EXPERIMENTAL STUDY OF ACCELERATED DEACTIVATION OF HIGH-ACTIVITY REACTOR WATER IN GROWING MICROBIOLOGICAL CULTURES

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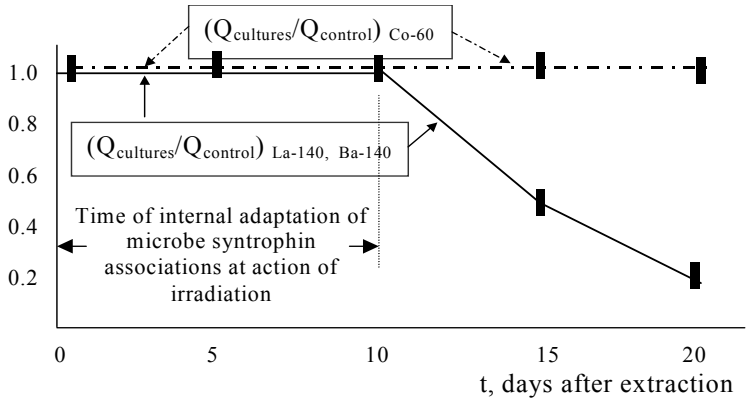
Abstract

In the work for the first time has been observed the process of direct deactivation and utilization of highly active waste by the way of transmutation radioactive isotopes to non-radioactive isotopes by growing microbiological systems. Nuclear transmutation of several kinds of radionuclides by the special MCT (Microbial Catalyst-Transmutator) has been investigated. The MCT represents special granules that include: concentrated biomass of metabolically active microorganisms, sources of carbon and energy, phosphorus, nitrogen, etc., and gluing substances which keep all components in the way of granules stable in water solutions for a long period of time at any external conditions. The base of the MCT are microbe syntrophin associations that contain many thousands kinds of different microorganisms that are in the state of complete symbiosis. These microorganisms appertain to different physiological groups that represent practically whole variety of the microbe metabolism and relevantly all kinds of microbe accumulation mechanisms. The state of complete symbiosis of the syntrophin associations results on the possibility of maximal adaptation of the microorganisms' association to any external conditions changes (including utmost aggressive environments and effect of highly active ionizing irradiation). Typical reaction of the association for such aggressive effects demands the existence of some time for internal adaptation. This time is necessary for mytagene change of 5-10 generations that corresponds to several days. During this time occurs a purposeful synergy process of stimulation of the mutant formation of such micro organisms, which are maximally adapted to the changed aggressive conditions. This MCT is able to develop actively, for example, in the water with very high specific activity, while ordinary, not radioactively stable, monocultures die in such environment very rapidly.

The research has been carried out on the basis of distilled water from first contour of water-water atomic reactor of Kiev Institute of Nuclear Research. The water with total activity about 10^{-4} Curie/L contained highly active isotopes (e.g., Na^{24}, K^{40}, Co^{60}, Sr^{91}, I^{131}, Xe^{135}, Ba^{140} , La^{140}, Ce^{141}, Np^{239}) was extracted from the active zone. In our experiments MCT was placed in the glass flasks with 10 ml of water from the atomic reactor. In control experiments the same radioactive water but without MCT was used.



The cultures were grown at the temperature 25^0 C. Activity of all flasks has been measured every 5 days.

For the first time we have observed fast utilization (accelerated decay after time for internal adaptation) of several kinds of highly active isotopes (Ba^{140}, La^{140}) to nonradioactive nuclei in the flasks that contained MCT. The results of investigation of the activity of the same reactor La^{140}, and Ba^{140} and Co^{60} isotopes in the experiment on transmutation (activity is $Q_{cultures}$) and in the control one ($Q_{control}$) are presented on the figure. Initial activities of the Ba^{140} and La^{140} isotopes (on the 10th day after extraction of water from the active zone of the nuclear reactor) were $Q_{Ba\text{-}140} = 1.46.10^{-7}$ Curie/L and $Q_{La\text{-}140} = 2.31.10^{-7}$ Curie/L. The theory of the effect of radioactive isotope utilization to nonradioactive nuclei in growing associations of microbiological cultures [1] is discussed.

[1]. Vysotskii V.I., Kornilova A.A. Nuclear fusion and transmutation of isotopes in biological systems, Moscow, "MIR" Publishing House, 2003, 302 p.