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THE BLACK SEA PROBLEM – POSSIBLE SOLUTIONS

Abstract: The book The Black Sea problem – possible solutions presents authors research efforts in the field of cleansing hydrogen sulphide from sea basins as well as waste waters. It contents 3 chapters. First Chapter includes the history of the Black Sea, geological and geomorphological characterization and hydrogen sulphide formation. The second Chapter includes brief literature review of proposed methods for purifications and exploitation of the hydrogen sulphide from deep Sea waters. The third part presents the methods for solution of the Black Sea problem developed by the authors: (i) The Black Sea and Hydrogen Energy Economy - Electrolysis of H2S (production of hydrogen and sulfur); (ii) Electrochemical methods for concurrent (simultaneous) oxidation of H2S with reduction of O2 or SO2; (iii) Application of hydrogen sulphide in H2S-O2 fuel cells for Black Sea waters purging.

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The Black Sea problem – possible solutions [1]

INTRODUCTION

The Black Sea is an elliptical basin in the middle of the "Old World". The sea area is 123 000 km^2. The average depth is 1263 m suggesting a total volume of 534 000 km^3.

More than 7000 years ago the Black Sea was a fresh water lake. The level of the lake was about 100 meters lower than that of the world oceans. Due to the favorable climate a civilization developed in the vicinity of the lake the so called "Varna civilization". Close to the present city of Varna a necropolis was found with the oldest golden treasure on earth. This showed that the people living on the shore of the lake were technologically advanced.

Unfortunately the Varna civilization was destroyed 7200 years ago by an earthquake that breached the Bosporus and salty water from the Ocean flooded into the lake causing an ecological disaster along its coastline. This natural catastrophe is reflected in the ancient scriptures describing the Flood in the Bible and the testimony of Gilgamesh in the old Indian texts.

The consequences of this catastrophe are still apparently visible. Nowadays 90 % of the sea water is anaerobic. This sea water contains hydrogen sulphide, produced by sulphur reducing bacteria. The interface between anaerobic and aerobic water lies at depths of about 140 m at the centre of the Black Sea and about 250 m along its shoreline. The content of hydrogen sulphide, dissolved into the water increases steadily to a concentration of 8 $ml.l^{-1}$ at a depth of 1000 m below which it increases slightly to 8.5 $ml.l^{-1}$ at a depth of 2000 m. At the bottom of the sea the hydrogen sulphide concentration reaches 13.5 $ml.l^{-1}$. Hydrogen sulphide is still continuously being produced. The total sulphide production in the sediments of the sea is estimated to be 10 000 $tn.day^{-1}$. About ⅓ to ¼ of this amount is lost by chemosynthesis at the upper interface.

The increase of hydrogen sulphide concentration in the Black Sea poses a significant environmental problem. It reduces life in the Black Sea and may transform it into a dead sea.

Our intentions in compiling this book are: (i) to inform the public about the Black Sea problem; (ii) to explain the geological and biological history as well as the contemporary conditions of the Black Sea ecological system; (iii) to present our work describing possible methods that can be employed to cleanse the waters of the Black Sea from their hydrogen sulphide content.

The book is comprised of three chapters. Chapter 1 describes - The Black Sea – as a unique natural geo-bio-technological reactor which is written mainly by Dr. Dimitrov. He presents the literature overview as well as his own studies.

Chapter 2 is our attempt to describe all the methods presented in the literature. Indeed there are so many papers, patents and communications, that the task is almost impossible. Unfortunately, we have clearly missed some works, which we sincerely regret.

Chapter 3 includes our work on possible methods to cleanse the hydrogen sulphide content from Black Sea waters. It starts with the initial idea of Prof. K. Petrov to utilize hydrogen sulphide as a source of hydrogen. Two methods for concurrent oxidation of H_2S with reduction of O_2 or SO_2 are described. Our recent studies on fuel cells using H_2S are presented at the end.

