a polluted soil sample was decontaminated by a thermal method. The soil sample was polluted with 5% oil. The soil sample was characterized by capillarity, being established the maximum height of the moistened layer of 7.6 cm and 14.1 cm for oil, but also permeability of 218.5 cm^3/h for water and 70.83 cm^3/h for oil. Knowing the average permeability, it can be determined the corresponding retention capacity: 873.14 kg/m^3 for water and 776 kg/m^3 for oil. Restoration of the germination potential for the analyzed soil also determined the presence of nutrients required before and after remediation. The analyzed nutrients were nitrogen, phosphorus and potassium. The soil sample had no nitrogen, but phosphorus and potassium were in medium concentration. The soil sample that was polluted with oil and decontaminated by a thermal method, has nitrogen, the potassium content does not change, but the phosphorus content increases.

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Keywords: soil polluted, nutrients, decontamination, germination, oil products

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1. Introduction

In developed areas of human societies, vital elements (water, air and soil) are invaded by residues that exceed the natural power of transformation. the degradation of the environment had a worrying increase, the amount of pollutants growing. Soils represent the key reservoirs of environmental pollutants, the storage and persistence of pollutants in soil being dependent on several factors. of soil structure, humus is the main component, with a role in ensuring a reserve of nutrients. At the moment, full hectares of farmland and forest are polluted with oil, oil waste, refined products and salt water. The problem of the recovery of land contaminated with crude oil can be done by studying the fertility or quantitative characteristics of the exchanges made in the soil. The studies that have been conducted so far refer largely to biological decontamination methods and methods of phytoremediation (Huang, 2004, Nwadinigwe, 2012, Pavel, 2008, Shirdam, 2008, Xu, 1997, Boros, 2014). This paper is a part of an extensive study of the authors on pollution and remediation of soils contaminated by petroleum products (Popa, 2014, Popa, 2015, Onutu, 2015). The studies are conducted in the laboratory, trying to reproduce, as much as possible, the situations encountered in practice. All these techniques aim to recover the germinating potential of the plants.

2. Materials and methods

The present work aims to study the change of the content of nutrients in a soil sample polluted with oil at a rate of 5% and then decontaminated by a thermal method – combustion. There are compared the nutrient content N, P and K. The soil sample subjected to pollution and thermal pollution was firstly characterized by capillarity and permeability. Determination of physical properties was done at laboratory level. Capillarity phenomenon is the rise of a liquid through the spaces between solid particles. The height of the moistened layer was measured from 10 to 10 minutes. Soil permeability is its property to allow the flow of liquid through its structure. From 15 to 15 min it was measured the volume of the liquid that has passed through the layer of soil and it was established a medium permeability expressed in cm3 / h. Retention capacity (RC) is the amount of liquid product that its included in a soil structure. In both the cases, for capillarity the used liquids were water and crude oil.

Determination of nutrients was made by a qualitative method, using a special laboratory kit. In agricultural applications, monitoring the quality of the soil is extremely important for the health and growth of crops. By using this special laboratory kit it is possible to measure the pH and the most important elements for plant growth, nitrogen, phosphorus and potassium. Nitrogen and phosphorus were determined by colorimetric method, and potassium turbidimetry method. High temperatures, above 400 ^{0}C, lead not only to the transformation of the pollutant, but also to the change of both organic and inorganic structure of the soil. The method of decontamination through combustion, in the laboratory, as well as the used equipment was described in a previous paper (Popa, 2014).

3. Results and discussions

The characterization of a type of soil is very important if determinations include characterization in terms of nutrient content in the soil. This addition to the characterization of the soil is important, given that when soil is polluted by accident, it is sought to provide a method of remediation as fast, efficient and economical as possible. All these elements are following an effective decontamination in order for the polluted soil to enter, in most of the cases, the agricultural circuit. The cationic exchange capacity influences the soil fertility, the presence of the Ca and Mg favors the development of humus and soil structure, optimizing water and air regime, plant root uptake and microbiological activity in soil. In soils with a greater presence of H^{+} ions, the soil becomes acid, negatively affecting the availability of microelements and macroelements. The basic elements for a balanced soil, which may influence the development of plant, N, P, K (nitrogen, phosphorus, potassium) are assimilated by them depending on the pH values (Neag, 1997). Nutrients are chemicals that plants, animals and people need to grow or survive, and their presence in water, soil and subsoil is normal. However, when their quantities are too high, we are talking about nutrient pollution that is dangerous for health and for our crops. Nutrients (nitrates, nitrites, ammonia, phosphates)