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ТЕХНОЛОГИИ БИОТЕСТИРОВАНИЯ В ЭКОЛОГИЧЕСКОЙ ОЦЕНКЕ АГРОЦЕНОЗОВ И ГУМИНОВЫХ ВЕЩЕСТВ

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Application of Research Methods of Soil Organic Matter to Assess the Technical Properties of Biochars

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Currently, there is an increasing interest in the using of biochars produced pyrolysis processing plant residues of different origin as a perspective meliorants. Biochar application allows you to simultaneously solve the two major problems of our time: the long-term improvement of soil fertility and the need sequestration carbon atmosphere. The use of biochar in these aspects determines the need to of develop a set of methods of assessing the technical properties that allow to predict the behavior of biochar in the soils of different origin. The purpose of this study is to evaluate the possibility of using the methods developed for the study of soil organic matter (SOM) for the characterization properties of biochars.

Biochars are made from a variety of woody and herbaceous material, in different modes of heating were kindly provided by Dr. M. for Bayan (Department of Agriculture and Environmental Sciences, Lincoln University, Missouri, USA). Samples were subjected to pyrolysis technology developed by Dr. M. Bayan, in two temperature ranges: «high temperature» - 400-600 °C, «low temperature» - below 400 °C. The total organic carbon content in the samples determined by dry combustion varies from 57,2 to 86,3% (coefficient of variation is V = 12,7%), total nitrogen content is from 0,17% to 0,90% (V = 53.9%). Also ratio of gross carbon to nitrogen varies (V = 65,6%), the meaning of which is much higher than in the poorest nitrogen plant residues in average. Sampling of biochars can be assessed as sufficiently homogeneous according to content of total carbon, but a very different quality of SOM content and mineral elements.

For general characteristics of the properties of biochars they used the method of step oxidative degradation by Chan (Chan et al., 2001), which combines the method of soil oxidation with potassium dichromate at different concentrations of sulfuric acid (modified method of Walkey-Blake) with the determination of total carbon content of dry incineration. The method involves the allocation of 4 fractions of OM by exposure oxidizability. Fractions 1-3 are calculated from the difference between the content of organic carbon oxidized with potassium dichromate at concentrations of H_2SO_4 12 N, 18 N and 24 N. Faction 4 is the difference between the total carbon content determined by dry combustion, and carbon is oxidized with potassium dichromate at a concentration of 24 N H2SO4. To characterize the labile fraction of biochar samples they used method of extraction with hot water extract (Korschens et al., 1990), and rapid method for the determination of organic carbon extracted with a mixture of $Na_4P_2O_7$-NaOH (Kononova, Belchikova, 1961). All used methods have been modified and adapted to the characteristics of the physical properties of biochars.

Analysis of the data shows that the content of readily degradable OM (fraction 1 by the method of Chan) and srednerazlagaemogo (fraction 2) is the maximum in the samples obtained by pyrolysis at low temperatures of herbaceous plant residues and willow. The content of these fractions in the samples obtained at high temperatures (> 600 °C) is approximately at the same range, but is also highly variable. The coefficient of variation calculated on the options «high temperature» is for a fraction 1 is 55,8%, for a fraction 2 is 34,9%, indicating a high degree of dependence of the content of the active fractions of SOM in the form of biochar from the source material. Any laws could not be detected on the content of fraction 3 (hardly OM). The low content of non-oxidizable by potassium dichromate in 24 N H_2SO_4 (fraction 4) of the biochar is typical for the samples obtained by pyrolysis at low temperatures of herbaceous plant residues and willow. In biochars produced from the same material at high temperatures (>600°C), the fraction 4 is

significantly increased and becomes comparable with other biochars. The coefficient of variation calculated on the options «high temperature» is for the fraction of 4%, which can be regarded as a lack of significant effect on the content of potassium dichromate non-oxidizable fraction of OM and properties of the raw material using high technology pyrolytic treatment.

The results of determination of carbon content extractable with hot water and extracted with a mixture of $Na_4P_2O_7$-NaOH of biochars of different origin show that the content of labile OM is maximum in samples obtained by pyrolysis at low temperatures of herbaceous plant residues and willow. In the samples obtained by pyrolysis at high temperatures the labile OM is sufficiently homogeneous. It is shown that the organic carbon content of hot water and extracted with a mixture of $Na_4P_2O_7$-NaOH is closely and statistically significantly correlated with each other and with a content of fractions 1 and 2 obtained by the method of Chan. There is a statistically significant inverse correlation of content between tight carbon emitted by boiling and by treatment with $Na_4P_2O_7$-NaOH with the content of non-oxidizable fraction (fraction 4 by the method of Chan).

Conclusion. Chan method developed to evaluate the oxidizability of SOM, can be modified to assess the oxidizability OM biochars. Separation of OM into 4 fractions (easy-, medium-, and hardly a non-oxidizing) can be informative, and used for the technical evaluation of biochars of different origin as promising components for application to the soils. The results of the analysis may be useful for predicting the behavior of biochars in high biochemical activity of soil microflora, since it is assumed that the treatment of SOM oxidizing reagents can be considered as an imitation of biochemical degradation, which largely is also an oxidation process. The content of organic carbon extracted from biochars with hot water and a mixture of $Na_4P_2O_7$-NaOH, which has a close correlation with the content of OM fractions determined by the method of Chan, can be used for indirect, but a quick and easy procedure feasible evaluation of various properties of biochars.

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