



Investigation of motor oil biodegradation by different bacterial strains



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Introduction & Objectives:

Large amount of motor oil is used in many branches of industry. The new generation of motor oils contains high percentages hydrocarbons (C16-C36), more than 75% cycloalkane and polycyclic aromatic hydrocarbons (PAH). However, used motor oils contain a higher percentage of aliphatic and aromatic hydrocarbons, nitrogen and sulfur compounds, and metals (Mg, Ca, Zn, Pb, etc.). In addition to these compounds, the presence of PAHs (naphthalene, benzo [a] pyrene and anthracene) is also expected. Therefore these oils represent a great danger to the environment, because all these compounds are known as mutagenic and carcinogenic [1, 2]. Globally, biodegradation is a common choice for remediation, because the pollutants become substrates for the growth of microorganisms [3]. The objective of this experiment was to investigate the biodegradation of motor oil by bacteria *Stenotrophomonas* sp. (NR 1), *Rhodococcus* sp. (UG 10) and *Bacillus* sp. (F 231) isolated from activated sludge of industrial wastewater treatment plant.

Materials & Methods:

The process of biodegradation of motor oil was monitored for 45 days. Each 15 days the process was stopped, the hydrocarbons were extracted, and the samples were analyzed by gas chromatography. Samples were analyzed on an Agilent 7890A gas chromatograph with a flame ionization detector (FID), equipped with a chromatographic column HP-5, length 30m and diameter 0,32mm, the thickness of the stationary phase 0,25µm. The carrier gas is hydrogen with a flow rate of 2 mL / min, injector temperature is 250 °C and the detector temperature is 320 °C. Temperature program: initial temperature of 40 °C during 1min., then heated to 100 °C at a rate of 15 °C / min., and then to a temperature of 310 °C is 10 °C / min and finally isothermal 310 °C for 15 minutes. The software that was used for data processing is ChemStation, Agilent Technologies.

Comparison of motor oil concentration in the samples and in the abiotic controls provided insight into the biodegradation activity of bacteria. The results showed a reduction in concentration of motor oil comparing to the beginning of the experiment (300 ppm). The growth of bacteria confirmed that the motor oil was the only source of carbon. The reduction of motor oil concentration was correlated with the number of bacterial cells.

Results & Discussion:

Comparison of motor oil concentration in the samples and in the abiotic controls provided insight into the biodegradation activity of bacteria. The results showed a reduction in concentration of motor oil comparing to the beginning of the experiment (300 ppm) shown in Table 1. The growth of bacteria confirmed that the motor oil was the only source of carbon. The reduction of motor oil concentration was correlated with the number of bacterial cells (Table 2).

Table 1. Percentage of degraded motor oil.

Microorganism	<i>Stenotrophomonas</i> sp. (NR 1)		<i>Rhodococcus</i> sp. (UG 10)		<i>Bacillus</i> sp. (F 231)	
	remaining (mg)	% biodegradation ^a	remaining (mg)	% biodegradation ^a	remaining (mg)	% biodegradation ^a
15.day	12,3	62,7	16,1	51,2	22,7	31,2
30.day	9,6	70,9	15,1	70,9	21,0	36,3
45.day	7,8	76,6	9,6	84,9	1,5	95,4

^athe values obtained by measuring the mass of the extracted remaining engine oil; %% biodegradation is calculated to the initial amount of engine oil.

Table 2. Number of bacteria cells during the experiment.

N° of bacteria cells	0.day	15.day	30.day	45.day
<i>Stenotrophomonas</i> sp. (NR 1)	2x10 ⁷	1x10 ⁷	5x10 ⁷	2x10 ⁷
<i>Rhodococcus</i> sp. (UG 10)	1x10 ¹⁰	1x10 ⁷	3x10 ⁷	1x10 ⁷
<i>Bacillus</i> sp. (F 231)	7x10 ⁸	2x10 ⁷	8x10 ⁷	1x10 ⁷

Conclusion:

Based on the results, it was concluded that the biodegradation activity was highest in *Bacillus* sp. (F 231). After 45 days this bacterial strain degraded 95.4% of motor oil (Fig. 1). Under the same conditions two other bacterial strains showed lower biodegradation activity: 84.9% by *Stenotrophomonas* sp. (NR 1) (Fig. 2), and 76.6% by *Rhodococcus* sp. (UG 10) (Fig. 3).

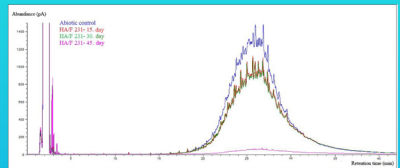


Fig. 1. Biodegradation of motor oil by *Bacillus* sp. (F 231) after 15, 30 and 45 days.

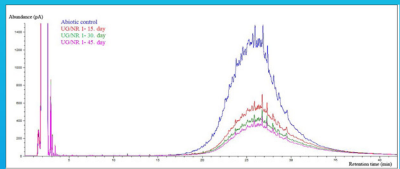


Fig. 2. Biodegradation of motor oil by *Stenotrophomonas* sp. (NR 1) after 15, 30 and 45 days.

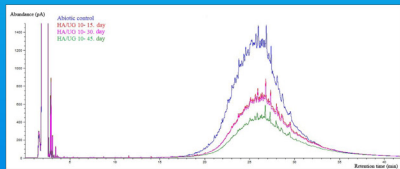


Fig. 3. Biodegradation of motor oil by *Rhodococcus* sp. (UG 10) after 15, 30 and 45 days.

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