НАУЧНЫЙ ЖУРНАЛ
НАУКА И МИРОВОЗЗРЕНИЕ

УДК-553

POSSIBILITIES OF OBTAINING HUMIC ACID FROM COAL, A NATURAL RESOURCE OF TURKMENISTAN

Ryzayev Kerim
Supervisor: Dean of Chemical and Nanotechnologies faculty of Oguz han Engineering and Technology University of Turkmenistan
Ashgabat, Turkmenistan

Shemmedov Dovletgeldi
Student of Oguz han Engineering and Technology University of Turkmenistan
Ashgabat, Turkmenistan

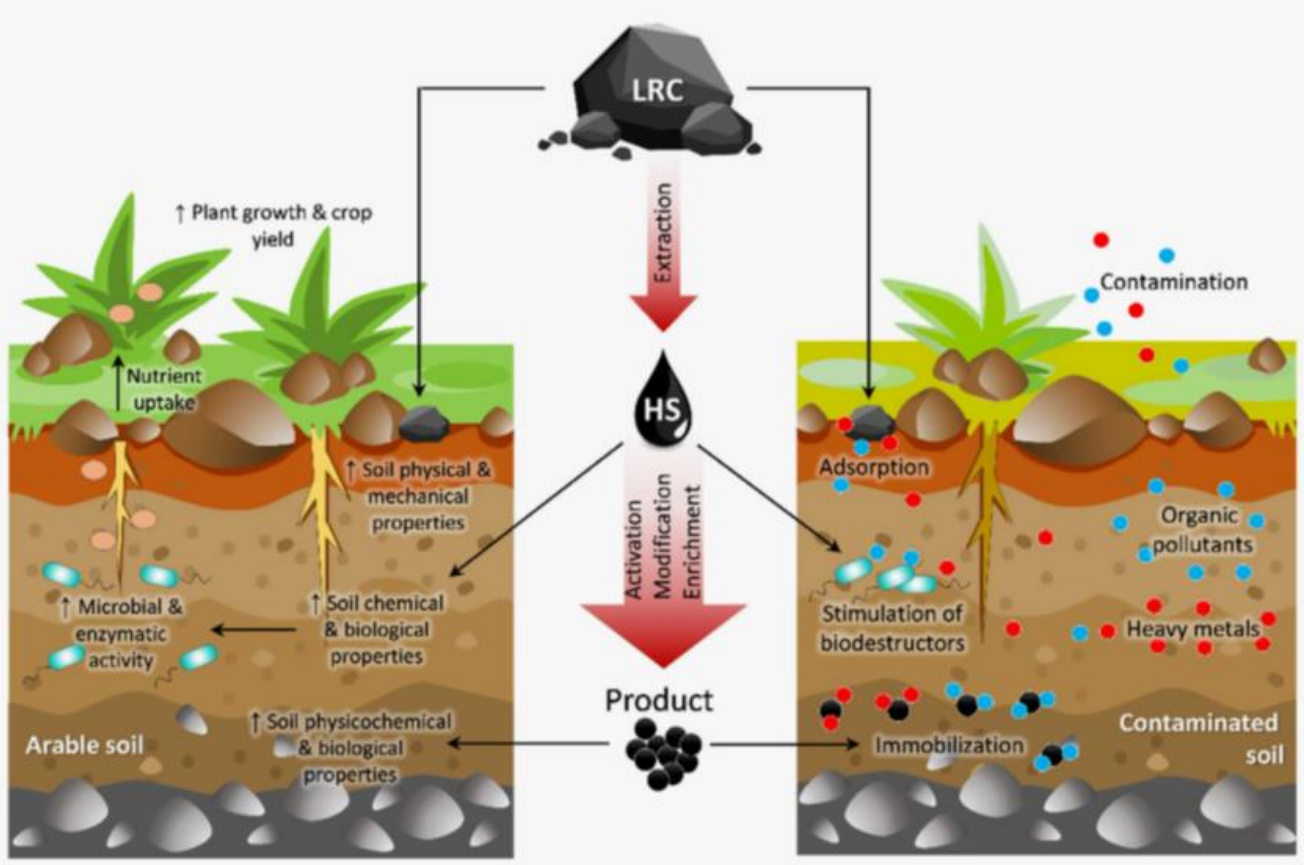
Abstract: Humic acid, a complex mixture of organic compounds, is widely recognized for its potential applications in agriculture, environmental management, and industry. One of the promising sources of humic acid is coal, a natural resource abundant in Turkmenistan. This article explores the possibility of obtaining humic acid from coal, focusing on the methods of extraction, challenges, and potential applications of humic acid derived from Turkmenistan's coal deposits. The study emphasizes the environmental and economic benefits of utilizing coal as a source of humic acid in the context of sustainable development. It also discusses the various industrial and scientific advancements in the extraction technologies, the economic impact of utilizing humic acid in agriculture and industry, and the long-term sustainability of this resource extraction.

