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A Study on SPI(soil pollution index) in City Land

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Abstract: To estimate the soil quality of Miryang area, soil analysis were conducted according to the city and out of city of soil expenses at according to analysis components and heavy metal pollution of irradiation sampling sites. The through soil components the principal element about the 71% SiO_2 and Al_2O_3, the pH of field area near the city center was lower than that of the other field area, which indicated that this acidification was probably attributed to the acid rain caused by the traffic exhaust gas such as SO_x and NO_x. Acidification was more severe in the field area than in the farming land. The concentration of five heavy metals such as Cu, Cd, Pb, As and Cr were found to be lower than the standard of soil pollution. An assessment using the SPI(Soil Pollution Index), which was developed to estimate an overall soil quality, was performed. Each SPS(Soil Pollution Score) were evaluated with the results of the data from this study. The soil quality of most area of Miryang land was determined to Class 1, which indicated that the soil was healthy.

Keywords: heavy metals, SPI(soil pollution index), SPS(soil pollution score), city land

Introduction

The metals in soil and their compounds are released into the environment from a wide spectrum of natural and anthropogenic sources. The principal anthropogenic sources of metals in the atmosphere, however, are smelting of metallic ores, industrial fabrication and commercial applications of metals, as well as burning of fossil fuels.[1,2] Lead and arsenic are notable exceptions, the principal sources of these elements being the use of leaded gasoline and the spraying of arsenic pesticides.[3] Metal pollution in soils is derived mostly from atmospheric fallout, coal fly ash and bottom ash, urban refuse, animal wastes, and agricultural and food wastes. On the other hand, the principal sources of pollutant metals in natural waters are the discharge of domestic and industrial(including mine and smelter) wastewaters and the dumping of sewage sludge.[4] For most metals, the order of magnitudes of input is soil>water>air. Although considerable attention has been paid to the atmospheric cycle of the trace elements, much less has been done to understand the fate and effects of metal pollution in soils and natural waters. Metals are omnipresent in the environment, occurring in varying concentrations in air, bedrock, soil, water and all biological matter.[5] The greatly increased circulation of heavy metals in soils, results in the inevitable build-up of such toxins in the human food chain. Industrial discharges of heavy metals are considered a threat to public health.[6] Accordingly, disposal of residues on land can result in increased contamination with heavy metals.[7,8] For example, the radiator manufacturing industry was chosen because it includes operations generating fine lead particles[9] and mercury can be transformed to methylmercury in anaerobic conditions by silfate reducing bacteria.[10] The objective of this research are first, using laboratory investigations, to determine a suitable expression which describes the temporal accumulation of heavy metals on soil, and secondly to use that expression in mathematically determining a soil pollution index. Finally, the results are used to predict the pollution expectancy of a land application site.

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Materials and Methods

The sampling were conducted at five lands, which is located in Miryang city. The soils were

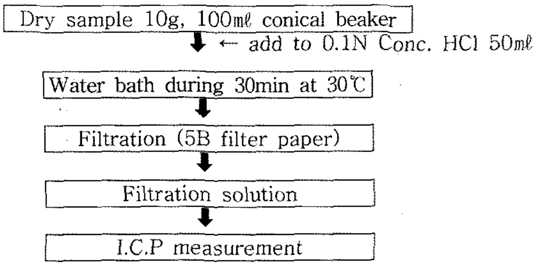

Fig. 1. The extraction method of heavy metals from soil.

sampled once a weekly from April until May 2006. The metals and their compounds were measured in field, farming land, factory land, residence and school, respectively. The influence of pH on the soil distributions of heavy metals was established by adjusting the pH of the soils. X-ray fluorescence (XRF-1500, Shimadzu, Japan) was used *in qualitative and quantitative the analysis of* the elements and heavy metal were measured with Induced Coupling Plasma (ICP, Spec Tro Co.).

X-ray fluorescence is a technique in which x-ray are used to bombard a sample, producing second an x-rays characteristic of the element in the soil. These secondary x-rays are separated and detected and in this manner both qualitative and quantitative analyses can be made.

Results and Discussion

The results of chemical components with five land sites are summarized in Fig. 2. As shown in Fig. 2, the element components of soil were 53.72% SiO_2 and 18.01% Al_2O_3, respectively.

The pH of field area near the city center was lower than that of the other field area, which indicated that this acidification was probably attributed to the acid rain caused by the traffic exhaust gas. As shown in Fig. 3, acidification was more severe in the field area than in the farming land. Cu, Ni, Cd, Pb, Zn, and to a lesser extent Mn and Co, behave similarly in soils. In acid soil, these elements could exist as the divalent cations, for example, Cu^{+2}, Zn^{+2}. In alkaline or neutral soils, they may be combined with a hydroxyl ion, for example, $Zn(OH)^{+}$. The hydrous oxides of Mn and Fe can control the availability of heavy metals by sorption and desorption, organic matter binds

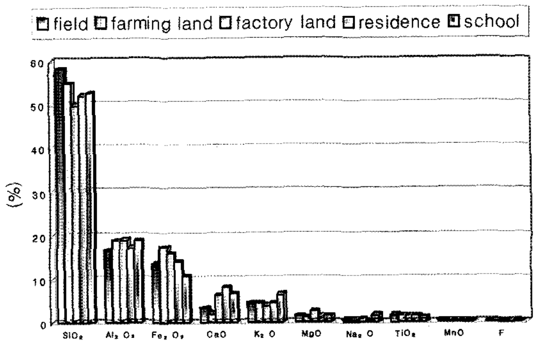

Fig. 2. The chemical components in Miryang land.

