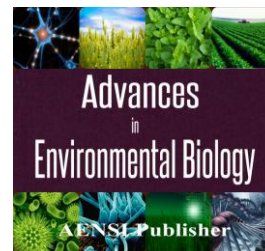




AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: <http://www.aensiweb.com/AEB/>

Prospects of Using Immobilized Cells of Oil Oxidizing Microorganisms for Purification of Water from Oil

Khusnetdinova Landish Zavdetovna

Kazan (Volga region) Federal University 18 Kremlyovskaya St., Kazan 420008 Republic of Tatarstan, Russian Federation

ARTICLE INFO

Article history:

Received 25 June 2014

Received in revised form

8 July 2014

Accepted 10 August May 2014

Available online 30 August 2014

Keywords:

oil, microorganisms, culture, sorbing agent, immobilization, destruction.

ABSTRACT

Annotation. The possibility of intensifying the processes of oil destruction by immobilized cells of oil oxidizing microorganisms was studied. We showed that application of the husk of buckwheat and barley as the medium for immobilization of bacteria helps to expedite the biodegradation of oil in water, than when suspended cells are used. We found the dependence of the extent of water purification on airtight and various temperature conditions of cultivation (+4, 20-22, 28° C).

© 2014 AENSI Publisher All rights reserved.

To Cite This Article: Khusnetdinova Landish Zavdetovna., Prospects of Using Immobilized Cells of Oil Oxidizing Microorganisms for Purification of Water from Oil. *Adv. Environ. Biol.*, 8(13), 287-289, 2014

INTRODUCTION

The pollution of the natural environment with oil and oil products is a very urgent environmental problem currently. As they get into the environment, oil hydrocarbons influence on the ecosystems activity adversely, decrease their biological productivity, and the aquatic life.

There are many publications on use of oil oxidizing microorganisms at biological purification of water and soil [1, 2, 3, 4, and 5]. At purification of water polluted with oil, either microbe associations (biocenoses) are preferred, or specialized, adapted to the certain content of chemical pollution and cultures of microorganisms [6 and 7].

However, oil and oil products are complex, multicomponent pollutants, and application of comprehensive approach to protection of water resources, which is based on wide application of immobilized catalytically active cells of heterotrophic bacteria – destructors of various substances [8, 9 and 10], can provide for high efficiency at purification of natural and sewage waters.

The objective of this research was to study the ability of immobilized cells of microorganisms on the sorbing agents of vegetable origin to dispose of the elements of oil hydrocarbons depending on the abiotic factors of the environment.

In this work, we used strains of oil oxidizing microorganisms, related to the following kinds: Rhodococcus G0611VT(#18), G0612VT(#19); Pseudomonas G0613VT(#20); Corynebacterium G0614VT(#21); Flavobacterium G0615VT(#22), G0620VT(#27); Micrococcus G0616VT(#23); Arthrobacter G0617VT(#24); Mycobacterium G0618VT(#25); Bacillus G0619VT(#26).

To immobilize cells of microorganisms, we used granules with buckwheat husk (BWH) and barley husk (BH) as carrying sorbing agents.

As the only source of carbon, we used the marketable oil of the Almetyevsk deposit of the Republic of Tatarstan in the concentration of 0.5% (by the volume).

The qualitative determination of the residual oil for evaluation of the oil destructive activity of microorganisms was carried out by the gravimetric method after its extraction with carbon tetrachloride [11].

Immobilization of the bacteria cells was carried out using granules of agar-agar adding BWH and BH [12].

In order to study the effect of immobilized cells of the microorganisms, consisting of various number of strains: 1 - G0611VT (# 18), G0612VT (# 20), G0616VT (# 23); 2 - G0611VT (# 18) G0612VT (# 19) G0613VT (# 20), G0614VT (# 21), G0615VT (# 22), G0616VT (# 23), G0617VT (# 24), G0618VT (# 25), G0619VT (# 26), G0620VT (# 27) on the degradation of oil, we studied the dynamics of development of free and adsorbed associations on different media with BWH and BH.

