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VOLATILE ORGANIC COMPOUNDS ELIMINATION IN AN ACTIVATED PINE-BARK CHARGE OF A BIOFILTER USING CULTIVATED ASSOCIATIONS OF NATURAL MICROORGANISMS

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EXTENDED ABSTRACT

Different technologies are used for purifying the air of volatile organic compounds, such as butanol, butyl acetate, ethyl acetate, xylene, etc. Besides these traditional air purification methods, more up–to–date, cost–efficient and powerful biological air purification technologies of unsophisticated design are available. The charge used in biological air purification devices may consist of natural (straw, bark, peat, etc.) and synthetic (chopped brick, glass tubes, chip, etc) materials that usually are obtained in the course of different industrial processes. The choice of the charge is usually predetermined by its structure, porosity, sorption properties, life, and the cost. A biofilter containing the activated charge of pine bark with natural microorganism associations being cultivated in it has been assembled in the Department of Environmental Protection of Vilnius Gediminas Technical University [1].

The aim of the paper is with the help of various experimental researches to describe natural microorganism associations, to find out the efficiency of the filter and to evaluate the ability of different charge fractions (1-2 and 3.5-5 cm) to sorb the pollutants being treated by feeding organic compounds (butyl acetate, butanol, and xylene) of different nature and similar concentrations (up to 100 mg/m^3) through the filter.

The research has showed that the biofilter efficiency highly depends on the nature and concentration of the incoming pollutants. With the initial concentrations of butyl acetate and butanol equal to 30 mg/m^3 and that of xylene equal to 19 mg/m^3, the air purification efficiency is 80-98 %; the efficiency goes down with the rising concentrations. The filter efficiency largely depends upon the amount of microorganisms in the charge and the duration of the charge activation. During 65 days of air purification of butanol, the increase was seen not only in the number of bacteria (from $2 \cdot 10^6$ to $1.26 \cdot 10^8$ cfu/g) but also in the filter efficiency (from 60 to 82 %). At the initial stage of filter operation (after 20 days), compounds with higher water-solubility – butanol and butyl acetate – feature better sorption in the biocharge (up to 75-100 %) if compared to xylene that has low water-solubility (up to 35-65 %). In the course of further research (20-40 days later), with the charge getting further activated the process of biological air purification was markedly improving (35-45 %), while the sorption of butanol and butyl acetate into the biomedium slightly dropped (15 %). Meanwhile the sorption of xylene was proceeding in a way similar to the process of biological air purification. After 65 days of filter operation, when the equilibrium of sorption and biochemical mechanisms was achieved, the amount of sorbed pollutants equalled to the amount of oxidized pollutants (60–95 %). During the research it has been established that replacement of coarse fraction of the bark (3.5-5 cm) with finer one (1-2 cm) results in 10-15% improvement of the devise efficiency and in higher sorption power of the biologically activated pine bark charge, as fine fraction has larger surface area and greater number of microorganisms.

Key words: biofilter, volatile organic compounds, activated pine bark charge, natural microorganism association, sorption, elimination, biodegradation.