the use of a two catalyst system comprising a hydrotreating catalyst and a dewaxing catalyst. The aging of the dewaxing catalyst may be slowed by the presence of the hydrotreating catalyst layer.

U.S. Patent Nos. 6,468,417 and 6,468,418 disclose the production of lube oil having a reduced tendency to form a haze by a process including contacting a dewaxed lube stock or base oil feed with a solid sorbent to produce a dehazed base oil having a reduced cloud point relative to that of the dewaxed lube stock or base oil feed.

There is a continuing need for improved dewaxing processes and catalyst systems showing increased isomerization selectivity and conversion of waxy hydrocarbon feedstocks for the production of valuable Group II and Group III base oils.

SUMMARY OF THE ~~INVENTION~~DISCLOSURE

This ~~invention~~disclosure relates to processes for efficiently converting wax-containing hydrocarbon feedstocks into high-grade products, including lubricant base oils having a low pour point, a low cloud point, a low pour-cloud spread, and a high viscosity index (VI). Such processes employ a layered catalyst system comprising a plurality of hydroisomerization dewaxing catalysts. Hydroisomerization converts aliphatic, unbranched paraffinic hydrocarbons (n-paraffins) to isoparaffins and cyclic species, thereby decreasing the pour point and cloud point of the base oil product as compared with the feedstock. In an embodiment, a layered catalyst system of the present ~~invention~~disclosure may further comprise a hydrotreating catalyst as a guard layer, whereby "aging" of the hydroisomerization catalysts is decelerated, and base oil product yield can be maintained for longer periods of time, as compared with conventional processes, at a temperature in the range from about 450°F to about 725°F (232°C to 385°C).

According to one aspect of the present ~~invention~~disclosure there is provided a process for catalytically dewaxing a waxy hydrocarbon feedstock comprising contacting the hydrocarbon feedstock in a first hydroisomerization zone under first hydroisomerization dewaxing conditions with a first hydroisomerization catalyst to provide a first isomerization stream, and contacting at least a portion of the first isomerization stream in a second hydroisomerization zone under second hydroisomerization dewaxing conditions with a second hydroisomerization catalyst to provide a second isomerization stream. Each of the first hydroisomerization catalyst and the second hydroisomerization catalyst may comprise a molecular sieve and a Group VIII metal. Each of the first hydroisomerization catalyst and the

second hydroisomerization catalyst may be selective for isomerization of n-paraffins in the feedstock. The first hydroisomerization zone and the second hydroisomerization zone may be disposed within the same reactor. Each of the first hydroisomerization catalyst and the second hydroisomerization catalyst may be doped with a metal modifier selected from the group consisting of Mg, Ca, Sr, Ba, K, La, Pr, Nd, Cr, and combinations thereof.

According to one aspect, there is provided a process for catalytically dewaxing a waxy hydrocarbon feedstock, comprising:

a) contacting the hydrocarbon feedstock in a first hydroisomerization zone under first hydroisomerization dewaxing conditions with a first hydroisomerization catalyst to provide a first isomerization stream; and

b) contacting at least a portion of the first isomerization stream in a second hydroisomerization zone under second hydroisomerization dewaxing conditions with a second hydroisomerization catalyst to provide a second isomerization stream;

wherein the first and second hydroisomerization catalysts comprise a layered catalyst system, the first hydroisomerization catalyst is disposed upstream from the second hydroisomerization catalyst, the first hydroisomerization catalyst has a first level of selectivity for the isomerization of n-paraffins, the second hydroisomerization catalyst has a second level of selectivity for the isomerization of n-paraffins, the layered catalyst system has a third level of selectivity for the isomerization of n-paraffins, and wherein the third level of selectivity is higher than each of the first level of selectivity and the second level of selectivity, and the first level of selectivity is at least substantially the same as the second level of selectivity;

wherein each of the first hydroisomerization catalyst and the second hydroisomerization catalyst comprises a molecular sieve and a Group VIII metal, each of the first hydroisomerization catalyst and the second hydroisomerization catalyst is selective for isomerization of n-paraffins in the feedstock;

wherein the first hydroisomerization zone and the second hydroisomerization zone are disposed within the same reactor; and

wherein each of the first hydroisomerization catalyst and the second hydroisomerization catalyst is doped with a metal modifier selected from the group consisting of Mg, Ca, Sr, Ba, K, La, Pr, Nd, Cr, and combinations thereof.

