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SPECIFIC BIOSORBENTS COMPOSITE FOR NEUTRALIZATION OF OIL POLLUTION OF SANDY SOILS

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Oil is a complex and persistent pollutant. Hydrocarbons of oil are available for assimilation only specialized bacteria. Such selectivity in relation to oil formed the basis for bacterial methods of neutralizing oil pollution. Bacteria are highly active microorganisms, which contain enzymes, that is, biological catalysts that can act on a large amount of substrate per unit time. Biosorbents, built based on adsorption material with immobilized oil-oxidizing bacteria, are able to localize and destroy oil products. Oil destruction can be carried out to the final stages, when only the decomposition products of oil remain carbon dioxide, water and asphaltenes, environmentally inert components. The residual part of the biosorbent is the initial base of the sorption material. The process of biodegradation of oil takes place both on the surface under aerobic conditions and in depth, that is, under microaerophilic conditions.

This effect is achieved by introducing aerobic and anaerobic oil-oxidizing bacteria into the composition of biosorbents. Biosorbents can often be the only means of dealing with accidental oil pollution. The use of sorbents of this type will quickly and effectively localize emergency spills of oil and oil products and further ensure a complete schedule of the remains of the latter.

Investigation of adsorption and destructive properties with respect to oil samples of various origin of oil absorbing biologically active sorption material will determine the directions of practical implementation of the technology for obtaining and applying effective environmentally friendly biosorbents for the localization of oil pollution and its subsequent destruction. The optimum parameters for the synthesis of the oleophilic sorption matrix from various types of raw materials and the production of microbial biomass with high destructive activity to oil hydrocarbons are established. Sorption properties of the matrix carrier relative to petroleum products of various chemical composition and microorganisms-destructors have been studied. Microorganisms-destructors, isolated from oil contaminated natural objects and immobilized on the surface of the sorbent-carrier, have an increased destructive capacity with a wide spectrum of action. This fact determines the performance characteristics of bioactive oil absorbing sorbents.

Technological features and technical methods of their application at various environmental objects have been determined. Cleaning of soils contaminated with oil and oil products has features. Due to a large adsorbing surface, the soil accumulates a

pollutant. The sorption capacity depends on the properties of the soil, primarily on the capillary forces, which are determined by the granulometric composition of the soil and its moisture content. Dependence of migration - the accumulation of oil and oil products in soils from the level of their moisture content is confirmed experimentally and shown by calculation methods. With increasing soil moisture, there is less likelihood of soil consolidation of oil and high activity of its radial and material displacement. The water-saturated soils bind only the residual amount of oil in the form of a liquid phase.

Cleaning of sandy soils from oil pollution has certain differences. The mineral composition of the sand is heterogeneous, there are many minerals in it, but several are worth mentioning, the number of which is significant as a percentage: chlorites - 1%, dolomite - 3%, calcite - 7%, feldspars 8%, quartz (which, by the way, is the most common mineral on Earth) - 70%, other minerals account for 11%. This statistics shows that sand consists mainly of quartz and feldspar. It follows that such sands are the most widely distributed. The light color of sandy soils requires the use of only light modifications of bioactive sorbents of destructive type. Secondly, the natural biocenosis. Sandy soils are poor in microorganisms. In such soils, only 1% of dry biomass is. In addition, there is a low moisture content of sandy soil. In moist soils microorganisms reproduce better than in dry form, therefore the microbial component in the biosorption preparation for purification from oil contamination of sandy soils should have increased directed activity.

Surface and sorption characteristics of various possible carriers for immobilization of oil-oxidizing microorganisms are studied. The sorption capacity of the carrier relative to the microbial culture is very important when creating a light-colored biosorption complex and is determined by the adsorption interaction between the carrier sorbent and the bioculture. The evaluation of this characteristic was carried out according to the index of "specific sorption" and the strength of the culture fixation in the stage of intensive growth under standard conditions. The amount of fixed biomass (dry weight) was calculated from the difference in weight of the sample before and after treatment of the sorbent with biomass (weight in mg per 1 g of sample weight). The results of the study showed that the sorption of biomass on the carrier is from 100 to 400 mg of dry biomass per g of sorbent. It is known that with "monomolecular" adsorption (one layer of cells), specific sorption of the biomass of the culture is 80-120 mg / g of material.

