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HYDROCRACKING

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ABSTRACT OF THE DISCLOSURE

A lube oil hydrocracking process wherein the lube oil charge stock is mixed with a low viscosity material as diluent prior to charging to a hydrocracking reaction carried out at a temperature in the range of about 650° to 875° F. and a pressure of at least about 500 p.s.i. over a hydrocracking catalyst.

This invention broadly relates to an improved lube oil hydrocracking process wherein the normally viscous hydrocracking charge stocks are first diluted with a light material whereby catalyst beneficiation is obtained as to both activity and longevity and the V.I. profile of the hydrocracked product appears to be enhanced in some cases.

BACKGROUND OF THE INVENTION

In recent times, the demand for high V.I. lube oil products has increased at a tremendous pace, and the natural sources of these materials continues to diminish up to the present time. Because it increases the supply of such materials, one process is very important because it provides for synthetically preparing high V.I. lubes by hydrocracking certain natural crudes with a low V.I. In hydrocracking, the V.I. of a lube fraction is upgraded by molecular transformation. Accordingly, any significant improvement in a lube oil hydrocracking process for upgrading the V.I. of lube fractions is to be commended, and the present process constitutes a significant advance as will become apparent from a reading of this disclosure in entirety.

SUMMARY OF THE INVENTION

The present improvement in lube oil hydrocracking comprises adding a low viscosity diluent having a kinematic viscosity in the approximate range of about 0.15 cs. to 17 cs. at 100° F. to a suitable lube oil hydrocracking charge stock having an initial boiling point above about 650° F. and hydrocracking the diluted lube oil charge stock at a temperature of at least about 650° F. and a partial pressure of hydrogen of at least about 500 p.s.i. over a hydrocracking catalyst.

DETAILED DISCUSSION

Lube oil hydrocracking is now well known in the art. Among the more advantageous processes, however, is the one which will be briefly described hereinafter.

While the precise reason or mechanism involved in the beneficial effect of the diluent is not known for certain, we propose the following theory with the understanding that we are not in any way bound by such mechanism since it may not be correct. In final analysis we propose an improved technique of hydrocracking which comprises positive process features which, if practiced, will provide one or more advantages regardless of whatever mechanism or mechanisms may be involved. To the extent, however, that the mechanism we propose may be of some additional benefit to those skilled in the art, we now set same forth.

The catalyst is very heat sensitive and so are some of the reactions which occur in hydrocracking operations. The hydrocracking reaction, or more properly the overall

net energy state of the several reactions involved in such a process, is exothermic in nature. There is, therefore, the likelihood of some hot spots and/or great heat release near the surface of the catalyst. In addition to promoting less desired reactions which normally occur in hydrocracking, the reaction temperatures involved, especially when increased in localized areas by the release of heat by the reaction, can cause coke formation on the catalyst. Coke deposition causes catalyst deactivation by occlusion of the surface. Temperature itself, however, accelerates catalyst change with decreased activity. The temperature and catalyst deactivation relationship is especially important because at the elevated temperatures required for the reaction the deactivation rate becomes progressive in a geometric fashion. In short, the diluent probably operates as a heat sink although it may function also to continuously wash the catalyst in some fashion to keep its surface cleaner and therefore more active. It is also possible that the diluent provides for better contact of the lube with the catalyst because of the reduction in the viscosity in the reactor.

The hydrocracking feed for lube oil production comprises waxy and dewaxed vacuum distillates, a deasphalted or Duo-Sol extracted residuum, waxy and dewaxed deasphalted residuum boiling above about 650° F., or blends thereof. Preferably, the lube oil charge boils above about 700° F., and most preferably above about 735° F.

Any lube oil hydrocracking catalyst suitable for the manufacture of high V.I. lubes can be employed. As is well known, such catalysts are materials having a high activity for saturation of aromatics and high activity and selectivity for ring-scission. Generally preferred catalysts are sulfides of a Group VI metal, left-hand column, of the periodic system, mixed with an iron group metal. Most preferably, the catalyst is a mixture of nickel sulfide and tungsten sulfide in a 1:1 to 4:1 metal ion ratio on an alumina carrier. Other advantageous catalyst metals are cobalt and molybdenum. The catalyst may be in two or more beds, and the feed can be fractionated and charged at different points with the heavier fractions generally charged to provide for a greater exposure to hydrocracking conditions. This is so whether the beds are in a serial or parallel arrangement or if the reaction is carried out in a blocked-out operation. Also, the catalyst composition may be the same or different in the several beds or zones of a single bed, with the composition selected dependent upon the properties of the charge stock to be passed over same (i.e., refractory content which correlates directly with polycyclic content and boiling point) and the known performance characteristics of the particular catalyst composition.

