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AN OIL SHALE CONFERENCE IN AUSTRALIA

The Sixth Australian Workshop on Oil Shale was held in Brisbane, Queensland, Australia, on December 5—6, 1991. The seminar took place in the University of Queensland. About 40 papers on various aspects of oil shale science were presented and discussed. Besides Australian oil shale specialists, representatives of the U.S.A., Japan, New Zealand, Jordan and Estonia took part in the forum's work.

It is quite natural that papers dealing with Australian oil shales and their processing predominated.

The interest in utilizing considerable oil shale resources of Australia is caused by a decline in indigenous oil reserves and the necessity to import an increasing proportion of its crude requirements. Potential shale oil reserves in the major deposits of Queensland are estimated to be about 5 billion tons. Efforts are being made towards constructing the first oil shale processing plant based on oil shale from the Stuart deposit. There is also a project concerning the Rundle oil shale deposit. Above all, Southern Pacific Petroleum N.L. and Central Pacific Minerals N.L. are committed to the development of Queensland's oil shale. These companies in conjunction with co-venturers have accomplished most of the preparatory work necessary for the industrial development of oil shale reserves and processing the shale. At present, some other companies are also involved in oil shale activities.

Processing of oil shale and upgrading of the oil obtained may be considered one of the main topics discussed (in total 24 papers), both fundamental and technical aspects being under review.

As in earlier works by Australian oil shale chemists and technologists, considerable attention was paid to the problems of the influence of mineral compounds on the thermal destruction of kerogen (H. J. Hurst, J. H. Levy, J. H. Patterson a.o.). The catalytic effect of clays and siderite on this process has been demonstrated, it leading to reduced oil yields and aromatization of oil.

The Queensland oil shales being rich in clay minerals (montmorillonite, kaolinite, etc.), the presence of these compounds can influence and indeed does influence the yield and composition of thermolysis products. The yield and quality of oil are to a great extent determined by the ratio of clay minerals to kerogen, both in MFA and solids recycle retorting (A. J. Gannon, A. W. Lindner). It is interesting to note that various mineral additives not only alter the yield of oil but also cause an increase in the ratio of external to internal alkene protons in the oil, this being in contrast with the action of typical cracking catalysts (H. R. Rose a.o.). At the same time, the abundance of *n*-1-alkenes is often interpreted as an indication of a predominantly primary character of oil and a limited scale of isomerization reactions. Indeed, due to the lower influence of the mineral matrix and the greater velocity of evacuation of volatile substances from the hot zone, the role of secondary cracking reactions is expected to diminish with increasing shale grade and, hence, the prevalence of external alkenes. The dominance of *n*-1-alkenes over *n*-alkenes with a different position of the double bond in the chain is typical of most shale oils, at least those obtained by Fischer Assay.

The mineral oil shale components undergo remarkable changes during retorting and this is to be taken into account when interpreting the data obtained. It has also been established that these mineral reactions may be used to control sulfur emission (it is possible to retain up to 95 % of initial sulfur in spent shale). An interesting fact has been established that sulfur dioxide emission in the process of spent shale combustion is to a great extent the result of the reaction of pyrite with the steam produced from moisture and clay water, partially via hydrogen sulfide (R. G. Benito, N. V. Dung). In the Institute of Chemistry, Estonian Academy of Sciences, the same process up to the stage of hydrogen sulfide formation has been shown to occur during the retorting of shales, while the shale free moisture and clay bound water, as well as the water resulting from kerogen thermal destruction take part in the reaction.

The research results obtained by Australian and Estonian scientists are also in accord in respect of the effect of drying the shale prior to its processing on oil yield. Still, it seems that the oil loss is brought about not only by organic matter oxidation on drying but also by the water taking an active part in oil formation, its hydrogen being largely incorporated into the oil compounds (it has been established by using D_2O).

Specific effects are observed when oil shale is heated by microwave energy (D. H. Bradhurst). Various shales differ among themselves in their receptivity to microwave heating, and this is thought to depend on the mineralogical composition of their inorganic part as well as moisture content. It has been demonstrated that in the case of Kerosene Creek shale, Stuart deposit, the inclusion of a microwave-retorting stage to a shale processing plant results in higher quality shale oil in comparison with conventional thermal processing oil containing larger percentages of lighter fractions and less sulfur.

A series of investigations have been carried out on the mechanism and technique of coking processes with particular emphasis on shale oil. Development of models for coking shale oil vapours over shale ash by N. Dave, P. H. Wallmann and co-workers, a study of the coking and cracking of a heavy oil derived from Stuart shale by P. Udaja a.o., an investigation of the properties of pyrolyzed, gasified and combusted shale to induce coking reactions by S. D. Carter and colleagues are to be mentioned here. Processing oil shales with heavy oil recycle in order to crack oil to lighter fractions has also been studied (N. V. Dung a.o.).

