«IMPROVEMENT OF THE HYDROPHYSICAL PROPERTIES OF SUBSTRATES OF TECHNOCENIC LANDSCAPES USING EXPANDED VERMICULITE»

E. A. Krasavtseva¹,², T. K. Ivanova¹,³, V. V. Maksimova¹,², I. A. Mosendz¹,⁴, I. P. Kanareykina⁴, T. L. Panikorovskii¹, A. A. Shirokaya³ and M. V. Slukovskaya¹,³,⁴

1 Laboratory of Nature-Inspired Technologies and Environmental Safety of the Arctic KSC RAS, Apatity, Russia
2 Institute of North Industrial Ecology Problems KSC RAS Apatity, Russia
3 Institute of Chemistry and Technology of Rare Elements and Mineral Raw Resources KSC RAS, Apatity, Russia
4 Department of Landscape Design and Sustainable Ecosystems, Agrarian-Technological Institute, «Peoples' Friendship University of Russia», Moscow, Russia
The aim of the study is to assess the prospects of using thermally activated vermiculite as an ameliorant for correcting the hydrophysical properties of substrates of technogenic landscapes (tailing dumps).

Contaminated areas are characterized by the absence of vegetation and a low probability of initiating the process of soil formation without direct intervention. Thermally activated vermiculite has been proposed as an ameliorant to improve the quality of soil and reduce the geochemical mobility of metals. The proposed materials have water-retaining properties, high sorption activity with respect to a number of metals, developed specific surface area and availability in sufficient quantities. The use of local mining enterprises as remediators of waste makes it possible to increase the profitability of developments and helps to reduce the volume of accumulated waste.
• We investigated the substrates of two technogenic surface formations formed as a result of the storage of mining waste by enterprises located in the center of the Murmansk region, in the Russian Arctic zone (North-West Europe):

Object 1 - nepheline tailing dumps of a mining and processing plant that extracts and processes loparite ores with the subsequent production of a concentrate of rare earth metals, as well as niobium and tantalum (NS).

Object 2 - quartz tailing dumps of the mining and processing enterprise (QS), which provides the extraction, processing of ferruginous quartzites and the production of iron ore concentrate.
Curves of the main hydrophysical characteristics of technogenic substrates (NS and QS), thermovermiculite (V) and their mixtures in ratios 1:1, 1:2 and 1:4.

### Table 1. Granulometric composition of substrates.

| Particle size, mm | >10 | 5-10 | 3-5 | 2-3 | 1-2 | 0.1-1 | 0.01-0.1 | 0.001-0.01 | <0.001 |
|-------------------|-----|------|-----|-----|-----|-------|-----------|------------|--------|
| QS                | 0.08 | 0.94 | 1.11 | 6.26 | 84.32 | 6.11 | 0.82 | 0.35 |        |
| NS                | 0    | 0    | 0    | 0   | 1.4  | 80.9 | 15.17  | 1.85 | 0.68  |
Content of chemical elements in water-soluble fraction in mixtures of expanded vermiculite with nepheline (a,b) and quartz (c, d) industrial substrates.
• The physicochemical, hydrophysical and chemical properties of alkaline technogenic substrates of tailing dumps in the Arctic zone of Russia have been investigated. The material of the nepheline tailing dump was characterized by the most unfavorable hydrophysical properties; however, the introduction of moisture-retaining materials during the artificial creation of vegetation cover is necessary for all studied substrates.

• The introduction of thermovermiculite led to an improvement in the hydrophysical properties of substrates, a decrease in their alkalinity, and an increase in the content of the water-soluble fraction of macroelements necessary for plant nutrition.

• The most favorable are the ratio of thermovermiculite and substrates 1: 2 and 1: 1 by weight.

Funding
The research was supported by the Council on grants of the President of the Russian Federation, grant MK-2697.2021.1.5. Chemical and mineralogical analyses were supported by the Russian Academy of Sciences theme № 0226-2019-0011.
Contacts

E. A. Krasavtseva\textsuperscript{1,2}, T. K. Ivanova\textsuperscript{1,3}, V. V. Maksimova\textsuperscript{1,2}, I. A. Mosendz\textsuperscript{1,4}, I. P. Kanareykina\textsuperscript{4}, T. L. Panikorovskii\textsuperscript{1}, A. A. Shirokaya\textsuperscript{3} and M. V. Slukovskaya\textsuperscript{1,3,4}

1 Laboratory of Nature-Inspired Technologies and Environmental Safety of the Arctic KSC RAS, Apatity, Russia
2 Institute of North Industrial Ecology Problems KSC RAS Apatity, Russia
3 Institute of Chemistry and Technology of Rare Elements and Mineral Raw Resources KSC RAS, Apatity, Russia
4 Department of Landscape Design and Sustainable Ecosystems, Agrarian-Technological Institute, «Peoples’ Friendship University of Russia», Moscow, Russia

E-mail: e.krasavtseva@ksc.ru