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PROCESS FOR REDUCING THE CLOUD POINT OF A BASE OIL

The invention is related to a process for reducing the cloud point of a base oil feed having a kinematic viscosity at 100 °C of greater than 10 cSt.

WO-A-02070627 describes a process to prepare a base
5 oil having a kinematic viscosity at 100 °C of 22.9 cSt and a pour point of +9 °C and a viscosity index of 178. The process involves the hydroisomerisation of a Fischer-Tropsch synthesis product boiling from C5 up to 750 °C. From the effluent of the hydroisomerisation a
10 distillation residue boiling above 370 °C was isolated and catalytically dewaxed. The dewaxed oil was distilled to obtain as a distillation residue boiling above 510 °C the base oil as described above.

WO-A-2004007647 describes a process to prepare a
15 heavy base oil from a Fischer-Tropsch derived wax. The process involves the hydroisomerisation of a Fischer-Tropsch synthesis product boiling from C5 up to 750 °C. From the effluent of the hydroisomerisation a distillation residue boiling above 370 °C was isolated.
20 This residue was split into a light and a heavy base oil precursor fraction. By catalytically dewaxing the heavy base oil precursor fraction a base oil having a pour point of -15 °C, a viscosity index of 157 and a kinematic viscosity at 100 °C of 26.65 cSt was prepared.

25 An advantage of the process of WO-A-02070627 or WO-A-2004007647 is that base oils are obtained having a high viscosity and a high viscosity index. A problem is that when the base oils are obtained by means of a catalytic dewaxing step a hazy product may be obtained.
30 The hazy product has a high cloud point resulting in a hazy product at ambient temperature. This property makes the base oil less suitable for certain applications.

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WO-A-03033622 describes a process to prepare a low haze heavy base oil from a Fischer-Tropsch derived wax by isolating by means of deep cut distillation a fraction boiling between 1000 and 1200 °F (538 and 649 °C) and a residue boiling above 1200 °F. The fraction boiling between 1000 and 1200 °F is subjected to a hydroisomerisation step. According to the specification a base oil having no haze can be obtained having a pour point of less than +10 °C and a kinematic viscosity at 100 °C of greater than 15 cSt.

According to WO-A-03033622 the haze precursors are removed from the base oil by the deep cut distillation whereby the haze precursors remain in the residual fraction. A disadvantage of this process is the deep cut distillation itself. Such a distillation is difficult to perform. Moreover, because a substantial part of the feed is recovered as the top product, a substantial amount of energy will be required for such a distillation. Furthermore valuable heavy base oil molecules are removed with the distillation residue. This is disadvantageous for the yield to the heavy base oils. Moreover the maximum achievable viscosity of the heavy base oil is limited by this distillation.

WO-A-0077125 describes a process to remove haze precursors from a heavy mineral base oil, referred to as Bright Stock, by contacting the base oil with a solid alumina sorbent.

EP-A-1548088 describes a process to prepare a haze free base oil having a cloud point of below 0 °C and a kinematic viscosity at 100 °C of greater than 10 cSt by hydroisomerisation of a Fischer-Tropsch synthesis product, isolating a residue from the effluent of the hydroisomerisation step, reducing the wax content of the residue to a value of below 50 wt% and finally solvent dewaxing the residue to obtain the haze free base oil.

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EP-A-1550709 describes a process to prepare a haze free base oil having a kinematic viscosity at 100 °C of greater than 10 cSt from a Fischer-Tropsch wax feed. The process involves reducing the wax content in the feed to a value of below 50 wt% by contacting the feed with a hydroisomerisation catalyst under hydroisomerisation conditions at a remote location, transporting an intermediate product having a wax content of below 35 wt% from the remote location to a location closer to the end user of the haze free base oil, and solvent dewaxing the transported intermediate product to obtain the haze free base oil at the location closer to the end-user.

A disadvantage of the processes as described in EP-A-1548088 and EP-A-1550709 is that a solvent dewaxing step is performed which process is considered complex and involving usage of additional chemicals as ketone and aromatic type solvents.

