

# Effect of thermal transformed sewage sludge on copper and zinc content in soil and plants

## Wpływ osadu ściekowego przekształconego termicznie na zawartość miedzi i cynku w glebie i w roślinach

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The basis for a sustainable agriculture is a rational management of fertilizers, which should satisfy the nutritional requirements of the plant and ensure the maintenance of soil fertility. Intensification of crop production forces searching for new sources of nutrients, including the waste materials. Sewage sludge are a potential source of macro- and micronutrients and organic matter, but the effect that they exert, in particular following different treatment processes, the quantity and quality of biomass and various elements of the natural environment is not sufficiently understood.

The aim of the study was to determine the effect of thermal transformed sewage sludge on the content of copper and zinc mobile forms in the soil and the content and uptake of these elements by the test plants. The study was based on a three-year pot experiment. In the experiment, the stabilized municipal sewage sludge from Wastewater Treatment Plants in Krakow-Plaszow and its mixtures (1: 1 w/w) with wheat straw, sawdust and conifer bark were converted thermally (with no air access, according to the following procedure: 130°C for 40 min → 200°C for 30 min).

Thermally converted mixtures of sludge demonstrated an improvement of the amount of plant biomass (particularly in the second and third year of the study) compared to the mineral salts. The highest content of zinc and copper were found, regardless of the plant part, in spring oilseed rape, oats and corn from the object in which mineral salts were applied. Thermally converted mixtures of sewage sludge did not cause an excessive accumulation of studied micronutrients in the aboveground parts of the plants, both in direct and subsequent effect. Significantly higher values of copper and zinc bioaccumulation index, compared to the non-transformed sewage sludge, were computed only for the roots of spring rape and aboveground parts of oats.

The content of mobile forms of copper in the soil with addition of thermally transformed mixtures of sewage sludge was lower as compared to the soil with addition of stabilized sewage sludge and remained at a similar level in the first two years of experiment, and in the third year the contents has been significantly reduced. Similar dependencies were found in direct action of these materials for zinc, but the content of mobile forms of this element in the next two years of the study did not change significant.