Mustafa Ghazi Hasan. Formulation of Greases Using Iraqi Bentonite as Thickening Agents for Lubricating Oils. University Of Technology. Department Of Chemical Engineering. The Degree of Master of Science in Chemical Engineering / Gas and Petroleum Refining Engineering. Supervisor: Prof. Dr. Bashir Youssef Sharhan & Prof. Dr. Zaidoon Mohsin Shakor. 2024. 110 P

ABSTRACT

The rapid development of industrial machines requires greases with efficient properties that vary depending on the severity of operating conditions and range from fluid to hard. Accordingly, this study presents two aims:

The First Aim is to prepare environmentally friendly inorganic lubricating greases that are not of soap origin in their compositions and have properties suitable for working under different service conditions. To make the manufacturing process economically feasible, emphasis was placed on using locally available raw materials such as Iraqi clay as a solid porous thickener with both 60 and 150 Stoke base oils in addition to hard and soft paraffin waxes all fabricated by Iraqi refineries. Raw Iraqi bentonite (RIB) has been treated with various acids such as HCl, H_2SO_4, HNO_3, and a mixture of all acids for activation and converting the surface from hydrophilic to organophilic to facilitate dispersion in the organic base oil. The physical properties of the treated clays (RIB) were studied using XRD, EDX, SEM, FTIR, and BET-surface areas and pore volume analyses. The highest surface area of 221.051 m^2/g and the highest porosity of 0.5411 cm^3/g were found by removing about 35 wt. % aluminum from the bentonite lattice. The crystal dimensions also increased, reaching a maximum range of 41.08 nm, while the degree of crystallinity remained relatively high. It has been found that the type of acid used in treatment has a striking effect on the structure and composition of the resulting thickeners, thus generating lubricating greases with dissimilar properties. For that reason, synthetic greases have been observed to have a variety of dropping points and working penetrations ranging between 86 ˚C with stock 60 and 300+ ˚C with stock 150, as well as 202 with stock 150 and 427 with stock 60, respectively. The

National Lubricating Grease Institute (NLGI) consistency grades of these greases ranged from semi-fluid using AIBMIX as a thickener with the base oil stock 60 and soft wax, to very firm using AIBHNO_3 as a thickener with the base oil stock 150 and hard wax. Treatment with nitric acid resulted in an effective clay surface capable of absorbing both types of either base oil stock and/or paraffinic wax homogeneously upon mixing compared to the rest of the acid-treated bentonite thickener surfaces.

The Second Aim is presents a comparative study and analysis of the effect of adding PTFE and graphite to Iraqi acid-activated bentonite lubricating greases (AIBLG-HNO_3) of which 24 types were synthesized in the laboratory. The tribological characteristics such as corrosion resistance and diameter of wear scars (WSDs) that take place due to friction between metal surfaces inside the equipment were studied, as WSDs are directly proportional to friction. The results showed that the manufactured Iraqi bentonite greases have a high ability to resist corrosion and anti-wear, especially when adding Polytetrafluoroethylene (PTFE) to all samples, where it was of grade 1a, but after adding graphite, a slight corrosion of grade 1b and 2c occurred for some samples. It was concluded that adding either PTFE or graphite nanocomposites should preferably be at a weight percentage of not less than 15 wt. %. Moreover, in comparison with the parent Iraqi bentonite lubricating greases (IBLG) samples free of additives, the results also indicate a decrease in WSDs by 90 to 93% using base oil 150 for four samples and in the presence of soft and/or hard wax. It became clear that determining the effectiveness of Iraqi bentonite greases in preventing corrosion is through their ability to create effective seals and form a boundary lubrication film in addition to the chemical composition and structure of these greases.

Key Word: Base Oil, Methanol, Iraqi Bentonite, (HCl, H_2SO_4, HNO_3) acids, Paraffin Wax, Graphite, and Polytetrafluoroethylene (PTFE).