The object of this invention is to provide a process to prepare haze free heavy base oils which is more simple to perform. The haziness of the base oil is defined as a cloud point of below 15 °C.

This object is achieved with the following process. Process for reducing the cloud point of a base oil feed having a kinematic viscosity at 100 °C of greater than 10 cSt by separating the molecules inferring the high cloud point from the base oil by (a) depositing said molecules on one side of a cooled surface, (b) obtaining a base oil having a reduced cloud point and (c) melting the deposited molecules and separating the melted molecules from the surface and reusing said surface to perform step (a).

In step (a) the temperature of the cooled surface is preferably between the cloud point and the pour point of the base oil feed. The surface may be cooled by various methods. Suitably the surface is cooled by contacting the

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opposite side of the surface, i.e. the side opposite the side at which the base oils contacts the surface, with a suitable cooling medium. Examples of suitable cooling media are evaporating liquids, for example evaporating ammonia or nitrogen. Nitrogen may be advantageous in situations wherein liquid nitrogen is available at low cost and where the nitrogen does not need to be liquefied again. Other examples are chilled water or other process streams available having the required temperature and cooling capabilities.

The design of the surface is not critical. It may be flat, corrugated or tubular. The design should be such that the surface can be cooled to the desired temperature for a prolonged period of time, at least long enough to achieve that at least part of the molecules inferring the high cloud point solidify and deposit on said surface. Examples of possible surfaces are double walled, optionally corrugated, plates. Between the plates the cooling medium is allowed to flow resulting in a cooled surface at the opposite, outer, side. One or more of such plates may be submerged in the base oil as present in a large vessel. In such a configuration step (a) is preferably performed in a batch operation mode. After a certain time the oil is removed and the molecules inferring the high cloud point remain behind on the cooled surface of the plates. Examples of suitable plate type apparatuses, which can be used, are described in US-A-6074548 and US-A-6145340, which publications are hereby incorporated by reference.

If a tubular surface is used the cooling medium may pass at the inside or outside of the tube. In such an embodiment one and more preferably more tubes are arranged vertically in a vessel. The vessel is provided with tube sheets and inlets and outlets for feed, product, cooling medium and used cooling medium. The

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cooling medium may be present at the outside of the tubes and the base oil is present inside the tubes. Such configurations are well known for de-oiling of wax and are referred to as a so-called "vertical tube sweating stove" as described in GB-A-1535345 as published in 1978. In such a vessel the de-oiling is performed in a batch wise operation. The cooling medium may also be provided inside the tubes while the base oil flows at the outside of the tubes as for example described in EP-A-937489 and US-A-6024793. Preferably step (a) is performed in a semi-continuous type of operation. The use of a tubular surface as described above makes such a continuous type of operation possible for the feed of the process of the present invention. In such an operation the base oil feed is circulated along or within the tubes while the molecules inferring the high cloud point are deposited at the opposite surface of the tubes. Only after reducing the pour point sufficiently a base oil product is recovered from the circulating stream in step (b). Examples of possible apparatuses having tubular surfaces and examples of how to operate said apparatuses are described in EP-A-937489, US-A-6024793, and US-A-5700435, which publications are hereby incorporated by reference.

Both the plate and tubular surface type apparatuses may be provided with elements to stabilize the layer of solidified haze inferring molecules. Preferably these elements are positioned near the cooled surface at the side where the layer will form as described in EP-A-1216734, which publication is incorporated hereby by reference. The surface may be further modified by roughing or by applying a thin layer having a composition similar to the waxy molecules to be separated. Examples of such materials are poly olefins, for example polyethylene and polypropylene.

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Step (b) is preferably performed by removing the base oil product from the vessel after performing step (a). Thus step (b) is performed after the cloud point of the base oil has been lowered sufficiently in step (a), also
5 in situations wherein step (a) is performed by circulating said base oil along the surface as for example described for the tubular surface above.

