Trials towards treating water and soil polluted due to some anthropogenic activities

G.F.O. El-Shiekh

Contamination of soil and water by various pollutants(synthetic and organic) such as pesticides, polyaromatic hydrocarbons as well as the heavy metals, etc. have caused imbalance in the natural functioning of the ecosystem. Among these , heavy metals with cause severe damage for the living systems at various levels.Soils can naturally reduce mobility and bio availability of heavy elements as they are retained in soil by sorption , precipitation and complexation reaction. This natural attention process can be accelerated by addition of amendments converting the soluble form to more geochemically stable solid phases.On the other hand, algae have been proved to play an important role in purification and removal of trace elements fromwastewater.The current study represents trials towards ameliorating soils and waters polluted with heavy metals due to anthropogenicactivity.In situ soil decontamination incubation experiments were executed. In these experiments , two soil samples from El-Gabal El-Asfar farm and El-Saff regions polluted due to irrigating them with sewage water and industrial wastewater, respectively were incubated with either poultry manure , compost El-Khalil (organic amendments) , bentonite, rock phosphate or calcium carbonate (inorganic amendments) at a rate of 2% after being mixed thoroughly in pots of 200 g soil capacity. The pots were wetted to field capacity and incubated at room temperature for different incubation periods i.e. 0 ,25 , 50 and 75 day and moisture content was maintained constant at field capacity throng daily application ofdistilled water.Soil samples were taken to represent the different amendment treatments as well as the different incubation periods and extracted with EDTA, the Ni, Co and Cd were determined in EDTA-extracts using an Atomic Absorption Spectrophotometer , Perken Elmer (Model 2380) .A wastewater experiment was conducted on two wastewater samples collected from the effluents of El-Gabal El-Asfar station and the industrial wastewater at El-Saff. These wastewater samples were inoculated with either of Scenedesmus obliquus , Chlorella vulgaris or spirulena plantensis algae . The inoculated as well as the control wastewater samples were incubated at 28 ± 2C° under light of 4000 lux intensity (14 h light followed by 10 h darkness) for periods of 7 ,15 and 21 days beyond which Ni, Co and Cd were determined .The most important obtained results could be summarized in the following :-1- Effect of poultry manure:•EDTA-extractable amounts of Ni, Co and Cd were decreased in both the investigated soils due to amending these soils with poultry manure at a rate of 2%. The decrease was more obvious by increasing time of contact between the applied amendment and the investigated soils.•Although it was found that the removed amounts of the studied metal ions from both the investigated soils followed the descending order : Ni > Co > Cd, yet the corresponding removal percentage values followed the descending order Co > Ni > Cd all over the periods of incubation.•Values of the removal capacity of poultry manure seemed highest with Ni, lowest with Co and came in-between for Cd, however, these values were generally higher in El-Gabal El-Asfar poultry manure amended soil than in El-Saff poultry manure amended soil.2- Effect of El-Khalil compost:-•Application of the compost could minimize value of EDTA-extractable Ni , Co and Cd in both soils under study especially by increasing period of incubation, yet such an effect was more obvious in El-Gabal El-Asfar soil than El-Saff soil.* Sorbed amounts of Ni , Co and Cd in El-Gabal El-Asfar soil exceeded obviously the corresponding ones in El-Saff soil. On the other hand, sorption (removal) percentages of the concerned metal ions in El-Saff soil exceeded obviously the corresponding values in El-Gabal

El-Asfar.•Removal capacity of the compost for Ni , Co and Cd was of higher values in El-Gabal El-Asfar soil than in El-Saff soil.3- Effect of bentonite :-•Values of EDTA — extractable Ni , Co and Cd from both the bentonite-amended soils decreased progressively with increasing period of incubation. Consequently , it was found that values of sorbed Ni, Co and Cd increased with increasing time of contact between the investigated soils and bentonite.•Absolute values of sorbed Ni were the highest whereas those of Co were the lowest while those of Cd were in-between, however, sorption percentages of Co were shown to be highest withing the first and second periods of incubation in El-Gabal El-Asfar soil and over the whole period in El-Saff•Removal capacity of bentonite for Ni was higher than for Co and Cd over the studied periods of incubation which were characterized by increasing the removal capacity by progressingtime except for Co whose one remained almost constant over the different periods of incubation .4- Effect of rock phosphate:-•Increasing time of contact between the studied soils and rock phosphate caused values of EDTA-extractable Ni, Co and Cd to decrease progressively with increasing period of incubation.•The sorbed (removed) amounts of Ni , Co and Cd increased with prolonging time of contact between rock phosphate and soils and hence removal percentages of Ni , Co and Cd by the rock phosphate —amended soils increased with time. According to those percentage values, the studied metal ions followed the descending order : Cd > Ni > Co. This sequence characterized both the studied soils over all periods of incubation except for the 75 day period in El-Gabal El-Asfar soil where removal percentage of Cd highly exceeded that of Co which slightly exceeded that of Ni.•El-Gabal El-Asfar soil could adsorb values of Ni , Co and Cd higher than El-Saff soil did , however, sorption percentages of the metal ions under study were relatively higher in El-Saff than El-Gabal El-Asfar soil except for Cd after 75 days where its sorption percentage in El-Gabal El-Asfar soil was higher than in El-Saff soil.•The removal capacity of rock phosphate for studied metal ions increased with time of contact between rock phosphate and soils.5- Effect of calcium carbonate:-•Increasing time of contact between soils and $CaCO_3$ reduced progressively the amount of EDTA-extractable Ni ,Co and Cd . The reduced amounts seemed highest with Ni, lowest with Co and came in-between with Cd .•Sorbed amounts of these elements increased with time of contact following the descending order: Ni > Cd > Co regardless of type of soil.•Values of removal capacity increased with time to be in the following descending order : Ni > Cd > Co.6- Effect of algae on ameliorating the wastewaters:-•Algea could succeed in reducing concentrations of Ni ,Co and Cd in the studied wastewaters.•The used algal species could be arranged according to the mean values of removal percentage of Ni in the following descending order:Scenedemun> Chlorella > Spirulina•The corresponding sequence according to the removal percentage of Co and Cd followed the descending order :Chlorella > Scenedemun > Spirulina* The efficiency of fungus regardless of its species on removing Ni from the studied wastewaters was lower than the corresponding ones on removing Co and Cd.