

ABSTRACT

The aim of this study was to investigate the concentrations of heavy metals in biosolids (stabilized sewage sludge) of Al Bireh Wastewater treatment plant (AWWTP). The study has looked at certain types of heavy metals which could enter the AWWTP through industrial and domestic discharges. The specific objective of the study was to measure the concentrations of heavy metals in biosolids produced by AWWTP to evaluate its potential impacts on plant growth and production if applied to agricultural land.

To achieve these objectives, 10 composite samples of biosolids were collected from AWWTP thickener tank during a period of 6 months. Samples were handled and analyzed according to the standard methods for analyzing water and wastewater using ICP-AES analysis method for heavy metals determination. Biosolids samples were initially characterized to identify its primary physiochemical characteristics (pH, EC, TS, TSS, and TVSS). Laboratory testing to analyze heavy metals (Zn, Cu, Ni, Cr, Cd, Pb, As), in addition to Boron (B), were performed for each sample using the ICP-AES instrument applying the standard methods for water and wastewater analysis. Analysis results indicated that the maximum concentrations of analyzed metals found were 1150.3, 411.4, 115.7, 232.9, 94.0, and 62.6 mg/kg dry weight for Zn, Cu, Ni, Cr, Cd, Pb, while As was not detected in any of analyzed samples. Moreover, the maximum concentration for Boron was 58.8 mg/kg. These concentration values did not exceed the maximum permissible concentration limits in both EPA and EU standards for biosolids land application. Moreover, these values are lower than the maximum permissible concentrations (except for Nickel), for biosolids application if compared to the Israeli standards. Accordingly, these results indicate that biosolids of AWWTP can be utilized for land application in terms of heavy metals concentration limits, although there is the necessity to follow some restrictions and preventions related to soil, crop types and any potential impacts on surrounding environment and natural resources.

Of equal importance, the concentrations of heavy metals in wastewater influent and the treated effluent of AWWTP were also investigated by performing the ICP –AES analysis for 8 samples of each type. It was found that the maximum concentrations of Zn, Cu, Ni, and Cr in treated effluent were 1480, 207.6, 47.6, and 89.4 µg/l respectively, while Cd, Pb, and As were not detected in any of the analyzed effluent samples. These values are below the permissible limits of the Palestinian standards for effluent quality. Moreover, mass balance calculations have been also performed to quantify the average daily loads entering and exiting the treatment plant, and this has provided an approximate assessment of retained quantities from each metal in disposed biosolids.

Biosolids have been also assessed in terms of its potential impact on crop productivity if applied during the initial land preparation and mixed with soil before growing. For this purposes, four loading rates of dried biosolids of AWWTP (0, 20, 40, 60 tons /ha) were applied to a pilot scale plots of 0.25 m² with 4 replicates for each treatment. A commonly open field grown fodder crop in Palestine, Egyptian clover (*Trifolium alexandrium* L), was used to investigate the impact of biosolids application rates on plant growth and productivity. Plant growth indicators have been measured and recorded. A significant positive impact on plant growth and production was obtained in the treatments compared to control treatment. Furthermore, a significant difference in plant growth and productivity was obtained in loading rates of 40 and 60 tons/ha compared to the loading rate of 20 tons /ha. However, no significant differences were recorded regarding plant growth and productivity between loading rates of 40 and 60 tons/ha. In addition to this, no visual symptoms were appeared for heavy metals toxicity on plant parts in all treatments during the whole plant growth period.

The results of this study are only valid for short term crop cycles and do not consider the existence of other organic and inorganic pollutants. However, the long term impact of biosolids application and the impact of other toxic organic and inorganic pollutants should be subjected to further investigation.