1. Introduction Humic acid is a major component of humic substances, which are naturally occurring organic materials found in soil, peat, coal, and water. It plays a vital role in soil fertility, water retention, and nutrient cycling, making it indispensable for sustainable agriculture and environmental management. The extraction of humic acid from coal has become an important research area due to the high concentrations of organic materials present in coal, especially lignite and bituminous coal types. Given Turkmenistan’s substantial coal reserves, particularly in the Akhal, Mary, and Lebap regions, the potential for utilizing coal for humic acid extraction could significantly contribute to the country's economy and its environmental sustainability goals.

This article explores the various methods of extracting humic acid from coal, focusing on Turkmenistan’s natural coal resources. It also examines the potential applications of humic acid, the economic benefits it could bring, and the environmental considerations associated with its extraction. In addition, it discusses the challenges facing the industry and the technologies that need to be developed to make the extraction process more efficient and sustainable.

2. Coal Reserves in Turkmenistan Turkmenistan is home to vast coal deposits, with estimated reserves of over 5 billion tons, making it one of the most coal-rich countries in Central Asia. The largest deposits are concentrated in the regions of Akhal, Mary, and Lebap. These deposits are primarily lignite and bituminous coal, which are rich in organic matter that is essential for the production of humic acid.

The country has been predominantly utilizing its coal for energy production, with several thermal power plants operational across Turkmenistan. However, there is growing interest in exploring alternative uses for coal, particularly in the extraction of humic acid. This not only provides an opportunity for additional economic gains but also contributes to environmental management efforts by turning waste products into valuable resources.



Turkmenistan's coal reserves are not only significant in terms of quantity but also in their chemical composition, which makes them suitable for the extraction of humic substances. The presence of rich organic compounds in the coal matrix enhances the possibility of obtaining high-quality humic acid that can be utilized in various industries such as agriculture, wastewater treatment, and even pharmaceuticals.

3. Methods of Extracting Humic Acid from Coal The extraction of humic acid from coal is a multi-step process that typically involves several chemical and physical treatments to break down the complex organic matrix of the coal. Several methods have been developed to extract humic acid, and the choice of method depends on factors such as the type of coal, desired purity, and economic feasibility.

- **Alkaline Extraction**: This is the most common method used for extracting humic acid from coal. It involves treating the coal with an alkaline solution, typically sodium hydroxide (NaOH) or potassium hydroxide (KOH). The alkaline treatment breaks down the coal's organic components, releasing humic acid into the solution. The humic acid is then isolated by precipitating it with an acid, such as hydrochloric acid (HCl), to neutralize the alkaline solution. The precipitate is filtered, purified, and dried to obtain the final product.
- **Acidic Extraction**: Acidic extraction methods involve the treatment of coal with strong acids, such as sulfuric acid (H2SO4) or nitric acid (HNO3). This method dissolves the organic material in coal, releasing humic acid and other humic substances into the solution. After neutralization and purification, the humic acid is separated from other components. Acidic extraction methods can provide higher yields of humic acid, but they may require more stringent handling and disposal procedures due to the use of corrosive chemicals.
- **Hydrothermal Extraction**: This method involves treating coal with water under high pressure and temperature conditions. Hydrothermal extraction utilizes the natural ability of water to break down complex organic compounds in coal. This method has shown promise in extracting both humic acid and fulvic acid, another important class of humic substances. While it can be more energy-intensive than alkaline or acidic extraction methods, it can result in higher yields and purity of humic acid.
- **Solvent Extraction**: Solvent-based methods use organic solvents, such as ethanol, methanol, or acetone, to dissolve the organic materials in coal. This method can be effective for extracting humic acid and other humic substances, particularly when the coal is difficult to treat with alkaline or acidic methods. However, the use of solvents requires additional purification steps to remove solvent residues from the final product.
- **Supercritical Fluid Extraction**: In recent years, supercritical fluid extraction has emerged as an innovative method for obtaining humic acid. This technique uses supercritical fluids, such as carbon dioxide, to extract humic substances from coal. It offers a more environmentally friendly alternative to traditional methods, as it does not require the use of harsh chemicals. However, supercritical fluid extraction is still in the experimental phase and requires further research to optimize its efficiency and economic viability.