Among light-colored sorption materials, moss natural and glauconite have the best indicators on sorption activity for both oil and petrooxidizing microorganisms. Glauconite is widely distributed in sedimentary rocks of shallow-marine origin and in modern marine sediments. Glauconite contains bathymal green ooze, glauconite sandstone, light green glauconite chalk sands and many other species. But it does not form large monomineral aggregations in nature, but occurs only as a mixture with other minerals of clayey or sandy strata. That is, glauconite is related to sandy soils.

The sorption capacity of the carrier relative to the microbial culture is very important for the creation of a biosorption complex and is determined by the adsorption interaction between the carrier sorbent and the bioculture. One of the important parameters of the immobilization process, which characterizes the possibility of functioning of immobilized cells under conditions of increased hydrodynamic action, is

the binding force on the carrier surface. Therefore, we have studied the ability to desorb cells from the surface of carriers. On average 76% of the cells are immobilized on the surface of the carrier.

A quantitative and qualitative assessment of the degradation of petroleum hydrocarbons was determined using IR spectroscopy and GLC. Studies have shown that the potential of oil-oxidizing microorganisms is much higher if they are immobilized on the surface of the sorbent. At the same sorbents are not inert, but are sorption active against carbohydrates. Such a complex of biosorption allows to clear sandy soil contaminated with oil by 90%. Microorganisms that are bound to the surface of the sorbent do not change their activity for a sufficiently long time (more than a year). It is possible to use the biosorption complex several times. It is only necessary to restore its activity (the addition of biological elements - phosphates and nitrates).

In the process of destruction, the number of microbial cells increases during the first 100 days of purification, when the maximum decomposition rate of petroleum hydrocarbons takes place. The dynamics of oil destruction was determined from the change in the content of residual oil in the soil (Table 1)

When a sandy soil contaminated with oil is treated with a biosorption complex, the mechanism of action is not only the biochemical destruction of oil, but also the activation of poor natural microbial biocenoses. The process of oil decomposition in soil has the same character for models and industrial designs. The studies show the change in the concentration of oil in the process of biodegradation in industrial soil samples (black earth,, loam, sand). After 140 days, the concentration of oil contamination decreased from 30-40% to 1-5%. Taking into account the specificity of sandy soils (light color), it was used in parallel for the treatment of biosorption complexes based on a light carrier (glauconite, sawdust, crushed straw, moss).

Table 1

Dynamics of soil purification from oil when treated with a biosorption complex

The term from the beginning of purification, the day	Residual oil content(loam), Carbon carriers - carrier glauconite - carrier natural moss, %			Residual oil content (sand), Carbon carriers - carrier glauconite - carrier natural moss, %		
0	40	40	40	40	40	40
10	24	29	31	26	18	14
33	18	20	20,1	21	18	15
42	13	18	19	18	21	22
56	11	14	17	16	14	16
68	10,5	11	12	14	13	15
85	9,8	9	10	10,1	12	11
91	8,4	10	9	9,1	8	6
110	7,6	6	7	8,4	7	6
126	5,2	4	7	6	5	7
130	2,4	3,5	5	4	4	5
140	0,4	2,1	1,9	2,8	2,9	1,8

The research of the processes of biodegradation of oil in soil under the action of biosorption complexes based on sorption matrix materials of various types, activated by an identical composition of oil-oxidizing microorganisms of natural origin, showed the possibility of using sorbent-microbial compositions on the basis of glauconite mineral or vegetable carrier (moss). The composition was injected with trace elements in an amount necessary for the development and life activity of microorganisms, and the starting concentrate of microorganisms-destructors isolated from natural eco-objects.