In an embodiment the present ~~invention~~disclosure provides a process for catalytically dewaxing a heavy hydrocarbon feedstock comprising contacting the hydrocarbon feedstock in a first hydroisomerization zone under first hydroisomerization dewaxing conditions with a first hydroisomerization catalyst to provide a first isomerization stream, contacting at least a portion of the first isomerization stream in a second hydroisomerization zone under second

hydroisomerization dewaxing conditions with a second hydroisomerization catalyst to provide a second isomerization stream, and contacting the second isomerization stream with a hydrofinishing catalyst to provide a base oil product having a pour point of not more than about -12°C and a pour-cloud spread of not more than about 5°C. Each of the first hydroisomerization catalyst and the second hydroisomerization catalyst may comprise a 1-D, 10-ring molecular sieve and a Group VIII metal. Each of the first hydroisomerization catalyst and the second hydroisomerization catalyst may be doped with a metal modifier selected from the group consisting of Mg, Ca, Sr, Ba, K, La, Pr, Nd, Cr, and combinations thereof. The first and second hydroisomerization catalysts may be disposed in the same reactor.

According to one aspect, there is provided a process for catalytically dewaxing a heavy hydrocarbon feedstock, comprising:

a) contacting the hydrocarbon feedstock in a first hydroisomerization zone under first hydroisomerization dewaxing conditions with a first hydroisomerization catalyst to provide a first isomerization stream;

b) contacting at least a portion of the first isomerization stream in a second hydroisomerization zone under second hydroisomerization dewaxing conditions with a second hydroisomerization catalyst to provide a second isomerization stream, wherein each of the first hydroisomerization catalyst and the second hydroisomerization catalyst comprises a 1-D, 10-ring molecular sieve and a Group VIII metal, each of the first hydroisomerization catalyst and the second hydroisomerization catalyst is doped with a metal modifier selected from the group consisting of Mg, Ca, Sr, Ba, K, La, Pr, Nd, Cr, and combinations thereof;

wherein the first and second hydroisomerization catalysts are disposed in the same reactor; and

wherein the first and second hydroisomerization catalysts comprise a layered catalyst system, the first hydroisomerization catalyst has a first level of selectivity for the isomerization of n-paraffins, the second hydroisomerization catalyst has a second level of selectivity for the isomerization of n-paraffins, the layered catalyst system has a third level of selectivity for the isomerization of n-paraffins, and wherein the third level of selectivity is higher than each of the first level of selectivity and the second level of selectivity, and the first level of selectivity is at least substantially the same as the second level of selectivity; and

c) contacting the second isomerization stream with a hydrofinishing catalyst to provide a base oil product having a pour point of not more than -12°C and a pour-cloud spread of not more than 5°C.

In another embodiment, the present ~~invention~~disclosure provides a layered catalyst system comprising a first hydroisomerization zone comprising a first hydroisomerization catalyst, and a second hydroisomerization zone comprising a second hydroisomerization catalyst.

Each of the first hydroisomerization catalyst and the second hydroisomerization catalyst may comprise a 1-D, 10-ring molecular sieve and a Group VIII metal. The first hydroisomerization catalyst has a first level of selectivity for the isomerization of n-paraffins, the second hydroisomerization catalyst has a second level of selectivity for the isomerization of n-paraffins, the layered catalyst system has a third level of selectivity for the isomerization of n-paraffins. The third level of selectivity may be higher than each of the first level of selectivity and the second level of selectivity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically represents a system for hydrocarbon dewaxing processes, according to an embodiment of the present invention;