# Egyptian Clays in the Treatment of Lubricating Oils

By SAMIR ELBADRAWY

## Summary

This paper deals with the use of an Egyptian bleaching clay instead of the Russian clay used in the Petroleum Suez-Company, for the refining of the lubricating oils. The effect of different clays on the adsorption of different group compounds was studied by adsorption analysis.

This problem was studied by the author to replace the Russian clay, by other sorts of Egyptian clays, in the treatment of lubricating oils, which were produced in Suez. The Egyptian clays were collected from different places and were compared with other world clays, such as that from Germany, Rome and USSR.

## Experiment No. I

As a first experiment, a diesel oil cut from the Arabian Ras Tanura crude, which was delivered from the Suez Refinery, was used. This diesel cut (number I) had the following physical constants:

| | |
|---|---|
| Specific gravity 15/4 °C | 0.8715 |
| Flash point P.M.C.C. °F | 215 |
| Viscosity Saybolt at 100 °C in sec. | 56 |
| Viscosity Saybolt at 210 °C in sec. | 41 |
| Viscosity index | 274 |
| Pour point °F | 56 |
| Aniline point °C | 76 |
| Sulphur content (wt %) | 1.78 |
| Unsaturates (wt %) | 29 |
| Refractive index $n_D$ 70 °C | 1.4775 |

Different bleaching agents were used to bleach the diesel oil, such as, silica gel, aluminium oxide, activated charcoal, Russian natural clay and the Egyptian Ras Ghareb clay. Each decolourising material was used in the percentages of 2.0, 4.0, 6.0, 8.0 and 10.0 (wt %) to the diesel oil. The bleaching agent was mixed with the oil at 70 °C for 30 min. in every case[1]). The refrac-

[1]) H. LEONHARDT, Diplomarbeit, Leipzig 1960.

tive index at 70 °C was measured from the filtrate after the mixing time. As given in Table 1, the Russian clay had the highest bleaching power and the Egyptian Ras Ghareb, the lowest. This was clear from the refractive index which is inversely proportional to the degree of bleaching.

Table 1
Decrease of refractive index after bleaching (diesel cut I)

| Percent weight of bleaching agent | Russian clay | Egyptian Ras Ghareb | Charcoal | Silica gel | $Al_2O_3$ |
|---|---|---|---|---|---|
| 2 | 1.4730 | 1.4773 | 1.4750 | 1.4760 | 1,4775 |
| 4 | 1.4726 | 1,4773 | 1.4747 | 1.4751 | 1.4770 |
| 6 | 1.4721 | 1.4770 | 1.4743 | 1.4748 | 1.4768 |
| 8 | 1.4718 | 1.4770 | 1.4736 | 1.4743 | 1.4765 |
| 10 | 1.4716 | 1.4770 | 1.4734 | 1.4740 | 1.4760 |

By the chemical analysis of the Russian and the Egyptian clay as given in Table 2, it was clear that the Russian clay had higher silica content than the Egyptian Ras Ghareb clay. It was also clear that the Russian clay had higher bleaching properties than silica gel, (see Table 1). This was due to the fact that adsorbability depends on the surface area and activity of the bleaching material.

Table 2
Chemical Composition of two bleaching clays

| Contents | Percent weight in Russian clay | Percent weight in Ras Ghareb clay |
|---|---|---|
| moisture | 10.7 | 1.23 |
| loss at 1000 °C | 3.04 | 16.1 |
| silica | 75.11 | 25.57 |
| $Al_2O_3$ | 5.16 | 9.8 |
| $Fe_2O_3$ | 2.5 | 3.5 |
| CaO | 1.86 | 22.3 |
| MgO | 0.97 | 1.11 |
| $Cl^-$ | 0.028 | 2.8 |
| $SO_4^-$ | 0.46 | 17.5 |

## Experiment No. II

These experiments were performed under the same conditions as in exp. no. I with a diesel oil cut from the arabian Ras Tanura crude of the following physical sonstants: (cut number II).

| | |
|---|---|
| Specific gravity 15°/4°C | 0.871 |
| Flash point P.M. c.c. °F | 245 |
| Viscosity Redwood No I at 100°C | 50 |
| Pour point °F | 60 |
| Unsaturates (wt %) | 26 |
| Aniline point °C | 75.8 |

The bleaching agents, German, Romanian, Russian and the Egyptian (Aswan, Ras Ghareb, and Sina clays) were used. Each of these materials were used in a percentage of 10% by weight to the diesel oil cut.

