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The reclaimed lands and their surrounding areas have to represent optimally organized and economically balanced landscape which appears organically to the surrounding environment. The final landscaping can be done during the closure work of the open pits.

REVIEW OF OUR BENEFICIATION OF OIL SHALE BY BIOPROCESSING ON LABORATORY SCALE

Prof. Miroslav Vrvic
Faculty of Chemistry, University of Belgrade, Full Professor,
Studentski trg 16, P.O.Box 51, 11158, Belgrade, Serbia, mmvchem@sezampro.rs

Mr. Vladimir Beskoski (a), **Dr.Olga Cvetkovic** (b), **Dr. Vesna Dragutinovic** (c), **Mrs. Valerija Matic** (d), **Dr. Snezana Spasic** (e), **Prof. Dragomir Vitorovic** (f)

(a, b, d, e) Department of Chemistry IChTM
(c) School of Medicine
(f) SASA

It is estimated that reserves of oil shale in Serbia amount to about 3 billion tons, while the largest deposit (approx. 2/3 of total amount) for open-pit and underground exploitation is situated in the locality of Aleksinac in East Serbia. This deposit is not exploited at the moment. Shale from Aleksinac is an immature Oligocene-Miocene lacustrine sediment. The average content of the organic substance in Aleksinac shale is about 20 %, with a dominant share of kerogen (the content of bitumen is less than 5 %). The mineral part comprises about 20 % carbonates, approximately 10 % pyrite and the rest are aluminosilicates. Our lab researches relating to the "quality improvement" of raw shale from Aleksinac that have been made for more than 25 years are primarily aimed at obtaining the structurally unchanged concentrate of kerogen for fundamental organic geochemical investigation, with the potential application, which has become more popular nowadays. As "non-destructive reagents" we use microorganisms that for the carbon source do not use the organic substance of oil shale as substrate.

In order to remove carbonates ("decarbonization") and aluminosilicates ("desilicification") we use strains of chemoorganoheterotrophic "siliceous bacteria" Bacillus circulans, and for depyritization we use strains of chemolithoautotrophic thionic bacteria Acidithiobacillus ferrooxidans. In a large number of experimental variations of the "shake flask test technique" the best results have been obtained for decarbonization (100%) and depyritization (more than 95%). The highest level of "desilicification" amounts to about 60 %. Improved oil shale is obtained through bioprocessing in all these cases.

Finally, by the removal of the organically bound sulphur, for the purpose of reducing the content of the total sulphur, primarily in order to reduce aero pollution, through an action of the bacterial generated iron (III)-ion from pyrite, with dibenzothiophene as the model substrate, the desulphurization is completed as well as the total biobeneficiation of oil shale.

The way to the application of microbial-bio (geo)technological methods for the purpose of obtaining oil shale of the improved quality as the source of energy and as an alternative liquid hydrocarbon fuel is long and hard, but certainly that should persist on it and work pursue to this goal with dedication and zeal.

REVIEW OF OUR BENEFICIATION OF OIL SHALE BY BIOPROCESSING ON LABORATORY SCALE

Miroslav M. VRVIĆ, Vladimir P. BEŠKOSKI*, Olga CVETKOVIĆ*, Vesna DRAGUTINOVIĆ**, Valerija MATIĆ*, Snežana SPASIĆ*, Dragomir VITOROVIĆ***

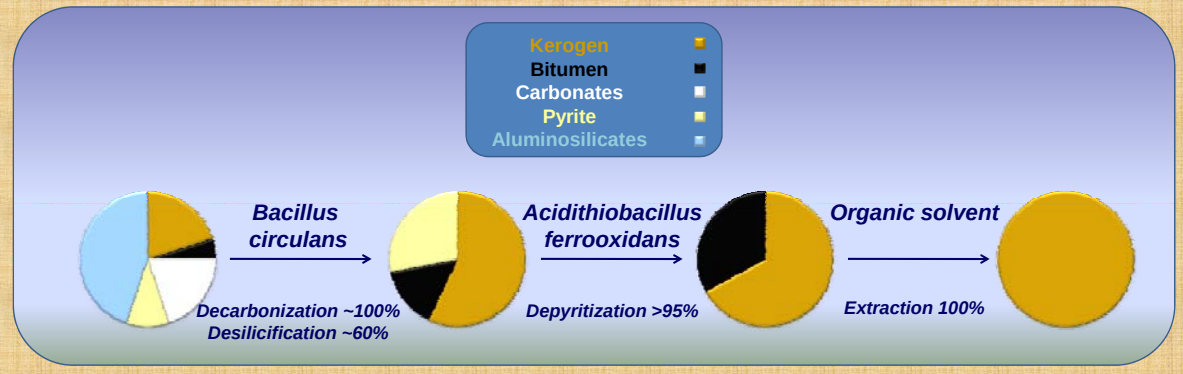
Faculty of Chemistry, University of Belgrade, P.O.Box 51, Belgrade, Serbia
*Department of Chemistry IChTM, University of Belgrade, P.O.Box 473, Belgrade, Serbia
**School of Medicine, University of Belgrade, Belgrade, Serbia
***Serbian Academy of Science, Belgrade, Serbia
E-mail: mmvchem@sezampro.rs

INTRODUCTION

It is estimated that reserves of oil shale in Serbia amount to about **3 billion tons**, while the largest deposit (approx. 2/3 of total amount) for open-pit and underground exploitation is situated in the locality of Aleksinac in East Serbia. This deposit is not exploited at the moment. Shale from Aleksinac is an immature Oligocene-Miocene lacustrine sediment.

RESULTS AND DISCUSSION

Our lab researches relating to the "quality improvement" of raw shale from Aleksinac that have been made for more than 25 years are primarily aimed at obtaining the structurally unchanged concentrate of **kerogen** for fundamental organic geochemical investigation, with the potential application, which has become more popular nowadays. As "non-destructive reagents" we use **microorganisms** that for the carbon source do not use the organic substance of oil shale as substrate[1-5].



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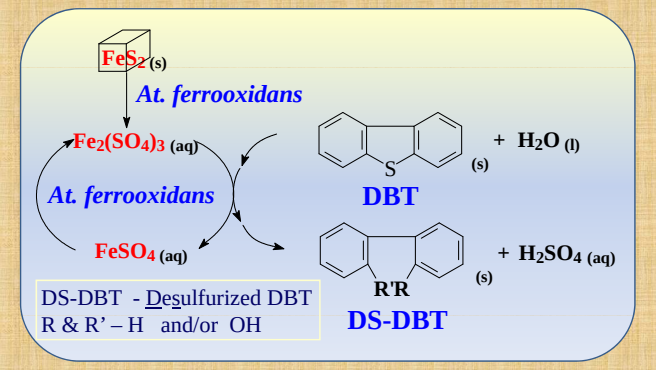
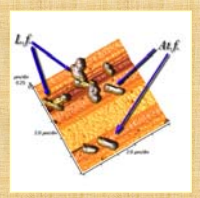


Hemolytotrophic acidophilic microbial strains in action on oil shale surface followed by ***A**tomic **F**orce **M**icroscopy* (AFM) [8].



Mixed culture of *Acidithiobacillus ferrooxidans* and *Leptospirilum ferrooxidans*

Pure culture of *At. ferrooxidans*

At. ferroxidans

CONCLUSION

The way to the application of microbial-bio(geo)technological methods for the purpose of obtaining oil shale of the improved quality as the source of energy and as an alternative liquid hydrocarbon fuel is long and hard, but certainly that should persist on it and work pursue to this goal with dedication and zeal.

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