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Biochar from Municipal Sewage Sludge as Soil Conditioner for Recultivation of urban and industrial areas

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Despite of many valuable properties of municipal sewage sludge (MSS), such as high content biogenic elements (carbon, phosphorus, potassium etc), no adequate recycling technique was yet found for the second biggest urban waste stream. Present days the MSS management in Europe expands from incineration to composting, landfilling and field spreading. At the same time, in many cities the soil in public areas (parks, squares, sport sites etc.) is in critical state. Often the urban "green zones" are planted on the artificial substrates consisting of construction rubble, poor soils from urban excavations with sparse amendments of natural soil and turf delivered from remote sources. Such a "soil" rapidly becomes compressed, its water holding capacity reduces by 5 or 7 times, frost penetration can reach more than 1 m. Soil quality defines the human life quality.

A company "Aktivil" developed an approach to produce a biochar (BC) from the MSS through a slow pyrolysis process in a proprietary multi-hearth reactor. Its elementary composition: 35% C, 2% N, 15% P_2O_5, 8.5% CaO, 2.7% MgO, 1.3% Al_2O_3, 4.6% Fe_2O_3, total heavy metals (mostly Zn>Cu>Cr>Pb) <0,35%. The biochar porosity is 40%, specific weight 0.8 g cm^3, phosphorus availability in neutral ammonium-citrate is 50% from total amount. Pot trials of the biochar as a soil conditioner were performed with two types of poor soils collected from tinned spots: loamy grey forest soil (GF) and sandy alluvial meadow soil (AM). The soil samples were amended with the BC (granules 2-5 mm) in amounts from 2 to 20%, put into vegetative pots, sowed by ryegrass (*Lolium perenne*), and incubated for 4 months. The green part of ryegrass was cut 3 times during that period, and finally roots were taken out, washed, dried and weighted. Then soil characteristics were determined by regular methods.

The experimental data indicated that the soil amendment with the sludge-based biochar resulted in the next positive changes: water holding capacity of sandy AM soil increased up to 25%; pH of slightly acid GF soil increased up to 6.6; content of available carbon determined by acid burning (on Tyurin) increased from 1-2 to 4-6%; content of available phosphorus and potassium increased up to high level. As a result, the total harvested green mass of ryegrass increased by 30-32%, and root mass – by 54-120% compared to unamended control. Meantime, concentrations of mobile forms of Zn and Pb (extractable with acetate-ammonium buffer, pH 4.8) only slightly increased in the amended soils compared to control, but their concentrations in the green mass and roots practically remained the same in all pots. Summing up, our results confirmed a good perspective of application of "locally produced-locally used" sludge-based biochar as soil conditioner in the urban landscape projects.