As the refractive index is inversely proportional to the bleaching degree, it was clear from Table 3 that the German clay "Tonsil" is the most ideal one among these clays. The Egyptian Aswan clay was near in its bleaching power to the Russian clay. The Egyptian Ras Ghareb and Sina clays have the least decolourising power.

Table 3
Refractive indices of diesel cut II after bleaching

| Kind of clay | German | Romanian | Russian | Aswan | Ras Ghareb | Sina |
|---|---|---|---|---|---|---|
| Refractive index at 70°C | 1.4780 | 1.4782 | 1.4788 | 1.4791 | 1.4793 | 1.4795 |

By the chemical analysis of these different clays as given in Table 4, it was clear that Aswan clay had a high percentage of silica; but the German clay had the highest one.

The Aswan clay was acid activated, but the activation of the clay had no effect on rising the adsorbability.

Table 4
Chemical composition of 4 different clays

| Contents (wt %) | Aswan | Sina | German | Roman |
|---|---|---|---|---|
| Moisture | 2.4 | 0.35 | 5.2 | 7.1 |
| Silica | 59.8 | 42.17 | 66.75 | 63.11 |
| Iron oxide | 28.7 | traces | 2.43 | 2.0 |
| $Al_2O_3$ | mostly $Al_2O_3$ | 43.87 | 15.02 | 8.11 |
| $Cl^-$ | — | 0.1 | 0.92 | 0.4 |
| $SO_4^-$ | — | — | — | 2.6 |
| CaO | 0.51 | — | 1.62 | 7.7 |

## Experiment No. III

The Egyptian Aswan clay was mixed with the German clay "Tonsil" in percentages of 10, 20, 30, 40 and 50% by wt.

As shown in Table 5, the Aswan clay which contain 20% by weight German clay, had the same bleaching power as the Russian clay, but it needed 50% by weight German clay to be equal to the Romanian.

Table 5
Decrease of refraction after bleaching with Aswan and German clay

| Percent weight of the German clay in Aswan clay | 0.0 | 10 | 20 | 30 | 40 | 50 | 100 |
|---|---|---|---|---|---|---|---|
| Refractive index at 70 °C | 1.4791 | 1.479 | 1.4789 | 1.4781 | 1.4787 | 1.4785 | 1.478 |

## Experiment No. IV

As the Arabian Ras Tanura crude is used in the Suez-Company for the production of lubricating oils, the mazot of Ras Tanura was used to obtain the three following lubricating oil fractions

| | |
|---|---|
| Non-viscous oil cut | 350—400 °C |
| Neutral oil cut | 400—450 °C |
| Viscous oil cut | 450—500 °C |

Table 6
General Analysis of the Arabian Ras Tanura Lube Oil-Fractions

| Test | Boiling range of the fraction | | |
|---|---|---|---|
| | 350—400 °C | 400—450 °C | 450—500 °C |
| % wt in 700 sec-Mazot | 11.76 | 14.62 | 17.66 |
| Spezific gravity | 0.852 | 0.860 | 0.887 |
| Pour point °C | 14.4 | 24.4 | 33.3 |
| Wax content % wt | 11.6 | 11.5 | 14.22 |
| Solid point of wax °C | 40.5 | 45.5 | 53.0 |
| Colour (union) | 4.0 | over 8 | over 8 |
| Kin. Vis. at 70 °C | 5.7 | 4.48 | 20.32 |
| Kin. Vis. at 80 °C | 4.57 | 6.02 | 14.93 |
| Kin. Vis. at 90 °C | 3.74 | 5.16 | 11.52 |
| Refractive Index (70 °C) | 1.4978 | 1.4978 | 1.5702 |
| Conradson C. % wt. | 0.06 | 0.217 | 1.22 |
| Anilin point °C | 71.4 | 73.6 | 85.2 |
| Asphaltenes % wt | — | — | 0.075 |
| Ash content % wt | Free | 0.006 | 0.02 |
| Acidity IP | 0.076 | 0.09 | 0.12 |
| Flash point °C clevland | 187.8 | 121.1 | 195.1 |

The physical properties of the cuts were given in Table 6.

