

FEATURES OF "MICROBIAL DETONATING " AT DESTRUCTION OF HYDROCARBONS AT PRESENCE OF BIOSORBENTS WITH NANOSTRUCTURES

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One of the most perspective ways of the development of materials for high technologies is the formation of systems in which the reductants exist in the thermodynamically non-equilibrium conditions.

The mathematical model of debacles envisions, that at variation of the environmental conditions of effect at system probably saltatory variation of system behaviour. The special concern is represented by systems, in which one the disastrous losses of stability result in optimization and intensification of processes.

Earlier [1] it was determined that in heterogeneous systems in conditions of a dissipation the situations of a rejection of system from balanced state are possible, therefore the system which is taking place far from this status, passes in an apart active stage. As a result of the subsequent transitions of system the non-stationary situations - abnormal activity are possible, i.e. the manifestation of an explosive status, which one is characterized by super fast-proceeding processes.

Using these submissions, we in papers [1-4] determined an opportunity of developing of systems basing on principles of disastrous losses of stability. It was increased, that in systems of such type the rate of course of processes of clearing or decomposing is enlarged on some orders and proceeds practically entirely ($G=100\%$).

Taking into account the special ecological danger of oil contaminating for an environment, we attempt of developing of new high effective sorbents for clearing of ecosystem from petroleum. As the starting thesis was accepted, that the material should answer conditions of thermodynamic instability, i.e. C_1 there is more C_2 , where C_1 and C_2 characterize high concentration reductants A and super-low reductants B. Differently, having a material, for example, porous solid, which one is characterized by very high significance C_1 , at introduction in system of component C_2 it is necessary to expect process of explosive nature.

Proceeding from this thesis, it was represented interesting to consider an opportunity of existence of such abnormal statuses, which one can be characteristic not only of free - radical products [1] (Fig. 1a), but also and systems of diverse type, for example, systems, in which one the basic role is played by microorganisms.

Pull downing the idealized backgrounds, we shall analyze its practical aspects. Analyzing these data on various parameters, it is possible to reach a conclusion about a substantial opportunity of existence of both types of stationary statuses. The directivity of operating of a microbiological substance in the field of $1 < \beta < \beta_c$, и $\theta < 1$, depending on a previous history of system, is possible both normal and activated («microbial detonating»).

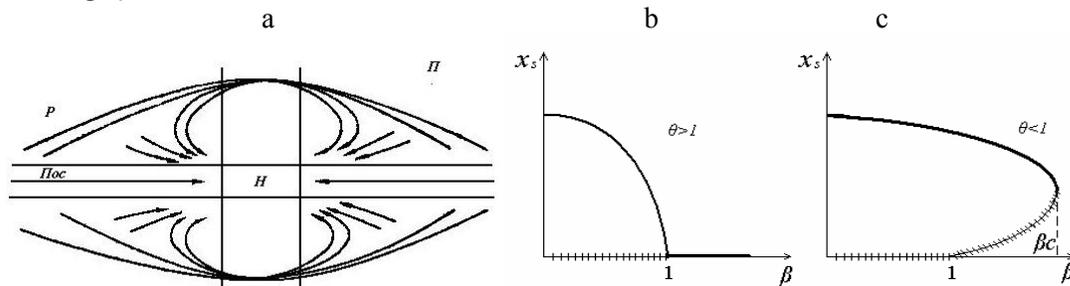


Figure 1. The processes variation by dissipation(a) and stationary concentration variation of destructed components in dependence of parameter β (b,c), which is characterizing of microorganisms activity: (b)-($x_s=0$) normal status; (c) - ($x_s > 0$) «microbial detonating».

In conditions of transition of a particular population in unsteady state there is a situation anomaly, i.e. active state, that corresponds to the earlier advanced submissions in papers [1-4].

This hypothesis was tested by us on an example of processes of biodestruction of liquid hydrocarbons (petroleum) on a surface of sorbents with the participation of microorganisms. As systems adequate in a particular degree requests of a developed hypothesis two systems were selected. The first - adequate to the equilibrium conditions: system - adsorbent (carbon matrix with nanotubes) - immobilized microorganisms (system A). As last the consortia of microorganisms adapted to conditions of their vital activity in conditions of the unfavorable climatic factors was used.

