MICROBIAL DESULFURIZATION OF EGYPTIAN CRUDE OIL BY A YEAST STRAIN ISOLATED FROM OIL POLLUTED SEA WATER

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Abstract
Sulfides and thiophenic compounds specially Benzothiophene and Di-benzothiophene (BTs and DBTs) are the main sulfur types present in crude oil and its distillates (diesel) where their removals are very difficult by hydrodesulfuri-zation (HDS). As an alternative method is microbial desulfurization by *Candida parapsilosis* Nsh45, a locally isolated microorganism, from Egyptian hydrocarbon sea water. It was found that it is very efficient to remove up to 82% of 12.400 ppm sulfur content in diesel oil and ≈75% from Belayim mix crude oil, respectively keeping the calorific value unchanged.
Keywords: Biotechnologies, Petroleum, Pollution, Red Sea

Introduction
In Egyptian crude oil, sulfur content ranges between (0.04- 4.19 wt.%) including DBTs and BTs and another thiophene compounds. The presence of sulfur has been correlated with the corrosion of pipelines, pumping and refining equipments. Hydrodesulfurization (HDS) is the current method used for sulfur removal, which is not only energy and capital intensive but also suffers from limitations in the removal of typical sulfur bearing aromatic compounds such as (DBT) and its derivatives. Microbial removal of organic sulfur from crude oil offers an attractive route because of the mild operating conditions afforded by the biocatalyst [1] offering significant cost and safety advantages. The first microorganism capable of S removal Rhodococcus rhodochrous (IGTS 8) that selectively cleaves sulfur from DBT through the 4S' pathway [2] In this work we study the BDS activity of a new isolated yeast strain *Candida parapsilosis* N.Sh 45 [3] on DBT. It is then applied to desulfurize diesel and crude oil comparing it with the standard strain *Rhodococcus erytrhopilis* (IGTS8).

Experimental work: The experiment was done using sterilized oil and basal salts medium (BSM) to study the ability of *Candida parapsilosis* NSh 45 to grow and desulfurize egyptian diesel of initial sulfur content (12,400 ppm) and Belayim mix crude oil (BX 2.76% sulfur). The desulfurization was carried here with the ratio of oil/BSM 1/3 (v/v) at pH 7 and inoculation size 10%. The cultures and the control oil were incubated at 30ºc and checking speed 200 rpm. Diesel oil was subjected to GC-FID analysis. Sulfur removal was determined using x ray sulfur meter (ASTM, D4294). Calorific value and dynamic viscosity were also measured to determine the effective microbial treatment.

Results and discussions
Identifications of the metabolites using GC-MS suggested that NSh 45 metabolized DBT trough the 4S pathway. This result is in agreement to that obtained by Baldy *et al* [4].

Biodesulfurization of Diesel oil: The effect of microbial treatment on diesel oil was studied after 7 days of incubation. The GC –FPD chromatogram of biodesulfurised diesel oil revealed extensive depletion of sulfur compounds (mainly BTs and DBTs) across the entire boiling range of the oil, with BDS potential of about 82% as shown in the figure.

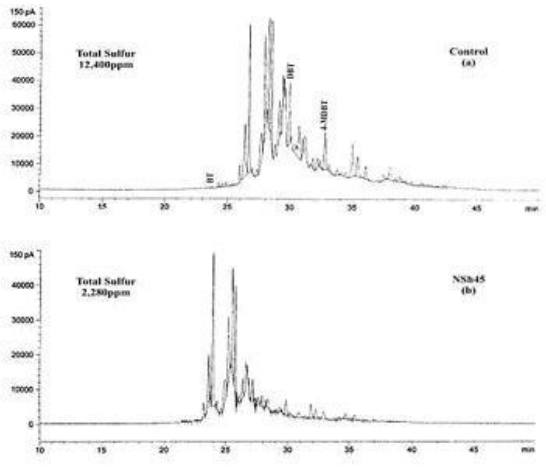

Fig. 1. GC-FPD chromatogram showing OSC in diesel oil

Biodesulfurization of crude oil: The effect of microbial desulfurization treatment of belayim mix 2.76% was studied after 7 days of incubation. Gravimetric determination of asphaltene content showed a decrease in its weight percentage associated with the decrease in sulphur content of the crude oil. GPC data of the average molecular weight in the following table support the above results where there was a general decrease in the average Mwt of asphaltene fraction and decrease in the dynamic viscosity about 69.62% [5].

Tab. 1. Effect of crude oil BDS on; asphaltene and maltene ratios, asphaltene Mwt and viscosity

Sample / Parameter	Control	NSh45	IGTS8
S-content (%wt.)	2.76%	0.70%	0.99%
%BDS		75%	64.0 %
% Maltene	92.00%	94.64%	93.97%
% Asphaltene	8.00%	5.36%	6.03%
Asphaltene Mwt.	14,384	10,371	10,978%
Viscosity (cp)	655	199	236

Conclusion
It was found that *Candida parapsilosis* is very efficient to remove up to 82% of 12,400 ppm sulfur content in diesel oil and approximately 75% from Belayim mix crude oil with initial sulfur content of 2.76% compared to the standard strain *Rhodococcus erythopilis* IGTS8 wich removed up to 46% and 64% from the diesel and crude oil respectively.

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