The solidified waxy material may be removed from the surface in step (c) by passing a hot gas through the
10 vessel at the side at the waxy material is present. The material will liquefy and may be separated from the surface by a flow of material due to gravity to a lower part of the vessel at which it can be removed from the vessel. Alternatively the temperature of the surface can
15 be increased by changing the cooling medium for a medium which heats the surface. This medium may be the same as the cooling medium if an evaporating medium is used. The heat of condensing may then be used to increase the temperature of the surface. By operating more than one
20 vessel a thermal efficient operation can be achieved wherein one vessel is performing step (a) using a evaporating cooling medium and another vessel is performing step (c) wherein said medium condenses as for example described in US-A-5700435, which publication is
25 hereby incorporated by reference.

The waxy molecules as obtained in step (c) may be used as a product as obtained or more preferably are co-fed to a hydrocracker/hydroisomerisation step or a catalytic dewaxing step of the process, which prepares
30 the base oil feed of the present process. Provided of course such process comprises said steps. An example of a suitable process which does involve these steps is a process wherein the base oil feed is prepared from a Fischer-Tropsch wax as will be described in greater
35 detail below.

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Removing only small quantities of haze incurring molecules could become difficult because the layer of solidified molecules would be too small to capture also the remaining haze incurring molecules. To improve

5 separation the content of molecules incurring the high cloud point is preferably increased if this content is too low to form a layer, which is capable of capturing also the last molecules haze incurring molecules. Increasing this content can be achieved by adjusting the

10 process, which prepares the base oil feed, or alternatively by recycling to step (a) any haze incurring molecules which have been separated from the base oil in an earlier cycle of the process according the invention.

The base oil used as feed for the process of the

15 present invention preferably has a kinematic viscosity at 100 °C of greater than 10 cSt and more preferably greater than 15 cSt. The base oil feed preferably has a cloud point greater than 10 °C, more preferably greater than 20 °C. The pour point is preferably smaller than +10 °C

20 and more preferably smaller than 0 °C The feed may also comprise said base oil, wherein the desired heavy and non-haze base oil is isolated from the product of the process of according to the present invention by separation of lower boiling compounds. Examples of such

25 base oils are so-called bright stock, which are obtained by de-asphalting the residue of a vacuum distillation, step of a mineral crude oil. This de-asphalted fraction is typically subjected to solvent extraction and solvent or catalytic dewaxing steps and may still contain some

30 haze. Application of the present invention would remove the haze problem. Such a mineral oil derived bright stock may even have a kinematic viscosity at 100 °C of greater than 30 cSt.

More preferably the base oil is a paraffinic base

35 oil. The saturates content of the paraffin base oil feed

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is preferably greater than 97 wt% and more preferably greater than 99 wt%. The sulphur content is preferably smaller than 50 ppm. The viscosity index of the paraffin base oil is preferably greater than 130 and in most cases smaller than 200.

Suitably the paraffin base oil feed having the above properties is the paraffin base oil feed as obtained by

(i) contacting carbon monoxide and hydrogen with a hydrocarbon synthesis catalyst at elevated temperature and pressure to prepare a substantially paraffinic hydrocarbon wax; and

(ii) subjecting the paraffinic wax, optionally after performing a hydrocracking/hydroisomerisation step, to a pour point reducing treatment by means of catalytic dewaxing/isomerisation and

(iii) isolating by means of distillation a distillation bottoms fraction as the heavy base oil.

In step (i) a mixture of H₂ and CO is used.

Preferably the molar H₂/CO ratio of such synthesis gas is between 1.3 and 2.3, preferably between 1.6 and 2.1. This mixture may be made by gasification or reforming of a carboneous feed, for example coal, residual oil feeds and natural gas. In case natural gas is used as carboneous source the synthesis gas is preferably prepared by catalytic or non-catalytic partial oxidation, autothermal steam reforming, traditional steam reforming or convective steam reforming or combinations of said processes.

