Sand Separated from Athabasca Tar Sand (Canada) by Solvent Extraction

Ryoichi YOSHIDA,*,[1)] Takeshi OKUTANI, Katsuyoshi SHIMOKAWA, Yasuko IKAWA,** Yousuke MAEKAWA, Kohei KODAIRA,** and Yuji YOSHIDA

Government Industrial Development Laboratory, Hokkaido, Sapporo 061-01

***Department of Applied Chemistry, School of Engineering, Hokkaido University, Sapporo 060*

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Synopsis. The nature of the sand separated from Athabasca tar sand (Canada) by solvent extraction was examined. The existence of α-SiO_2 was confirmed by X-ray analysis. By DTA-TG determination, the occurrence of displacive transformation from low quartz to high quartz at 573±1 °C was proved, this coincides with the results obtained by means of X-ray analysis.

The amount of synthetic crude oil extractible from Athabasca tar sand is estimated to be roughly comparable with the total recoverable oil reserves in the Middle East.[2)] However, an inorganic matter, sand, constitutes 87—89 wt % of the tar sand.[3)] Consequently, if the tar sand is used as a source of petroleum in the near future, the treatment and/or utilization of the sand will be of great importance.

Hereby reported are the results of an examination of the nature of the sand separated from Athabasca tar sand by solvent extraction.

Experimental

Preparation. The procedure and apparatus employed for the extraction were the same as those used previously.[3)]

Measurements. The benzene-insoluble residue (sand) was observed under an optical microscope. X-ray fluorescence analysis and X-ray powder diffraction were carried out on the sand. Simultaneous DTA-TG determination was carried out with a sample weight of 61.7 mg at a heating rate of 10 °C min^{-1}.

Results and Discussion

Athabasca tar sand was extracted with hexane and benzene in steps.[3)] The yield of the sand (benzene-insoluble matter) was 87.6—88.5 wt.%, which is almost equal to the ash content of tar sand, 87.2 wt.%, as determined by a high-temperature ashing technique (815 °C).

The color of the sand after solvent extraction was brownish white, but it proved to be transparent upon

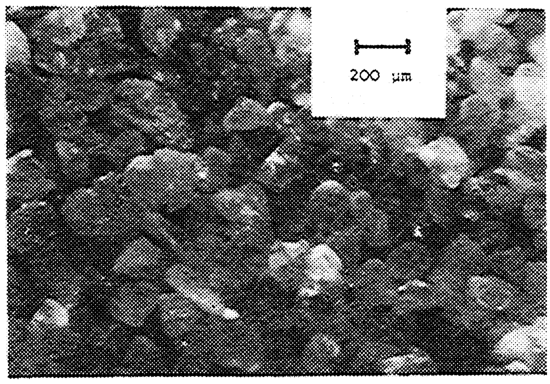

Fig. 1. The sands after washing with water.

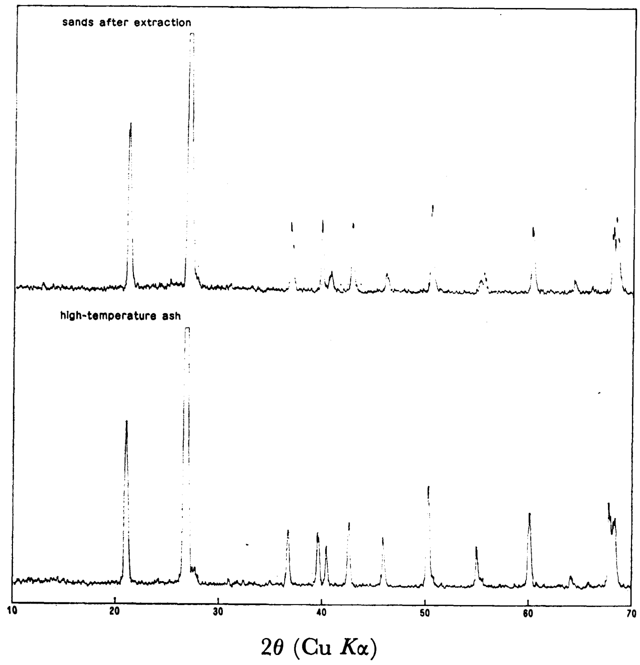

Fig. 2. X-Ray powder diffraction profiles of the sand and the high-temperature ash.

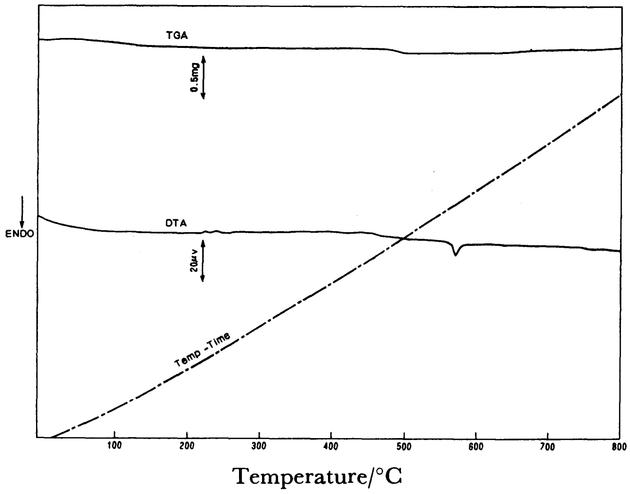

Fig. 3. DTA-TG profile up to 800 °C of the sand.

washing with water. The optical micrograph of the sands is shown in Fig. 1. The maximum diameter of sands is 400 μm, while a typical diameter is 100—150 μm.

The X-ray powder diffraction profiles of the sand and the high-temperature ash are shown in Fig. 2. All the peaks in both profiles were identified as those of α-SiO_2.

A DTA-TG profile of the sand up to 800 °C is shown in Fig. 3. The weight decrease up to 800 °C is 0.2 wt.%. An endothermic peak at 573±1 °C was observed, which corresponds to the displacive transformation from low quartz to high quartz. This result coincides with that obtained by X-ray analysis.

X-Ray fluorescence analysis of the sand shows that the principal constituting elements are Si and Al. Zn, Cu, K, Fe, Ni, Ti, Ca, and Cl are present as minor or trace elements. Therefore, the existence of other unknown components such as aluminates can be estimated.

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References

1) Visiting fellow at the Coal Research Institute, Hokkaido University.

2) N. Berkowitz and J. G. Speight, *Fuel*, **54**, 138 (1975).

3) R. Yoshida, T. Yoshida, Y. Ikawa, T. Okutani, Y. Hirama, Y. Nakata, S. Yokoyama, M. Makabe, and Y. Hasegawa, *Bull. Chem. Soc. Jpn.*, **52**, 1464 (1979).