HEAVY OIL SORPTION BY DIFFERENT CARBON MATERIALS

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Introduction

Recent oil tanker accidents, for example in Japan Sea and the Strait of Malacca, gave serious environmental problems, not only pollution of sea water and neighboring coasts but also serious effects on fishing, as well as a great loss of heavy oil. In our previous papers [1-3], it was reported that an exfoliated graphite was able to sorb a large amount of heavy oil, which was suspended in water, very quickly and also about 80 % of sorbed heavy oil could be recovered by a simple compression. As pointed out in our previous paper [1], not only removing the heavy oil spilled onto water but also recovering and recycling of both heavy oil and exfoliated graphite are expected to give important contribution to the present world-wide problems on energy, resources and environment.

In the present work, therefore, the detailed experimental results on maximum sorption capacity of both exfoliated graphite with different bulk densities and fibrous carbon prepared from a pine tree fir for heavy oils, and also recycling performance of sorbant two carbon materials, paying attention of sorption capacity and recovering ratio, are reported.

Exfoliated Graphite

Fig. 1 shows maximum sorption capacity at room temperature of two commercially available exfoliated graphite EG-1 and EG-2, of which bulk density was 0.006 and 0.013 g/cm^3, for four different grades of heavy oils. Capacity of EG-1 for A-grade heavy oil (viscosity of 4 poise) reaches 86 g/g. For more viscous heavy oils (B- and C-grade), capacity becomes less, but still is high in comparison with other sorption media as polypropylene etc. Sorption rate of exfoliated graphite was fast; for A-grade and crude oils sorption completing within 2 min. Sorbed heavy oil was confirmed to contain a negligibly small amount of water, showing preferential sorption of exfoliated graphite for heavy oils [5].

In Fig. 2, sorption capacity is plotted against bulk density of exfoliated graphites, which have been prepared from EG-1. A marked dependence of sorption capacity on bulk density is observed on each grade of heavy oil.

Heavy oils sorbed into exfoliated graphite could be recovered by filteration under mild suction with recovery ratio of 70-80 %. It was confirmed that these recovered oils were exactly the same as the original ones through different analyses [5]. Change of sorption capacity with recycling of EG-1 is shown in Fig. 3. Capacity decreases markedly with recycling.

Fibrous Carbon

In the case of fibrous carbons prepared from fir trees at 900 °C, a similar dependence of its sorption capacity for A-grade heavy oil was found [6], although maximum sorption capacity was a little smaller than exfoliated graphite.

In Fig. 4, sorbed and recovered amounts of heavy oil are shown as a function of recycling times. Though its capacity is not very high, about 32 g/g, heavy oil of about 27 g/g can be recovered by a simple filtering under suction for the first cycle. It is worth while to mention that almost 100 % recovery of heavy oil is possible after 2nd cycle.

Conclusion

Exfoliated graphite has very high sorption capacity of heavy oils but recycling performance is not satisfactory. Fibrous carbon prepared from fir, however, showed very good recycling performance, only about 10 % loss of heavy oil in the first sorption and desorption cycle, though sorption capacity is not very high as exfoliated graphite.

References

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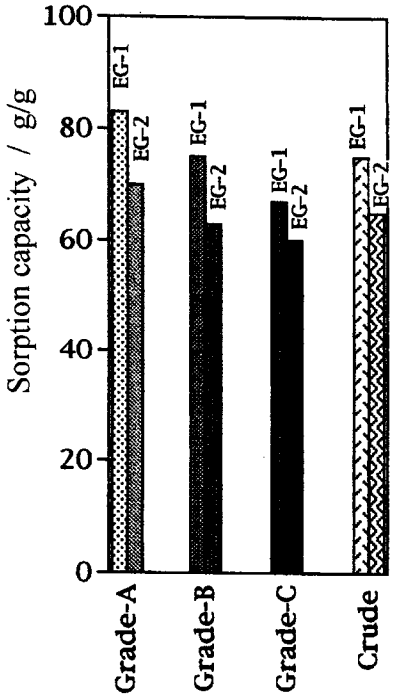

Fig. 1 Maximum sorption capacity of two exfoliated graphite for different grades of heavy oils

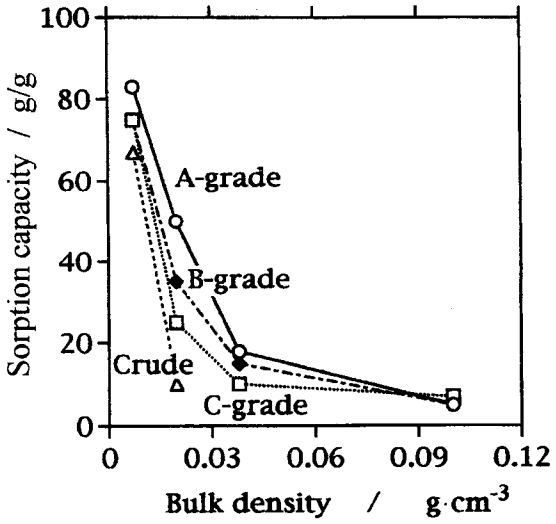

Fig. 2 Dependences of sorption capacity of exfoliated graphite EG-1 on bulk density

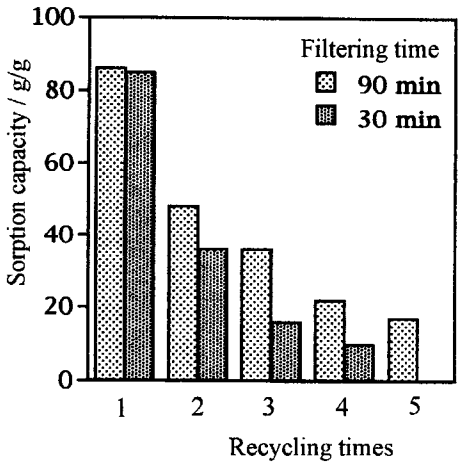

Fig. 3 Changes of sorption capacity of exfoliated graphite EG-1 with recycling after filtering under suction for A-grade heavy oil

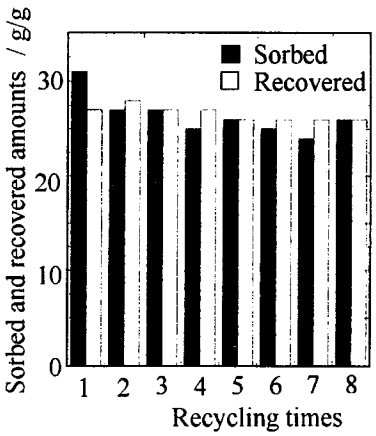

Fig. 4 Changes of sorbed and recovered amounts of A-grade heavy with recycling

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