Corresponding Author: Khusnetdinova Landish Zavdetovna, Kazan (Volga region) Federal University 18 Kremlyovskaya St., Kazan 420008 Republic of Tatarstan, Russian Federation

At cultivation of the studied groups of strains of microorganisms in associations consisting of three and ten species in free and immobilized states in the circumstances of airing the mineral environment with oxygen, it was found that the rate of oil degradation directly depends on the number of microorganisms, which consume the bound molecular oxygen for destruction of oil to simpler forms of hydrocarbons.

In the course of the experiment, it was shown that in the variants with three and ten cultures, the variant with immobilized microorganisms on the BWH and BH granules had better biologically degrading activity with regard to oil oxidizing, than the free cells did (Table 1).

Study of the influence of various temperature conditions between +4 °C and +28°C on the activity of microorganisms showed that the intensity of oil oxidizing is higher at higher temperatures.

It was stated that the temperature between 22-28° C is the most favorable environment for growth of the microorganisms, which is confirmed by the large number of cells of the bacterial suspension and the efficiency of oil destruction (Table 1).

Table 1: Efficiency of oxidizing oil with associations of cultures of microorganisms in the suspended and immobilized states.

Experiment variants	Medium	Temperature of cultivation			Airing
		+4	+20-22	+28	
the extent of oil destruction, %					
Free cells G0611VT (# 18), G0612VT (# 20), G0616VT (# 23)	—	17.7 ± 0.86	19.6 ± 1.10	27.3 ± 0.80	45.3 ± 1.69
Free cells G0611VT (# 18), G0612VT (# 19), G0613VT (# 20), G0614VT (# 21), G0615VT (# 22), G0616VT (# 23), G0617VT (# 24), G0618VT (# 25) G0619VT (# 26), G0620VT (# 27)	—	22.3 ± 0.53	27.5 ± 1.23	35.7 ± 1.16	51.5 ± 0.69
Immobilized cells G0611VT (# 18), G0612VT (# 20), G0616VT (# 23)	BWH	35.1 ± 0.60	53.17 ± 0.92	66.0 ± 0.85	80.17 ± 0.94
Immobilized cells G0611VT (# 18), G0612VT (# 19), G0613VT (# 20), G0614VT (# 21), G0615VT (# 22), G0616VT (# 23), G0617VT (# 24), G0618VT (# 25) G0619VT (# 26), G0620VT (# 27)		48.1 ± 0.76	69.4 ± 1.09	85.0 ± 0.89	98.17 ± 0.89
Immobilized cells G0611VT (# 18), G0612VT (# 20), G0616VT (# 23)	BH	29.7 ± 1.36	46.16 ± 0.75	56.17 ± 0.75	75.34 ± 1.17
Immobilized cells G0611VT (# 18), G0612VT (# 19), G0613VT (# 20), G0614VT (# 21), G0615VT (# 22), G0616VT (# 23), G0617VT (# 24), G0618VT (# 25) G0619VT (# 26), G0620VT (# 27)		36.0 ± 0.69	54.9 ± 0.79	67.17 ± 1.19	88.0 ± 1.10

*The initial quantity of added oil was equal to 0.5 %

Cultivation of the suspended and immobilized cells of microorganisms in consortia consisting of three and strains at the temperature of +20-28 °C, resulted in improvement of the efficiency of oil oxidization. The extent of oil destruction at the given initial concentration 0.5 % by the volume and in the consortium of microorganisms of 3 and 10 cultures immobilized on the granules of the buckwheat husk and barley husk was higher if compared to free cultures.