The hydrocarbon synthesis catalysts of step (i) are known in the art and are usually referred to as Fischer-Tropsch catalysts. Catalysts for use in this process frequently comprise, as the catalytically active component, a metal from Group VIII of the Periodic Table of Elements. Particular catalytically active metals include ruthenium, iron, cobalt and nickel. Cobalt is a

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preferred catalytically active metal in view of the heavy Fischer-Tropsch hydrocarbon that can be made. The catalytically active metal is preferably supported on a porous carrier. The porous carrier may be selected from any of the suitable refractory metal oxides or silicates or combinations thereof known in the art. Particular examples of preferred porous carriers include silica, alumina, titania, zirconia, ceria, gallia and mixtures thereof, especially silica, alumina and titania.

The amount of catalytically active metal on the carrier is preferably in the range of from 3 to 300 pbw per 100 pbw of carrier material, more preferably from 10 to 80 pbw, especially from 20 to 60 pbw.

If desired, the catalyst may also comprise one or more metals or metal oxides as promoters. Suitable metal oxide promoters may be selected from Groups IIA, IIIB, IVB, VB and VIB of the Periodic Table of Elements, or the actinides and lanthanides. In particular, oxides of magnesium, calcium, strontium, barium, scandium, yttrium, lanthanum, cerium, titanium, zirconium, hafnium, thorium, uranium, vanadium, chromium and manganese are very suitable promoters. Particularly preferred metal oxide promoters for the catalyst used to prepare the waxes for use in the present invention are manganese and zirconium oxide. Suitable metal promoters may be selected from Groups VIIB or VIII of the Periodic Table. Rhenium and Group VIII noble metals are particularly suitable, with platinum and palladium being especially preferred. The amount of promoter present in the catalyst is suitably in the range of from 0.01 to 100 pbw, preferably 0.1 to 40, more preferably 1 to 20 pbw, per 100 pbw of carrier. The most preferred promoters are selected from vanadium, manganese, rhenium, zirconium and platinum.

The catalytically active metal and the promoter, if present, may be deposited on the carrier material by any

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suitable treatment, such as impregnation, kneading and extrusion. After deposition of the metal and, if appropriate, the promoter on the carrier material, the loaded carrier is typically subjected to calcination. The effect of the calcination treatment is to remove crystal water, to decompose volatile decomposition products and to convert organic and inorganic compounds to their respective oxides. After calcination, the resulting catalyst may be activated by contacting the catalyst with hydrogen or a hydrogen-containing gas, typically at temperatures of about 200 to 350 °C. Other processes for the preparation of Fischer-Tropsch catalysts comprise kneading/mulling, often followed by extrusion, drying/calcination and activation.

The catalytic conversion process may be performed under conventional synthesis conditions known in the art. Typically, the catalytic conversion may be effected at a temperature in the range of from 150 to 300 °C, preferably from 180 to 260 °C. Typical total pressures for the catalytic conversion process are in the range of from 1 to 200 bar absolute, more preferably from 10 to 70 bar absolute. In the catalytic conversion process especially more than 75 wt% of C₅+, preferably more than 85 wt% C₅+ hydrocarbons are formed. Depending on the catalyst and the conversion conditions, the amount of heavy wax (C₂₀+) may be up to 60 wt%, sometimes up to 70 wt%, and sometimes even up till 85 wt%. Preferably a cobalt catalyst is used, a low H₂/CO ratio is used (especially 1.7, or even lower) and a low temperature is used (190-240 °C), optionally in combination with a high pressure. To avoid any coke formation, it is preferred to use an H₂/CO ratio of at least 0.3. It is especially preferred to carry out the Fischer-Tropsch reaction under such conditions that the ASF-alpha value (Anderson-Schulz-Flory chain growth factor), for the obtained

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products having at least 20 carbon atoms, is at least 0.925, preferably at least 0.935, more preferably at least 0.945, even more preferably at least 0.955.

Preferably the Fischer-Tropsch hydrocarbons stream
5 comprises at least 40 wt% C₃₀+, preferably 50 wt%, more preferably 55 wt%, and the weight ratio C₆₀+/C₃₀+ is at least 0.35, preferably 0.45, more preferably 0.55.

Preferably, a Fischer-Tropsch catalyst is used, which yields substantial quantities of paraffins, more
10 preferably substantially unbranched paraffins. A most suitable catalyst for this purpose is a cobalt-containing Fischer-Tropsch catalyst. Such catalysts are described in the literature, see e.g. WO-A-9934917.