4. Applications of Humic Acid Humic acid has a wide range of applications across several industries due to its beneficial properties. The following are some of the key uses of humic acid derived from coal:

- **Agriculture**: Humic acid is commonly used as a soil conditioner, fertilizer, and growth stimulant. It enhances soil fertility by improving the structure, water retention, and nutrient availability of the soil. Humic acid can also help in neutralizing soil pH, making it more conducive for plant growth. It stimulates root development, enhances the uptake of essential nutrients, and promotes plant growth, making it an essential component of sustainable farming practices.

- **Environmental Management**: Humic acid has several environmental applications, particularly in the reclamation of degraded soils and water. It is used in land restoration projects, where it helps to improve soil quality, enhance water retention, and promote plant growth. Additionally, humic acid has been shown to help in the removal of heavy metals and other pollutants from contaminated water sources, making it valuable in wastewater treatment processes.
- **Industrial Uses**: Humic acid is also used in industrial applications, such as in the production of concrete. It acts as a plasticizer, improving the workability and strength of the material. It is also used in the oil and gas industry, where it binds with heavy metals and other substances, aiding in the removal of impurities from crude oil. Humic acid is also utilized in various chemical processes, including the synthesis of fertilizers, pesticides, and other agricultural chemicals.
- **Pharmaceutical Applications**: Humic acid has shown promise in the pharmaceutical industry, particularly in the treatment of gastrointestinal disorders. Studies have suggested that humic acid has anti-inflammatory, antimicrobial, and antiviral properties, making it a potential treatment for a variety of conditions. Its ability to enhance immune function and improve gut health has sparked interest in its use as a natural supplement in the healthcare industry.

5. Environmental and Economic Benefits The extraction of humic acid from coal presents several environmental and economic advantages. Some of the key benefits include:

- **Sustainable Resource Use**: By extracting humic acid from coal, Turkmenistan can diversify its use of this natural resource, reducing reliance on coal for energy production alone. This approach not only adds value to coal but also contributes to the sustainable management of the country's natural resources.
- **Waste Minimization**: Coal extraction and processing typically produce large amounts of waste materials, such as ash and slag, which can have harmful environmental effects. By extracting humic acid, the waste generated during coal mining can be reduced, and the final product can be utilized in environmentally beneficial applications, such as soil enhancement and water treatment.
- **Economic Growth**: The commercial production of humic acid can contribute significantly to Turkmenistan’s economy. The extraction process can create jobs in the coal mining and processing industries and stimulate growth in sectors such as agriculture, environmental services, and industrial manufacturing. Furthermore, humic acid can be exported, providing a new source of revenue for the country.

6. Challenges and Limitations While the extraction of humic acid from coal holds great promise, there are several challenges that need to be addressed:

- **Economic Feasibility**: The processes involved in extracting humic acid can be costly, particularly when using high-temperature or high-pressure methods.

The economic feasibility of these processes needs to be carefully evaluated to ensure that the extraction of humic acid is commercially viable and competitive with other sources of humic substances.

- **Environmental Concerns**: Although extracting humic acid from coal may reduce waste, the environmental impact of coal mining must still be considered. Coal mining often results in habitat destruction, water contamination, and air pollution. To ensure the sustainability of humic acid extraction, it is important to implement responsible mining practices and mitigate the environmental impact of coal extraction.
- **Technological Advancements**: Continued research and development are necessary to optimize the extraction processes and improve the yield, purity, and environmental sustainability of humic acid production. New technologies, such as supercritical fluid extraction, may provide more efficient and environmentally friendly alternatives to traditional methods.

7. Conclusion The extraction of humic acid from coal in Turkmenistan offers a promising opportunity to make use of the country's abundant coal reserves in an environmentally sustainable manner. Humic acid has a wide range of applications, from agriculture to environmental management and industrial use. However, addressing the challenges of cost, environmental impact, and technological development will be key to unlocking the full potential of this valuable resource.

Literature:

1. Sposito, G. (2008). *The Chemistry of Soils*. Oxford University Press.
2. Tan, K. H. (2014). *Humic Matter in Soil and the Environment: Principles and Controversies*. CRC Press.
3. Castro, R. M., & González, J. (2009). "Humic substances from coal: A review of their characteristics and applications." *Energy Sources*, 31(11), 1000-1010.
4. Tomczyk, A., & Boguta, P. (2015). "The use of humic acids for improving soil quality." *Agricultural Sciences*, 6(5), 1725-1732.
5. Singh, S. K., & Mishra, R. (2012). "Extraction of humic acid from coal: A sustainable approach." *International Journal of Environmental Science and Technology*, 9(2), 195-202.