The improvement of efficiency of oil oxidization with hydrocarbon-oxidizing bacteria can be associated with the influence of the temperature on the structure of the cell components, especially proteins and lipids, and on the temperature coefficients of the reactions rates, which in their turn depend on the energy of activation of these reactions. The increase in temperature is the cause of expedition of all fermentation reactions, which results in high rate of oil degradation [13].

When the temperature of cultivation in mineral environment was decreased down to +4 °C, the intensity of oil destruction with suspended and immobilized cells of microorganisms decreased 1.5-2 times, which is explained by decrease of the biological activity of microorganisms and, consequently, reduction of the water self-purification.

Thus, the obtained results give reasons to recommend sorbing agents based on the buckwheat husk and barley husk for intensification of oil and oil products transformation in the sewage water of various extent of pollution.

REFERENCES

- [1] Venkateswaren, K., T. Iwabuchi, Y. Matsui, H. Toki, E. Hamada and H. Tanaka, 1991. Distribution and biodegradation potential of oil-degrading bacteria in North Eastern Japanese coastal waters. *Microbial Ecology*, 86: 113-121.
- [2] Becker, P.M. and W. Dott, 1993. Characterization of chemoheterotrophic bacteria associated with the in situ bioremediation of a waste oil contaminated site. *Microbial Ecology*, 26: 161-188.
- [3] Kampfer, P., M. Steiof, P.M. Becker and W. Dott, 1993. Characterization of chemoheterotrophic bacteria associated with the in situ bioremediation of a waste oil contaminated site. *Microbial Ecology*, 26: 161-188.
- [4] Avelin, M.S. and M.S. Vitalina, 1997. Microfouling bacteria. *Fouling Organisms in the Indian Ocean. In Biology and Control Technology*, Eds., Nagabhushanam, R. and M.F. Thompson. New Delhi: Oxford and IBH Publ. Co., pp: 189-220.
- [5] Borzenkov, I.A., E.I. Milekhina, M.T. Gotoeva, E.P. Rozanova and S.S. Belyaev, 2006. Properties of hydrocarbon-oxidizing bacteria isolated from the oil deposits of Tatarstan, West Siberia, and Vietnam. *Microbiology*, 1: 82-89.
- [6] Morozov, N.V., L.Z. Khusnetdinova and O.V. Zhukova, 2011. Use of oil oxidizing microorganisms immobilized on organic sorbent for purification of water from oil. *Fundamental Research*, 12: 576-579.
- [7] Pirog, T.P., T.A. Shevchuk, I.N. Voloshina and N.N. Gregirchak, 2005. Use of cells of oil oxidizing microorganisms immobilized on expanded clay for purification of water from oil. *Applied biochemistry and microbiology*, 1: 58-63.
- [8] Westmeier, F. and H.J. Rehm, 1985. Biodegradation of 4-chlorophenol by entrapped *Alcaligenes* sp. A₇₋₂. *Applied Microbiology and Biotechnology*, 5(22): 301-305.
- [9] Maximova, Yu.G., A.Yu. Maximov, V.A. Demakov, S.V. Kozlov, G.V. Ovechkina and V.F. Olontsev, 2010. Hydrolysis of acrylonitrile with cells of nitrile-converting bacteria immobilized on fibrous carbonic adsorbing agents. *Biotechnology*, 4: 51-58.
- [10] Wilson N.G. and G. Bradley, 1996. Enhanced degradation of petrol (Slovene diesel) in an aqueous system by immobilized *Pseudomonas fluorescens*. *Journal of Applied Bacteriology*, 1(80): 99-104.
- [11] Lurye, Yu.Yu. and A.N. Rybnikova, 1974. *Chemical analysis of industrial sewage water*. Moscow: Khimia, pp: 335.
- [12] Netrusov, A.I., M.A. Egorova and L.M. Zakharchuk, 2005. *Laboratory course in microbiology*. Moscow: Akademiya, pp: 608.
- [13] Pert, S.J., 1978. *Basic concepts of cultivating microorganisms and cells*. Moscow: Mir, pp: 331.