The Fischer-Tropsch process of step (i) may be a
15 slurry Fischer-Tropsch process or a fixed bed Fischer-Tropsch process, especially a multi tubular fixed bed.

The paraffinic wax as obtained in step (i) is optionally subjected to a hydrocracking/
hydroisomerisation step. In such a step the feed is
20 contacted with a suitable hydroconversion catalyst, which in principle be any catalyst known in the art to be suitable for isomerising paraffinic molecules. In general, suitable hydroconversion catalysts are those comprising a hydrogenation component supported on a
25 refractory oxide carrier, such as amorphous silica-alumina, alumina, fluorided alumina, molecular sieves (zeolites) or mixtures of two or more of these. Suitable catalysts have been found to be those comprising a
Group VIII metal, especially nickel, platinum or
30 palladium and a silica-alumina carrier as will be described in more detail below.

One type of preferred catalysts to be applied in the hydroconversion step in accordance with the present invention are hydroconversion catalysts comprising
35 platinum and/or palladium as the hydrogenation component.

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A very much preferred hydroconversion catalyst comprises platinum and palladium supported on an amorphous silica-alumina (ASA) carrier. The platinum and/or palladium is suitably present in an amount of from 0.1 to 5.0% by weight, more suitably from 0.2 to 2.0% by weight, calculated as element and based on total weight of carrier. If both present, the weight ratio of platinum to palladium (calculated as element) may vary within wide limits, but suitably is in the range of from 0.05 to 10, more suitably 0.1 to 5. Examples of suitable noble metal on ASA catalysts are, for instance, disclosed in WO-A-9410264 and EP-A-582347. Other suitable noble metal-based catalysts, such as platinum on a fluorided alumina carrier, are disclosed in e.g. US-A-5059299 and WO-A-9220759.

A second type of suitable hydroconversion catalysts are those comprising at least one Group VIB metal, preferably tungsten and/or molybdenum, and at least one non-noble Group VIII metal, preferably nickel and/or cobalt, as the hydrogenation component. Usually both metals are present as oxides, sulphides or a combination thereof. The Group VIB metal is suitably present in an amount of from 1 to 35% by weight, more suitably from 5 to 30% by weight, calculated as element and based on total weight of catalyst. The non-noble Group VIII metal is suitably present in an amount of from 1 to 25 %wt, preferably 2 to 15 %wt, calculated as element and based on total weight of carrier. A hydroconversion catalyst of this type which has been found particularly suitable is a catalyst comprising nickel and tungsten supported on fluorided alumina.

A preferred catalyst which can be used in a non-sulphided form comprises a non-noble Group VIII metal, e.g., iron, nickel, in conjunction with a Group IB metal, e.g., copper, supported on an acidic support. The

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catalyst has a surface area in the range of 200-500 m²/gm, preferably 0.35 to 0.80 ml/gm, as determined by water adsorption, and a bulk density of about 0.5-1.0 g/ml. The catalyst support is preferably an amorphous silica-alumina where the alumina is present in amounts of less than about 30 wt%, preferably 5-30 wt%, more preferably 10-20 wt%. Also, the support may contain small amounts, e.g., 20-30 wt%, of a binder, e.g., alumina, silica, Group IVA metal oxides, and various types of clays, magnesia, etc., preferably alumina.

The preparation of amorphous silica-alumina microspheres has been described in Ryland, Lloyd B., Tamele, M.W., and Wilson, J.N., *Cracking Catalysts, Catalysis: volume VII*, Ed. Paul H. Emmett, Reinhold Publishing Corporation, New York, 1960, pp. 5-9.

The catalyst is prepared by co-impregnating the metals from solutions onto the support, drying at 100-150 °C, and calcining in air at 200-550 °C. The Group VIII metal is present in amounts of about 15 wt% or less, preferably 1-12 wt%, while the Group IB metal is usually present in lesser amounts, e.g., 1:2 to about 1:20 ratio respecting the Group VIII metal.

