ABSTRACT

The increase of human activity in the scope of economy and living conditions, resulting in e.g. the expansion of urban agglomerations and the development of industry, leads to the production of a bigger and bigger volume of sewage sludge, which is a waste product highly detrimental for the natural environment. The volume of generated sewage sludge will systematically grow in the coming years. The chemical composition of the produced sewage sludge to the large extent determines the way of its management and the final disposal. A substantial portion of the sewage sludge is utilized in agriculture and soil recultivation. There is also a growing tendency to thermally process sewage sludge, which in the future will be the dominant direction of its management. Sewage sludge from small and rural treatment plants should be utilized naturally because of their low heavy metal content. Globally, the natural utilization and incineration are widely used methods of sewage sludge neutralization.

In Poland, for many years they conducted intensive research on the natural use of sewage sludge, which seems to be the most reasonable direction of their development, because of its low cost and high efficiency. The concept of the natural use of sewage sludge has its supporters, but also its detractors. On the one hand sludge can improve soil properties, on the other hand, however, may have a negative impact on the environment, which is associated with the presence in them of many impurities like heavy metals or organic pollutants. These substances when they were introduced along with the deposits to the soil, may be subject to long-term accumulation in the environment and there is a real chance that they can be incorporated into the food chain, of which man is the last link.

The aim of this work was to show the possibility of agricultural utilization of sewage sludge from a biological sewage treatment plant type "LEMNA" in the revitalization of soils set aside, in combination with Jerusalem artichoke cultivation.

Based on the obtained results, it was found that the use of sewage sludge has a very positive impact on the yield of the aboveground biomass of Jerusalem artichoke, especially on soils with sewage sludge applied with a thickness of pads 20 and 30 cm. Sewage sludge, due to the high proportion of biogenic elements, gradually releasing a 6-year period, significantly increased the yield of biomass dynamics of Jerusalem artichoke, over years of observation. Cultivated Jerusalem artichoke grown on soils amendment with sewage sludge (especially with the largest pads- 20 and 30 cm), were characterized by a much higher contents of manganese, copper, cadmium and lead in leaves and stems, and zinc in the leaves as compared to plants grown in soil control. The bioaccumulation factor (BAF) of these elements, both in the leaves

and in stems of Jerusalem artichoke, generally remained at the same levels in comparison to control.

Applied sewage sludge influenced indirectly by acidification of surface layers, which progressed relative to the thickness of the applied sewage sludge pads. The layers at a depth of 50-75 cm, was found while de-acidifying effect of these deposits. Under conditions of growing artichoke in six years and the use of one-off significant amounts of sludge (3-6-9 Mg /ha), there was a significant improvement in the previously of fallow soil fertility; the content of organic carbon, total nitrogen, base cations and available forms of phosphorus and a small range were increase of available magnesium.

There was also observed significant increase in the contents of total forms of Mn, Zn, Cu and Cd and Pb. However, despite a significant increase in the contents of total forms of these elements, sewage sludge agro-melioration, did not affect the contamination of the soil. It can be assumed that the use of sewage sludge biological treatment plant with a "LEMNA" can quickly lead to contamination of soil with zinc and cadmium, as the content of these elements, especially after the application of sewage sludge largest pads (20 and 30 cm), sometimes came close to the limit class the contents of with a higher concentration (I °).

Based on sequential extraction procedure for the speciation of microelements (Mn, Zn, Cu) and toxic heavy metals, it was found that contents of individual fraction were varied. It was observed that generally the largest share of the total content, characterized by a residual fraction (F4) and the oxidisable fraction (F3), which are considered potentially not available. The most pronounced change in fractions of these elements, the most frequent in the profiles with the largest inserts sewage sludge (20 and 30 cm), the layers of soil to depths of 25-50 cm and 50-75 cm, and sometimes even at 75-100 cm. As a result of sewage sludge application were significantly increased exchangeable fraction (F1), reducible fraction (F2) and the oxidisable fraction (F3) and a residual fraction (F4) was decreased, what has been found for manganese and zinc in the whole soil profile. Quantitatively also increased the lead fractions (F1, F2, and F3) to a depth of 25-50 cm and cadmium in the surface layers. Under the influence of sewage sludge, increased or tended to increase the reducible fraction (F2) of copper in the whole soil profile. The use of sewage sludge resulted in an increase (or trend growth) residual fraction (F4), copper and lead throughout the soil profile and cadmium at depths below 25 cm and depth. This fraction (F4) in terms of soil acidification can be activated and incorporated in the food chain.

Sewage sludge management for the revitalization of fallow silty soil and its inclusion in the cultivation and production of biomass for energy purposes Jerusalem artichoke in one

agricultural biotechnology, was ecological action. On the one hand, the use of sewage sludge resulted in an increase in the content of organic carbon, total nitrogen, base cations and available phosphorus, on the other hand, much more diverse contents of the total forms and individual fractions of heavy metals, particularly following the largest inserts sludge. A significant part of these elements still remained associated with the residual fraction (F4) and the oxidiasble fraction (F3), which are considered to be potentially not available, however, in soil amendment in sewage sludge it was significant increase in the exchangeable fraction (F1) which is the most mobile and plant available. Although sewage sludge agromelioration did not increase the degree of contamination of the soil with heavy metals, a significant increase in the fraction of mobile, may represent a potential threat to the natural environment by polluting soil and leaching of these elements into groundwater.