

# Methodology for Assessing the Oil-Oxidizing Ability of Biopreparations-Oil Destructors

**A.V. Nechaeva**<sup>1</sup>, S.N. Vinogradsky Institute of Microbiology of Federal Research Center Fundamentals of Biotechnology of RAS, nechaevasasha709@gmail.com

**S.V. Ostakh**<sup>2</sup>, I.M. Gubkin Russian State University of Oil and Gas (NRU), Assoc. Prof. PhD, ostah2009@yandex.ru

<sup>1</sup> Junior Researcher, Moscow, Russia

<sup>2</sup> Associate Professor, Moscow, Russia

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## key words

biological product, hierarchical approach, oil destructor, oil-oxidizing microorganisms, consortium design

A bioremediation is a technology for cleaning the environment with the help of living organisms. One of its options is the purification of oil-contaminated soil with the help of microorganisms. In order for the process of biodegradation of oil to be effective, the microorganisms involved in the process must be comprehensively studied. We believe that particular attention should be paid to the oil-oxidizing ability under different conditions of both each strain and the community as a whole. However, there are still no universal criteria for comparing strains and identifying the optimal strain, especially among those capable of oxidizing a wide range of petroleum hydrocarbons. In this regard, the purpose of this work was to compare different methodologies for assessing the oil-oxidizing ability of microorganisms, as well as to propose a way to design consortia of biological products taking into account the studied techniques. In this work, we have studied qualitative and quantitative methodological approaches for assessing oil-oxidizing activity based on such criteria of oil oxidation as biomass accumulation, homogeneity of the dispersed biodegradation system, the number of microorganisms, residual oil content. Among the methods studied are visual assessment, cup method, microscopy, gravimetric analysis, etc. Based on these methods, a method for designing consortia for biological products-oil destructors was proposed.

## References

- Sharma I. Bioremediation techniques for polluted environment: concept, advantages, limitations, and prospects, *Trace Metals in the Environment: New Approaches and Recent Advances*, 2020, pp. 221–236.
- Filonov A.E. Mikrobnye biopreparaty dlya ochistki okruzhayushchey sredy ot neftyanykh zagryazneniy v usloviyakh umerennogo i kholodnogo klimata: spetsial'nost' 03.01.06 — Biotekhnologiya (v tom chisle bionanotekhnologii) [Microbial biological products for cleaning the environment from oil pollution in temperate and cold climates: specialty 03.01.06 — Biotechnology (including bionanotechnology)], Pushchino, 2016, 46 P.
- Funtikova T.V. Razrabotka novykh biopreparatov, obladayushchikh nefteokislyayushchey i mikotoksicheskoy aktivnostyami [Development of new biopreparations with oil-oxidizing and mycotoxic activities], *Perspektivnye napravleniya fiziko-khimicheskoy biologii i biotekhnologii*, Moscow, 2017, 155 P.
- Mel'nikov D.A. Raspredelenie priznakov biodegradatsii uglevodorodov i otsenka tekhnologicheskoi vazhnykh svoystv nefteokislyayushchikh bakteriy: spetsial'nost' 03.00.23 — Biotekhnologiya: avtoreferat dissertatsii na soiskanie uchenoy stepeni kandidata biologicheskikh nauk [Distribution of signs of hydrocarbon biodegradation and assessment of technologically important properties of oil-oxidizing bacteria: specialty 03.00.23 — Biotechnology: dissertation abstract for the degree of candidate of biological sciences], Krasnodar, 2005, 28 P.
- WFD 39-1.13-056–2002 Technology for cleaning various media and surfaces contaminated with hydrocarbons, JSC Gazprom Order of 5.03.2002 N 27, Moscow, 2002.
- Report on the determination of the oil-oxidizing activity of microbial consortiums, Moscow, 2018.
- GPM.1.7.2.0008.15 Determination of the concentration of microbial cells, approved Pharmacopoeia Committee of the RF Ministry of Health of 29.10.2015, Moscow, 2016.
- Tyshchenko N.V. Vydelenie i izuchenie uglevodorodokislyayushchikh mikroorganizmov dlya razrabotki biopreparatov: spetsial'nost' 06.04.01 — Biologiya: masterskaya dissertatsiya [Isolation and study of hydrocarbon-oxidizing microorganisms for the development of biological products: specialty 06.04.01 — Biology: master's thesis], Tomsk, 2021, 63 P.
- ERD F 16.1.41–04 Quantitative chemical analysis of soils. Method for measuring the mass concentration of oil products in soil samples by the gravimetric method, Moscow, 2004.
- US Environmental Protection Agency. EPA method 3545 Pressurized Fluid Extraction (PFE); <https://assets.thermofisher.com/TFS-Assets/CMD/manuals/Man-ASE-ASE150-OperatorsNov2020-DOC065207-04.pdf> (acc.: 7.04.2021).
- GOST R 56720–2015 Petroleum products and stable gas condensate. Determination of the fractional composition by gas chromatography, Moscow, 2016.
- Rogozina E.A., Andreeva O.A., Zharkova S.I. i dr. Sravnitel'naya kharakteristika otechestvennykh biopreparatov, predlagaemykh dlya ochistki pochv i gruntov ot zagryazneniya nef'tyu i nefteproduktami [Comparative characteristics of domestic biopreparations offered for cleaning soils and soils from pollution by oil and oil products], *Neftegazovaya geologiya. Teoriya i praktika*, 2010, vol. 5, no. 3, 10 P.
- Patowary K., Patowary R., Kaila M. C., Deka S. Development of an efficient bacterial consortium for the potential remediation of hydrocarbons from contaminated sites, *Frontiers in microbiology*, 2016, vol. 7, 1092 P.
- Delegan Ya.A. Termotolerantnye bakterii-destruktory uglevodorodov nef'ti: spetsial'nost' 03.01.06 — Biotekhnologiya (v tom chisle bionanotekhnologii): dissertatsiya na soiskanie uchenoy stepeni kandidata biologicheskikh nauk [Thermotolerant bacteria-destructors of oil hydrocarbons: specialty 03.01.06 — Biotechnology (including bionanotechnology): dissertation for degree of candidate of biological sciences], Pushchino, 2016, 153 P.