The three cuts were analysed by adsorption chromatography on silica gel[2]) of particle size 0.2 to 0.5 mm. The results were given in Table 7.

To find the effect of clay on the adsorption group compounds, German clay in 10% by weight from a non-viscous cut was used. The oil cut was analysed by adsorption chromatography, before and after bleaching (Table 8).

Table 7
Constitution of the Arabian Ras Tanura Lube Oil-Fractions

| | 350—400 °C | 400—450 °C | 450—500 °C |
|---|---|---|---|
| Saturates % wt | 59.1 60.5 | 60.5 | 62.3 |
| Aromatics % wt | 38.8 | 35.9 | 35.4 |
| Resins % wt | 1.8 | 1.6 | 1.8 |
| Refraction of Saturates (70 °C) | 1.4552 | 1.4605 | 1.4749 |
| Refraction of aromatics (70 °C) | 1.5678 | 1.5702 | 1.5822 |
| Refraction of the original (70 °C) | 1.4945 | 1.4978 | 1.5702 |

Table 8
The effect of clay treatment on the constitution of the oil (non viscous oil from Ras Tanura crude)

| | before treatment | after treatment |
|---|---|---|
| $n_D^{70}$ | 1.4945 | |
| Colour (union) | 4.0 | $2^1/_4$ |
| Aromaties % wt | 38.8 | 38.0 |
| Resins % wt | 1.8 | 0.7 |
| Saturates % wt | 59.1 | 60.8 |

The change in colour was measured by the union colorimeter. In other experiments the non viscous oil was treated with different clays in different mixing relations and the effect of bleaching on the oil fractions was found through adsorption chromatography (see Table 9).

As it was clear from Table 8 and 9 that the action of the clay was mainly on the adsorption of resins, therefore, the percentage of resins before and after treatment of the oil was used as a measure of the degree of adsorption of the different clays, (the aromatics were slightly affected) (see Table 9).

From the different clays used, it was clear that the German clay „Tonsil" was the most ideal one for bleaching purposes in oil-refining processes.

The Egyptian Aswan clay No. 1 was less in its bleaching power than the Russian clay as it was clear from the resin content after treatment of the

[2]) M. LEDERER, Chromatography, Elsevier Punl. Corp. 1955, p. 67.

Table 9
Clay Treatment of Non Viscous Oil (Ras Tanura)

| Type of Clay used | % wt of Clay | Saturates wt % | Aromatics wt % | Resins wt % | Total wt % |
|---|---|---|---|---|---|
| German | 10 | 61.8 | 37.0 | 0.76 | 99.56 |
| Russian + German (2:1) | 5 | 61.2 | 37.2 | 1.3 | 99.70 |
| Aswan 1 + German (1:1) | 20 | 61.8 | 37.0 | 0.56 | 99.36 |
| Aswan 1 + German (2:1) | 5 | 61.0 | 37.2 | 1.4 | 99.60 |
| German | 1.7 | 60.0 | 37.8 | 1.65 | 99.45 |
| Kuom Imbo + German (2:1) | 5 | 60.1 | 37.67 | 1.7 | 99.45 |
| Aswan 2 + German (2:1) | 5 | 61.1 | 37.8 | 1.7 | 99.60 |

oil with the two clays. The resin content, after the Russian clay treatment, decreases from 1.8% by weight to 1.3%. It decreases to 1.4% after Aswan No. 1 clay treatment. The Kuom Imbo clay and Aswan No. 2 have a less adsorption effect on resins, i.e. on the improvment of the colour, than Aswan natural clay in its adsorbability.

Ras Ghareb and Sina clay could not be used as bleaching agents.

## Conclusion

Finally Aswan clays have different adsorption powers and they must be well chosen and tested before it can be used in place of the Russian natural clay.

Thanks are due to the Suez-Petroleum-Company for given help and products.

Cairo (UAR), The National Research Centre — Cairo Petroleum Department.

Bei der Redaktion eingegangen am 15. März 1965.