

CURRENT STATE IN COAL CHEMISTRY INVESTIGATION AND ITS USE AS BASIS FOR ENERGY SECURITY

Muzafar Isobaev,
Prof.,Dr. , Head of Organic
Synthesis Lab., Institute of
Chemistry Academy of Sciences,
Republic of Tajikistan



Purpose to conduct investigation in the area of Coal Chemistry & Energy Security

There are several ways to achieve energy security in Tajikistan.

- a) Develop the hydro power.
- b) Alternative and renewable energy sources.
- c) Implementation of Coal.

The last point is more realistic to current economic situation in Tajikistan.

The presentation contains main research achievements in development of ecologically clean coal utilization technologies.



•1

•Proven coal reserves in Tajikistan amount is about 4.3 billion tons of potential coal resources, of which 320.3 million tons are recoverable reserves, including high-quality coking coal deposits Fan Yagnob and anthracite mine Nazar Aylok.

•2

•Gasification of coal, along with the burning of coal in a coal-water mixture and a number of other technologies can significantly reduce the impact of massive use of coal for domestic and industrial purposes.

•3

•However, the problem of disposal of the products of thermal decomposition of coal is not the solution to the end and requires special attention. The emission of direct coal burning contains more than 200 chemical substances. The core part of them is very toxic.

•4

•The priorities, include water cleaning process during coke production, in order to separate contained impurities of organic acids, including phenol and its isomers.

•5

•There is a scientific interest related to toxic substances, such as tar and volatile acids and bases. Tested approaches to these problems are discussed in the presentation. In addition to issues related to the solution of environmental problems, we successfully promote technology liquefaction of solid fuels.

•6

•Using this directions it is suggested to prepare of high pure "syngas." This technology is allows to conduct the process at significantly lower temperatures in comparison with nowadays technologies.

•7

•For the energy efficiency of existing gas production is proposed to use the joint thermal decomposition of coal and secondary carbonaceous feedstock.

•8

•The significant indicator of coal revolution in Tajikistan is a construction of big Heat/Energy power station in Dushanbe, which will use coal of «Zyddi» mining.

HISTORY AND SCIENTIFIC DIRECTIONS



- The investigation on coal chemistry begun in 1946 when the Institute of Chemistry AS RT was established.
- Preliminary results were related to establish the petrographic composition of Fan-Yagnob mine – one of the biggest in Central Asia.
- Currently the institute is conducting research related to gasification of ash rich coal, developing technology of obtaining pure syngas and coke chemistry.

The results which are leading to energy security

- Determination of more effective coal burning. It could be: conversion of coal to cokes with separation of cokes gas
- Burning coal in the aerosol and water/coal emulsion ovens.
- One of such type of aerosol ovens you can see at the next slide.
- Preliminary results showed that prepared coke is replied to regulation of GOST and contained less than 5% water and ash about 7%.

- Technical conditions of producing coke from the Fan-Yagnob coal and its composition:

Temperature: 950°C,
anaerobic conditions.

Separated products:

- Coke gas 3.8- 13.5%
- Crude benzene 0.5-1%
- Coke 75-84%

Recommendations regarding producing coke

- The Institute of Chemistry AS RT has calculated the possibility of building the cokes-chemical enterprise
 - ▣ Calculation pointed that Fan-Yagnob coal sources would be enough for more than 100 years to cover the needs of metallurgy plant having annual productivity equal to 2 ml. tonnes.
 - ▣ The investigation showed that Fan-Yagnob coals should be used only for coke production.
 - ▣ Burning process for energy needs can be an exception only
 - Gasification of these kind coals is possible but not recommended. Unfortunately, currently Fan-Yagnob coal is used for gasification by TALKO – Tajik aluminum Company
 - For increasing economic profit the hydrogen cokes gas should be directed to a synthesis of ammonium and

Deep processing of coal



- The orientation of coal industry to coke production is one of the main ways to achieve energy security, which has additional contributions such as:
- Implementation of clean close cycle technology with exception of emission toxic volatile substances. In this way additional processing of separation volatile substances, organic acids and bases, coke gas, coal tar and other accompanying organic substances should be developed.
- Deep processing of coal opens a way to prepare high quality technical sorbent to defend the environment , receiving wide list of individual organic reagents, calcium carbide and many different commercial products.
- Some examples of new approaches related to this aspect could be a subject of ISTC project.

Generated gas

- Currently in Tajikistan production of gas from coal can be named as “Generated Gas” . Energetic base of this gas is composition of mixture of CO and H₂.
- Scheme of production:
 - ▣ By the way of passing air through hot coal or coke in the special ovens.
 - ▣ The next step is carbon oxide mixes with the water vapor with production of hydrogen.
 - $\text{CO} + \text{H}_2\text{O} = \text{H}_2 + \text{CO}_2$.
 - ▣ Yield from the coke 4,65 м³/кг. Efficiency is 65–70 %.
- Main lack: low heat capacity 800–1000 kcal/м³
- The goal of conducting research: Investigation of possibility join of termolysis of coal with carbon containing industrial waste to increase total yield of generated gas. This will give us a chance to have high heating capacity

Composition of high ashen coal of “Zyddi” mining»

- The separation process during thermolysis at 600°C yields :
 - Up to 19% burning gases,
 - 2.6% tar mass,
 - 8% absorbed water
 - 5% volatile acids and bases.
- Below are valuable products, which can be obtained from coal during its processing.
- Pre-allocation of humic acid significantly reduces emissions of toxic substances.

Coal absorbers from the “Zyddi” and “Fan-Yagnob” mining



Absorbent «Zyddi»
0.56- 1 MM



Absorbent «Zyddi»
1- 2 MM



Absorbent «Fan-Yagnob»
0.56- 1 MM

- The adsorption capacity of the final product depends on the degree of grinding of the starting material and the coal ranges from 25% to 54%.
- Adsorption capacity of produced sorbents are higher than bentonite deposits (0.02-0.07%) , which are currently used in Tajikistan.

Humic acids prepared from the “Fan-Aygnob” mining



Water solution of
ammonium gummat




Individual humic acids

- Humic acids have an ability to accumulate 90% of Nitrogen, approximately half of phosphorus and sulphur, different kinds of microelements.
- After usage of humic acids in agriculture, the productivity of plants is increased by 15-30 %.

Alternative hydrocarbon energy sources obtained by thermolysis of solid waste

Description of materials	Gas output in the thermolysis	Heat Producing Capacity Kcal/m ³
Polyethylentereftalate	276 L/Kg	14330
Coke Gas (Zyddi mining)	260 L /Kg	3950
Generate Gas		800-1000
Acetylene	-	13590

Conclusion

- 
1. Based on the results of coal studies, the scope of effective coal use as an energy feedstock should be based on environmentally sound technologies:
 2. Processing of coke coal deposit "Fan Yagnob" should be considered as the most efficient
 1. Use of the coke oven gas for industrial purposes/businesses is more efficient than gas generator and exceeds its capacity for almost 4 times
 2. For high ash coal we recommend to start producing adsorbent for the wastewater purification from motor oils and heavy metals
 3. It should be considered that alternative hydrocarbon energy sources, which are used as additives in the thermal decomposition of coal gasification increases the heat production capacity of generated gas.

Спасибо, за внимание
Thank you