The overall conclusion considering the methods presented is that they are viable and there are no technical obstacles to affect their realization in practice. All the necessary equipment, appliances and installations are readily available on the market. There are no technological difficulties in building the proposed installations intended to purge the hydrogen sulphide from the depths of the Black Sea. In addition, valuable products such as sulfur, polysulphides, metal salts and water for irrigation are also attainable. The ecological effect of these processes is obviously advantages for the future of mankind.

CONCLUSIONS

Several catalysts have been tested for the anodic oxidation of sulphide to sulfite and sulfate. The electrodes prepared with CoPc and perovskite ($La_{1.3}Ni_{0.7}SrO_4$) have been optimized and showed appropriate electrochemical characteristics. The influence of temperature and HS^- concentration has been revealed.

The performance of a newly developed sulphide driven fuel cell has been tested and proven using optimized electrodes and conditions. The H_2S/O_2 fuel cell was found to exhibit reasonable current

densities at room temperature and low HS^- concentrations, and has reached reasonable current densities due to sulphide to sulfite and sulfate oxidation without electrode poisoning.

Bases on these results we go further and propose the design of a practical fuel cell, applicable in the field based on sulphide to sulfate oxidation in liquid media at room temperatures.

OVERALL CONCLUSION

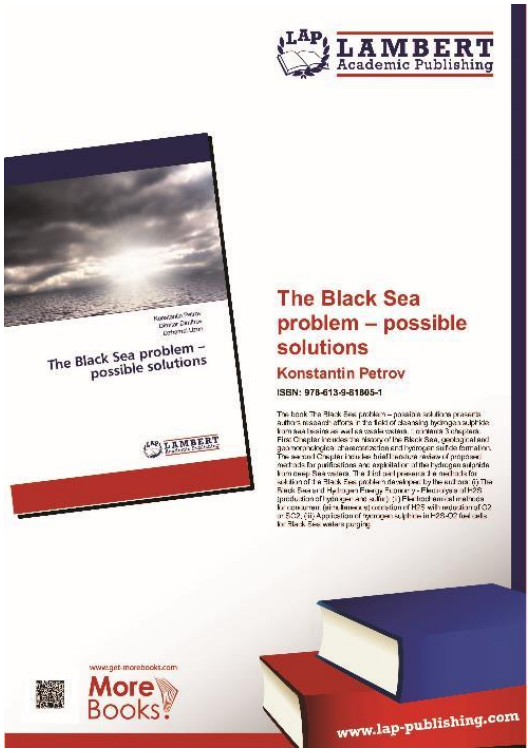
Most of the methods presented are applicable and there are no technical obstacles in their realization. All the necessary appliances and installations are available at the market. There are no technological difficulties in building the proposed installations intended to purge the hydrogen sulphide from the depths of the Black Sea. In addition, valuable products such as sulfur, polysulphides, metal salts and water for irrigation are also attainable. The ecological effect of these processes is obvious.

The only problem is the high cost required for the initial investment and the need for financial support from the governments of the Black Sea countries, the European Union and other organizations. Such intentions have been considered and accepted.

In 1992, the Black Sea countries signed the (Bucharest) Convention on the Protection of the Black Sea Against Pollution and its three Protocols on Land-Based Sources, dumping and cooperation in emergency situations. Pending the enforcement of the Convention/related Protocols and the establishment of the Permanent Secretariat of the Black Sea Commission to facilitate their implementation on the regional scale, the coastal countries decided to launch the Black Sea Environmental Programme *(BSEP)* in 1993.

To begin with, a system for monitoring and study of the processes in the Black Sea needs to be built in similarity of that existing in the North Sea. In the North Sea this was done in order to safeguard oil extraction.

We must protect the life habitat in the Black Sea region!



Marketing material [1]

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References:

1. Petrov K., D. Dimitrov, D. Uzun. 2018. The Black Sea problem – possible solutions. LAP LAMBERT Academic Publishing. ISBN: 978-613-9-81805-1, 112 p. https://www.morebooks.de/store/gb/book/the-black-sea-problem-%E2%80%93-possible-solutions/isbn/978-613-9-81805-1 https://www.researchgate.net/publication/327395601_The_Black_Sea_problem_-_possible_solutions