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INVESTIGATIONS IN THE FIELD OF OIL SHALE PYROLYSIS IN THE INSTITUTE OF CHEMISTRY OF THE ESTONIAN ACADEMY OF SCIENCES

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Studies on oil shale thermal decomposition were of great importance in Prof. A. Aarna's research work. Our reader can find a survey of these studies, a republication of his article from 1954 "Isothermal decomposition of Baltic oil shale" in this issue.

Prof. A. Aarna's pupils carried on his studies on kukersite genesis, chemistry, structure, thermal decomposition and utilization of the products of kukersite pyrolysis. In this field of oil shale chemistry sixteen chemists have defended their theses for candidate's degree (Ph. D.) under the supervision of Prof. A. Aarna: E. Lippmaa, Ye. Petukhov, V. Yefimov, E. Piik, Ü. Lille, K. Urov, L. Mölder, A. Rätsep, J. Soone, J. Teder, H. Silland, E. Rikk, T. Kaps, R. Soidra, K. Kiis, Yu. Zhiryakov.

Professor A. Aarna was a great scientist, widely known as a excellent teacher, brilliant lecturer and skilled man of letters.

Many of his students became well-known scientists, acknowledged industry specialists, and even politicians. Prof. I. Klesment, one of his successors, founded the laboratory of oil shale geochemistry at the Institute of Chemistry of the Estonian Academy of Sciences. In the present department of oil shales and shale oil, researches on oil shale chemistry are supervised by Prof. L. Mölder and Dr. K. Urov. They both were Prof. A. Aarna's postgraduate students.

Dr. K. Urov leads the research group which deals with the elucidating of the mechanism of oil shale pyrolytic decomposition, determination of the chemical composition of pyrolysis products, and fundamentals of oil shale industrial processing. One may distinguish the following fields and methods of research carried out by this group:

1. Geochemical characteristics of oil shales applying thermal decomposition method.

2. Composition of oil shales: yields of their thermal decomposition products during retorting (Fischer Assay).

3. Dependence of the thermal decomposition process on the mineral part of oil shale.

4. Mechanism of this decomposition process, studied by different methods (retorting in vacuum, in the presence of different gases, etc.).

5. Secondary reactions occurring during final stages of retorting.

Geochemical characteristics of different oil shales have been studied for many years. A large number of shales from various deposits have been investigated, and a complex scheme for these investigations has been worked out. Thermal decomposition is one of the basic methods of this scheme.

Besides geochemical aspects, oil shales were investigated considering their possible role as a perspective raw material for producing artificial liquid fuel.

The results of an extensive work - data characterizing different oil shales and similar rocks from different deposits and outcrops - are presented in the monograph "Characteristics of oil shales and shale-like rocks of the known deposits and outcrops" (K. Urov, A. Sumberg). This monograph includes the data of technical analysis of shales: content of organic and mineral matter, yields of bitumen and other products of thermal decomposition. Oil shale samples from 100 different deposits from all over the world through all geological ages from the Neogene to the Vendian were analyzed.

These data form a basis for evaluating the quality of oil shales from different deposits from the point of view of their industrial processing and enable to find possible correlations between different indices of oil shales.

For studying the influence of oil shale mineral part on the decomposition process also the standard Fischer Assay has been used.

It is obvious that mineral matter has an effect upon the properties of oil shale organic part already on the stage of the caustobyolith formation. Our data demonstrate that carbonates may promote the accumulation and preservation of organic matter in oil shales during their maturation stage. Such oil shales usually have a high oil potential. Oil shales containing clay minerals are poorer in organic matter and, as a rule, have a low oil potential. We have demonstrated that the effect caused by mineral matter does not depend only on its share and composition but is influenced by the properties of organic matter as well. The same mineral matter may effect on the decomposition of kerogen of different oil shales in different ways.

Besides the methods cited above also some others, such as retorting in vacuum, in the flow of various carriers (gases or steam), high-rate pyrolysis, etc. have been used. Basing on the collected data, the mechanism of thermal decomposition of oil shale kerogen has been proposed (K. Urov). It assumes the formation of high-molecular products during primary reactions. These products are absorbed on the surface of oil shale mineral matter where they undergo deeper catalytic decomposition with the formation of lighter liquid products, coke and gases. A more detailed study of secondary reactions which occur during the final stages of retorting helps to explain the mechanism of the thermal decomposition process. The corresponding studies (K. Urov, I. Blyakhina) have demonstrated that every shale has its own characteristic temperature after which the oil yield, on kerogen basis, does not increase any more although

the gas formation continues also at higher temperatures. Retorting of shales is not expedient at temperatures exceeding this characteristic one as in this case the elevated consumption of energy for heating the shale does not lead to improved quality of volatile compounds.

This short review does not reflect the real volume of research carried out by one group of the department of oil shales and shale oil. Nevertheless, we hope that it gives an outline of scientific activities started by Academician Agu Aarna and continued by his successors. The successful realization of his fruitful ideas is the best memorial to an eminent scientist.

Presented by K. Urov
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