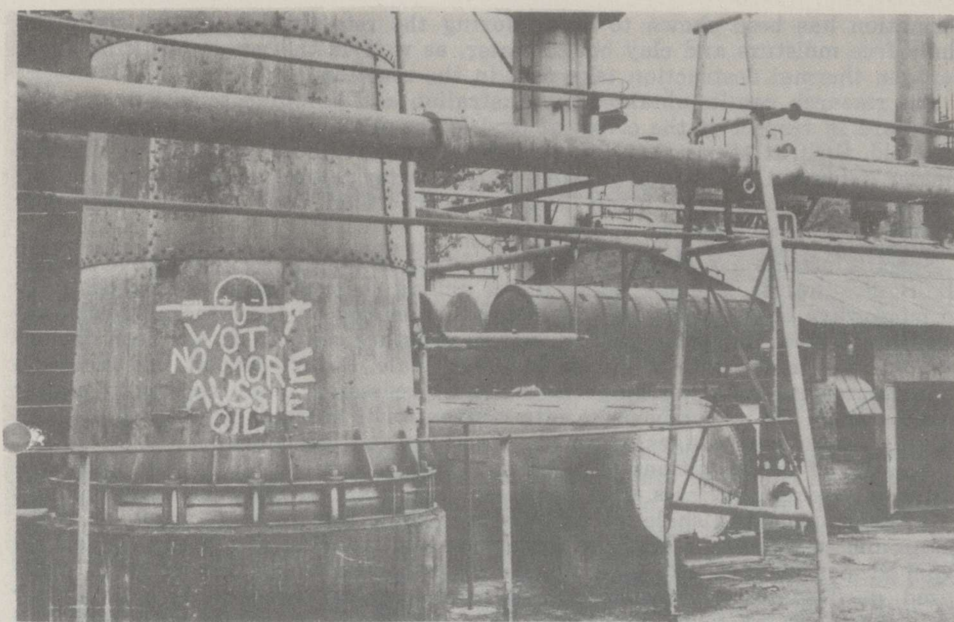
Somewhat lesser attention was devoted to shale oil upgrading problems. It has been established that hydrotreatment of the Stuart shale oil as two separate fractions can afford fully refining-acceptable products and the conditions required are significantly milder than those for total oil hydrotreatment (C. F. R. Fookes a.o.). A good review of the data available on the shale oil instability has been compiled by A. Zuhdan Fathoni and B. D. Batts.

The papers presented in the geology and mining section were of more heterogeneous nature, their scope extending from thorough researches by R. G. McIver and colleagues on the geological evolution and stratigraphy of the Stuart and Rundle oil shale deposits, as well as the study on the stratigraphy and mineralogy of Nagoorin South deposit to a detailed investigation into the carbon-sulfur chemistry of Devonian shales of Eastern Kentucky, U.S.A. (T. Robl a.o.).

Though the average population density in Australia is only about 2 persons per sq km and the average industry concentration is therefore also relatively low, keen attention is attributed to environmental aspects of industry developments, including oil shale utilization projects.

Several reports concerning environment protection problems were included in the workshop program with a special emphasis of wastewater management and the influence of shale processing on ground water quality. The water generated by the Stuart Oil Shale Project will be primarily treated by using oil-water separator followed by steam stripping (to separate volatile compounds such as ammonia, hydrogen sulfide a.o.), and subsequently by a combined use of adsorption (by a mixture of mining waste and shale ash) and biodegradation (A. Krol and colleagues). Problems related to waste products seem to be of a considerable importance for development of the Stuart shale reserves as it "will take place within a national climate which is particularly sensitive to potential environmental impacts associated with development and processing of primary resources" (S. Coomb a.o.). Of no doubt, Australia's unique environment must be well protected and there seem to be possibilities, means and good will to meet this challenge.

And last but not least, it must be noted that the Workshop was excellently organized and carried out, every support and assistance being given to participants, especially those from other continents.



The final closure of Glen Davis in 1952 due to technical difficulties, labour disputes, and cheap imported oil

The relationship between Estonian and Australian oil shale industries has its history. Glen Davise's project (in the picture) was completed in Tallinn in 1937. The equipment was planned under the direction of Prof. Petr Michailovits Schloumov, technical manager of Franz Krull's machine-building factory. The project was modelled after the Estonian shale-oil company Kiviõli oil plant. (One of the designers was Oil Shale's chief editor Ilmar Öpik who was studing at Tallinn Technical University.)

Operations at Glen Davis commenced in 1939. The plant produced about three per cent of Australia's petrol requirements during the war. With the end of the war the plant's usefulness was outlived; it was closed and dismantled in 1952.