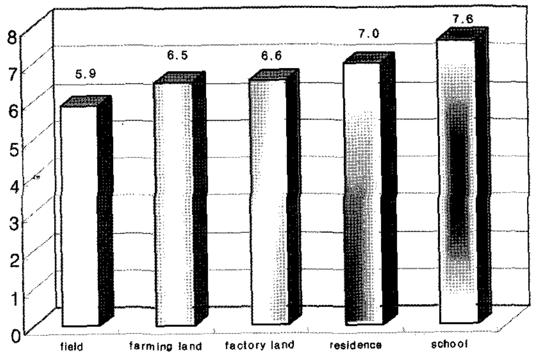

Fig. 3. The pH in Miryang land.

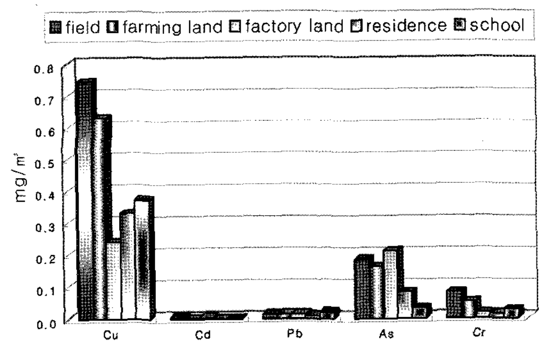

Fig. 4. The concentration of the heavy metals in Miryang land.

metals more strongly at a soil pH below 7.5. Arsenic reacts in soil with Fe, Al, Ca and Mg ions and its concentration in solution decreases with time sa a result. Chromium generally is oxidized or reduced to Cr^{+3} and precipitated as an insoluble hydroxide.[8]

As shown in Fig. 4, the concentration of five heavy metals such as Cu, Cd, Pb, As and Cr were found to be lower than the standard of soil

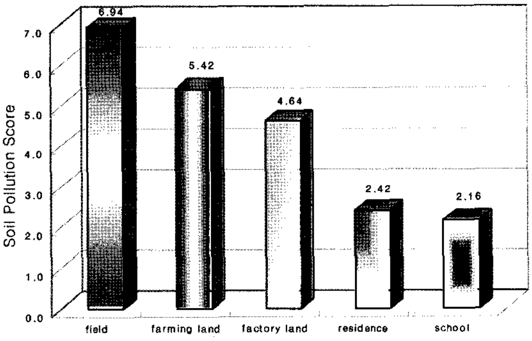

Fig. 5. The SPS (concern basis farm land) in Miryang land.

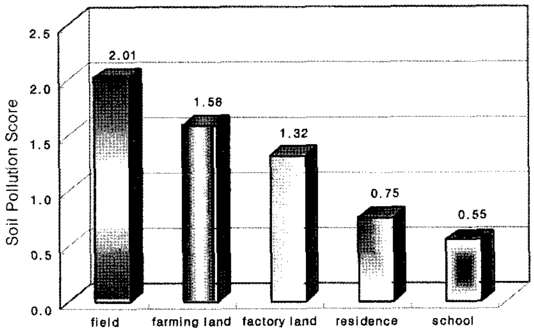

Fig. 6. The SPS (concern basis industrial complex) in Miryang land.

pollution.

The soil pollution score (SPS) can be defined with the standard of heavy metals in soil pollution (TVi) and the concentration of heavy metals (Conci) in soil as follows:

$$\text{SPS(soil pollution score)}=\frac{Conci}{Tvi}\times 100$$

As shown in Fig. 5 and 6, an assessment using the SPI (Soil Pollution Index), which was developed to estimate an overall soil quality, was performed. Each SPS(Soil Pollution Score) were evaluated with the results of the data from this study. The soil quality of most area of Miryang land was determined to Class 1, which indicated that the soil was healthy.

Conclusion

Resent restrictions on water and air pollution tend to increase the practice of land disposal of wastes containing heavy metals. Increases in population and greater demands for industrial products in the Miryang and Korea have also add to the waste disposal problem. Disposal of wastes on land must be compatible with land use and environmental constraints. Application of wastes to land must be accompanied by consideration of environmental pollution, soil pollution resulting in crop damage, and consequence to the human food chain.

SPS(Soil Pollution Score) were evaluated with the results of the data from this study. The soil quality of most area of Miryang land was determined to Class 1, which indicated that the soil was healthy.

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