The second system - system B, adequate to criterion «the active form»: the system biosubstrat on the basis of cylindrical nanotubes of vegetative type - consortium of microorganisms was used. Transfer of a sectional consortium in «the active form» carried out by effect on it of the energoactivating factors in controlling conditions.

The results of experiments are indicated in Figs. 2-3. In case of system A, as it is visible from Fig. 2b, the process of biodestruction proceeds without the special rejections from norm during long-lived (more than 30 days) time. At usage of system B the nature of processes of biodestruction (Fig. 2) during short time accepts explosive nature. The rough beginning of biodestruction process - «microbial detonating» - starts after 3-5 minutes contact of biosubstrate with microorganisms (system A) and liquid hydrocarbons. The rate of bioprocess in this system in an active phase on some orders exceeds rate of process including systems A (Fig. 2).

Independent confirmation of course of biodestructive process is intensive gas evolution on a surface of biosubstrate, taking place as on a surface of water, and at the bottom,

and also fast opacification of an aqueous medium, that testifies about biodestruction as in aerobic, and anaerobic conditions.

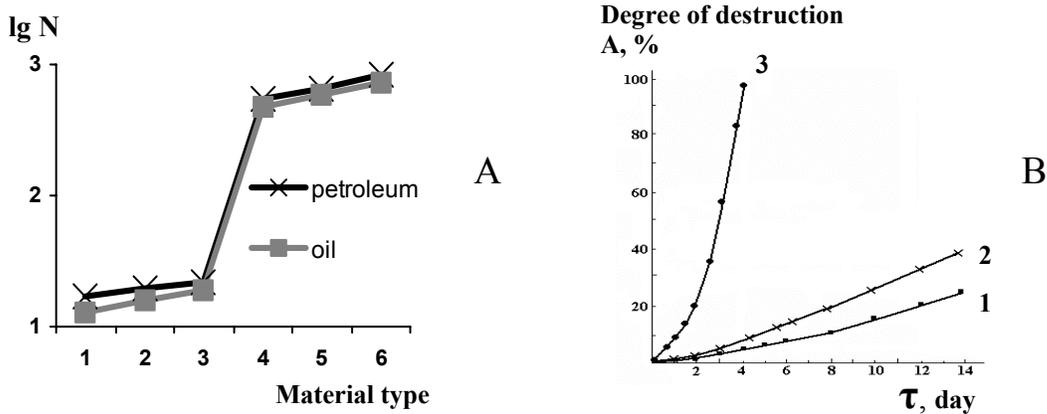


Figure 2. The influence of carboncontaining nanotubes nature (1 – 3 carbon nature, 4 – 6 organic nature) on the efficiency of the oilproducts adsorption from water surface (A). The influence of sorbents nature on effective of biodestructions oil on surface water: 1, 2 – sorbents without nanotubes, 3 – sorbents with nanotubes (B).

The data of fig. 3 demonstrate the efficiency of biodestruction process. It is seen that the rate of the process of biodestruction with use of the developed biosorbents is 2-3 times higher in comparison with the known.

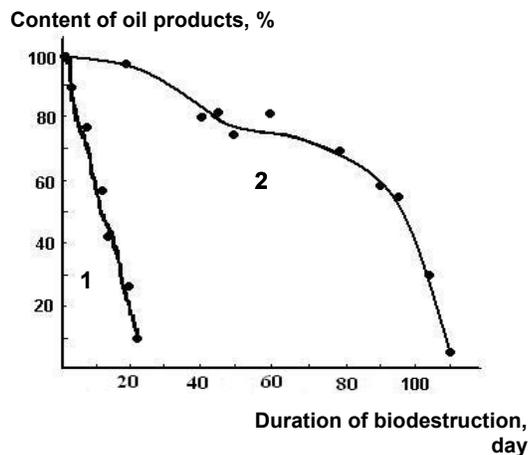


Figure 3. Kinetics of biodestruction of oil products by the systems based on carbon sorbents with immobilized bioactive microflora: 1 – with specially selected consortium of microorganisms; 2 – with nature microflora adapted to oil products

References

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