A typical catalyst is shown below:

	Ni, wt%	2.5-3.5
25	Cu, wt%	0.25-0.35
	Al ₂ O ₃ -SiO ₂ wt%	65-75
	Al ₂ O ₃ (binder) wt%	25-30
	Surface Area	290-325 m ² /gm
	Pore Volume (Hg)	0.35-0.45 ml/gm
30	Bulk Density	0.58-0.68 g/ml

The hydroconversion conditions applied in such a hydrocracking/hydroisomerisation step are those known to be suitable in hydroisomerisation operations. Suitable

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conditions, then, involve operating temperatures in the range of from 275 to 450 °C, preferably 300 to 425 °C, a hydrogen partial pressure in the range of from 10 to 250 bar, suitably 25 to 200 bar, a weight hourly space velocity (WHSV) in the range of from 0.1 to 10 kg/l/h, preferably 0.2 to 5 kg/l/h, and a gas rate in the range of from 100 to 5,000 Nl/kg, preferably 500 to 3,000 Nl/kg. Suitably the conditions are so chosen that the wax conversion be preferably between 40 and 90 wt% and more preferably between 60 and 90 wt%. In this context of the present invention the wax content is measured according to the following procedure. 1 weight part of the to be measured oil fraction is diluted with 4 parts of a (50/50 vol/vol) mixture of methyl ethyl ketone and toluene, which is subsequently cooled to -27 °C in a refrigerator. The mixture is subsequently filtered at -27 °C. The wax is removed from the filter and weighed.

The optionally partly isomerised paraffinic wax is subjected in step (ii) to a catalytic dewaxing/ isomerisation step. A combined hydrocracking/ hydroisomerisation and dewaxing process may be performed in series flow wherein the effluent of the first step is directly subjected to the dewaxing process. In another embodiment the lower boiling fractions, suitably the boiling fractions that boil in the middle distillate range and below are first separated from the effluent before performing the dewaxing step. In another embodiment also the light base oil precursor fractions are separated from the effluent before performing the dewaxing step. The effective cutpoint of such a separation is suitably in the range of from 400 to 550 °C. The effective cutpoint is the temperature above which at least at least 85% by weight and preferably at least 90% by weight, of the hydrocarbons present in this

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heavy fraction has its boiling point. This separation or fractionation can be achieved by techniques known in the art, such as atmospheric and vacuum distillation or vacuum flashing.

5 In step (ii) the waxy feed is subjected to a catalytic dewaxing treatment. In such process step the feed is contacted with a suitable catalyst under catalytic dewaxing conditions. The process conditions applied when using such catalysts are preferably chosen
10 that the resulting base oil feed has a pour point being substantially lower than its cloud point. The dewaxing catalyst which may be applied in step (ii) suitably comprises a molecular sieve and optionally in combination with a metal having a hydrogenation function, such as the
15 Group VIII metals. Molecular sieves, and more suitably molecular sieves having a pore diameter of between 0.35 and 0.8 nm have shown a good catalytic ability to reduce the pour point of the wax feed. Suitable zeolites are mordenite, beta, ZSM-5, ZSM-12, ZSM-22, ZSM-23, SSZ-32,
20 ZSM-35 and ZSM-48 or combinations of said zeolites. Another preferred group of molecular sieves are the silica-aluminaphosphate (SAPO) materials of which SAPO-11 is most preferred as for example described in
25 US-A-4859311. The other molecular sieves are preferably used in combination with an added Group VIII metal. Suitable Group VIII metals are nickel, cobalt, platinum and palladium. Examples of possible combinations are Pt/ZSM-35, Ni/ZSM-5, Pt/ZSM-23, Pd/ZSM-23, Pt/ZSM-48 and Pt/SAPO-11 or stacked configurations of Pt/zeolite beta
30 and Pt/ZSM-23, Pt/zeolite beta and Pt/ZSM-48 or Pt/zeolite beta and Pt/ZSM-22. Further details and examples of suitable molecular sieves and dewaxing conditions are for example described in WO-A-9718278, US-A-4343692, US-A-5053373, US-A-5252527,
35 US-A-20040065581, US-A-4574043 and EP-A-1029029.