The temperatures employed throughout the beds can be the same or different but, in general, will be in the range of about 650° to 875° F., more usually and preferably in the range of about 735° to 825° F. The partial pressure of hydrogen (i.e., refinery hydrogen streams can be employed preferably containing at least about 70% of hydrogen) can be as low as about 500 p.s.i. but should be at least about 1500 p.s.i., and preferably is above about 2500 to about 4000 p.s.i. Theoretically, hydrogen partial pressures as high as about 10,000 p.s.i., or higher can be employed. For most applications, the first-mentioned pressures suffice and are more economical. If adequate provisions are taken in constructing the equipment in a multiple catalyst bed and feed charge arrangement, the pressure can then be varied in the various catalyst beds to optimize the hydrogen pressure for each treating stage.

The space velocity will be slightly affected by the use of the diluent of the present invention; however, it generally will be found still suitable to employ conventional lube oil hydrocracking space velocities of about 0.1 to

volumes of liquid per volume of catalyst per hour. ferred space velocities to be employed with the other ferred operating conditions specified elsewhere herein in the range of about 0.4 to 1.5 on the same basis.

The diluent of this invention can be any low aromatic terial having a viscosity of about 0.15 cs. to 17 cs. at ° F. which does not exert an adverse effect on the lrocracking reaction or catalyst. More preferably, the ient has a viscosity of about 0.4 cs. to about 2 cs. at ° F. Illustrative but nonlimiting examples are hexane, itase, naphthas, spirits, fuel oil, and 60 SUS Neutral, ich has a viscosity in centistokes of about 10.3. The ount of diluent required will, of course, vary depend- upon the viscosity of the particular charge material l of the diluent itself employed. Accordingly, in some es an amount of diluent that can be employed is as low about 5% by volume based on the total charge with sfactory results. In other cases the amount of diluent irably employed will run as high as about 80% by ume based on the total charge. In the typical case, amount of diluent in the range of about 10 to 50% normally be adequate, especially when the diluent is aphtha. Following the hydrocracking operation, the ient is readily separated and recovered from the lube fraction by any conventional means. By some of these ventional techniques, of course, some light materials n the hydrocracking will be recovered with the diluent; vever, if further purification is required or desired, this be readily accomplished. For the most part, a portion this slightly "adulterated" diluent can be reused for ation purposes without further purification.

The present invention can be used in combination with other compatible refining procedures, particularly l pre-treatments and post-treatments of the hydro- king operation. Examples of these, in addition to e already briefly referred to hereinabove such as de- alting and dewaxing, are subsequent hydrogenating mprove color and UV stability of same, furfural or r solvent extraction, or rehydrocracking to further up- le the V.I. of the product or improve its stability.

We claim:

1. In a process wherein a lubricating oil fraction which boils above about 700° F. is hydrocracked under hydrocracking conditions, the improvement comprising mixing the lubricating oil fraction with from about 5 to 80 percent by volume of a hydrocarbon diluent having a kinematic viscosity in the range of about 0.15 to 17 centistokes at 100° F. prior to charging same to the hydrocracking reaction.

2. A process according to claim 1 wherein said hydrocracking is carried out at a temperature in the range of about 700° to 825° F. and a hydrogen partial pressure of at least about 1500 p.s.i.

3. A process according to claim 2 wherein about 10 to 50% by volume of diluent is employed.

4. A process according to claim 3 wherein the hydrocracking temperature is at least about 735° F.

5. A process according to claim 4 wherein the partial pressure of hydrogen in said hydrocracking is at least about 2500 p.s.i.

6. A process according to claim 4 wherein the hydrocracking catalyst is at least one metal oxide or sulfide of the group consisting of nickel, tungsten, cobalt, and molybdenum.

7. A process according to claim 6 wherein the diluent has a kinematic viscosity of about 0.4 to 2 centistokes.

8. A process according to claim 5 wherein the diluent has a kinematic viscosity of about 0.4 to 2 centistokes.

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