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The dewaxing catalyst suitably also comprises a binder. The binder can be a synthetic or naturally occurring (inorganic) substance, for example clay, silica and/or metal oxides. Natural occurring clays are for example of the montmorillonite and kaolin families. The binder is preferably a porous binder material, for example a refractory oxide of which examples are: alumina, silica-alumina, silica-magnesia, silica-zirconia, silica-thoria, silica-beryllia, silica-titania as well as ternary compositions for example silica-alumina-thoria, silica-alumina-zirconia, silica-alumina-magnesia and silica-magnesia-zirconia. More preferably a low acidity refractory oxide binder material, which is essentially free of alumina, is used. Examples of these binder materials are silica, zirconia, titanium dioxide, germanium dioxide, boria and mixtures of two or more of these of which examples are listed above. The most preferred binder is silica.

A preferred class of dewaxing catalysts comprise intermediate zeolite crystallites as described above and a low acidity refractory oxide binder material which is essentially free of alumina as described above, wherein the surface of the aluminosilicate zeolite crystallites has been modified by subjecting the aluminosilicate zeolite crystallites to a surface dealumination treatment. A preferred dealumination treatment is by contacting an extrudate of the binder and the zeolite with an aqueous solution of a fluorosilicate salt as described in for example US-A-5157191 or WO-A-0029511. Examples of suitable dewaxing catalysts as described above are silica bound and dealuminated Pt/ZSM-5, silica bound and dealuminated Pt/ZSM-35 as for example described in WO-A-0029511 and EP-B-832171.

The dewaxing conditions in step (ii) typically involve operating temperatures in the range of from 200

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to 500 °C, suitably from 250 to 400 °C. Preferably the temperature is between 300 and 330 °C. The hydrogen pressures in the range of from 10 to 200 bar, preferably from 40 to 70 bar, weight hourly space velocities (WHSV) in the range of from 0.1 to 10 kg of oil per litre of catalyst per hour (kg/l/hr), suitably from 0.1 to 5 kg/l/hr, more suitably from 0.1 to 3 kg/l/hr and hydrogen to oil ratios in the range of from 100 to 2,000 litres of hydrogen per litre of oil.

From the effluent of step (ii) lower boiling fractions are suitably separating in step (iii) to obtain a distillation residue as the base oil feed having the properties as described above.

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C L A I M S

1. Process for reducing the cloud point of a base oil feed having a kinematic viscosity at 100 °C of greater than 10 cSt by separating the molecules inferring the high cloud point from the base oil by (a) depositing said molecules on one side of a cooled surface, (b) obtaining a base oil having a reduced cloud point and (c) melting the deposited molecules and separating the melted molecules from the surface and reusing said surface to perform step (a).
2. Process according to claim 1, wherein the temperature of the surface is between the cloud point and the pour point of the base oil feed.
3. Process according to claim 2, wherein the surface is cooled at the other side of the surface by a cooling medium.
4. Process according to any one of claims 1-3, wherein the surface comprises a substantially vertical oriented tube or arrangement of tubes at which inner side of the tube or tubes the base oil feed is allowed to flow and wherein outside of the tube a the cooling medium flows.
5. Process according to any one of claims 1-4, wherein the base oil has a cloud point greater than 20 °C, a saturates content of greater than 97 wt%, a kinematic viscosity at 100 °C of greater than 12 cSt, a sulphur content of less than 50 ppm and a viscosity index of greater than 130.
6. Process according to any one of claims 1-5, wherein the base oil feed is prepared from carbon monoxide and hydrogen by
 - (i) contacting carbon monoxide and hydrogen with a hydrocarbon synthesis catalyst at elevated temperature

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and pressure to prepare a substantially paraffinic hydrocarbon wax; and

- 5 (ii) subjecting the paraffinic wax, optionally after performing a hydrocracking/hydroisomerisation step, to a pour point reducing treatment by means of catalytic dewaxing/isomerisation and
- (iii) isolating by means of distillation a distillation bottoms fraction as the heavy base oil.