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(54) AUTOMATIC TRANSMISSION FLUID

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(57) ABSTRACT

Provided are compositions for use in Automatic Transmission Fluids. More specifically, provided are Automatic Transmission Fluids made using Gas-to-Liquids lubricant base oils, which are formulated with minimal to no polymeric Viscosity Index improvers and processes for production thereof. The automatic transmission fluids disclosed herein contain a) a lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90;

b) an automatic transmission fluid additive package; and

c) less than 1.0 wt % Viscosity Index improver. The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 6.0 mm^2/s.

AUTOMATIC TRANSMISSION FLUID

RELATED APPLICATIONS

[0001] The present application is a divisional of U.S. patent application Ser. No. 12/068,455, filed 6 Feb. 2008, which claims priority to U.S. Provisional Patent Application Ser. No. 60/900,093, filed 8 Feb. 2007, the contents of both of which are hereby incorporated by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to compositions for use in Automatic Transmission Fluids, and more specifically to Automatic Transmission Fluids made using Gas-to-Liquids lubricant base oils, formulated with minimal to no polymeric Viscosity Index improvers.

BACKGROUND OF THE INVENTION

[0003] Automatic transmission fluids are lubricants used in motor vehicle transmissions. Different types of automatic transmission fluids are used depending on the design and severity of application. Generally, automatic transmission fluids are designed to meet specific manufacturer requirements.

[0004] An automatic transmission is composed of a complex variety of mechanical parts which operate at close tolerances. The purpose of automatic transmission fluid is to lubricate these close-fitting parts to reduce wear and to keep down temperature increases due to friction. To perform this function, the automatic transmission fluid must maintain its viscosity within certain specifications. Achieving this function is complicated by the changing temperatures under which the transmission is operated. It is desirable that an automatic transmission fluid perform well in all the various temperature conditions under which the transmission will operate.

[0005] For example, in a Northern location, the automatic transmission fluid may be below 0° C. prior to use and then heat up to over 149° C. during use. As automatic transmissions evolve, the maximum viscosity at low temperatures is reduced since too viscous an automatic transmission fluid will not adequately flow as needed to actuate the hydraulic valves and other hydraulic mechanisms of the automatic transmission. Automobile manufacturers have recently changed their specifications for automatic transmission fluid to require lower maximum viscosities at low temperatures. The next generation automatic transmissions will require next generation automatic transmission fluids, especially to be sure that the automatic transmission fluid flows adequately at low temperatures. For example, new generation automatic transmission fluids must have Brookfield viscosities at −40° C. of less than 10,000 mPas, 13,000 mPas, or 17,500 mPas. Current requirements for automatic transmission fluids typically only require a Brookfield viscosity at −40° C. of less than 20,000 mPas.

[0006] EP 1062305 is directed to an easily biodegradable low viscosity, low Noack volatility lube oil material having a viscosity index in the range of about 110-145, >98% saturates useful as lube oil basestock, automatic transmission fluid (ATF) basestock or blending stock. The lube oil material is produced by the isomerization of a wax feed having a viscosity of from 4 to 10 mm^2/s at 100° C. and containing less than about 25% oil in wax.

[0007] EP 1366138 discloses an automatic transmission fluid having a kinematic viscosity at 100° C. of between more than 4 and 10 mm^2/s, a dynamic viscosity at −40° C. of less than 10000 mPa·s comprising an additive package and a base oil, wherein the base oil fraction comprises at least 98 wt % saturates, of which saturates fraction the content of cycloparaffins is between 10 and 40 wt % and wherein the pour point of the base oil is less than −25° C.

[0008] EP 1632549 discloses an automatic transition fluid composition comprising a base oil prepared from a Fischer-Tropsch product. The base oil may have a pour point of below −40° C. and may have a kinematic viscosity at 100° C. of between 3 and 6 mm^2/s. The composition may comprises one or more of the following performance additives being an antiwear agent, an antioxidant, an ashless dispersant, a pour point depressant, and antifoam agent, a friction modifier, a corrosion inhibitor and a viscosity modifier. An Automatic Transmission Fluid (ATF) having too low a viscosity at higher operating temperatures will not provide sufficient protection to transmission components. However, an ATF having too high a viscosity at lower operating temperatures will have a negative influence on fuel economy. In order to avoid having too low a viscosity at higher operating temperatures and too high a viscosity at lower operating temperatures, an ATF needs to display a high Viscosity Index. Conventional lubricant base oils do not have sufficiently high Viscosity Indexes to meet those requirements. Therefore, when formulated as ATFs, these conventional lubricant base oils normally incorporate a polymeric Viscosity Index improver. However, when these ATF formulations are utilized in applications, the polymer molecules of the Viscosity Index improvers can be cleaved, leading to a permanent reduction in the viscosity of the fluid, which limits the applications in which the fluid can be used.

[0009] Accordingly, it would be advantageous to identify an ATF that does not require Viscosity Index improver. The ATF of the present invention meets this need.

SUMMARY OF THE INVENTION

[0010] Provided is an automatic transmission fluid comprising: a) a lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

$$\text{Viscosity Index Factor}=28\times\ln(\text{Kinematic Viscosity at } 100^\circ\text{ C.})+90$$

(wherein ln refers to the natural logarithm, which is the logarithm to the base e); b) an automatic transmission fluid additive package; and c) less than 1.0 wt % Viscosity Index improver. The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 6.0 mm^2/s. Also provided is an automatic transmission fluid comprising a lubricant base oil, the lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor plus 15, wherein the Viscosity Index Factor is calculated by the following equation:

$$\text{Viscosity Index Factor}=28\times\ln(\text{Kinematic Viscosity at } 100^\circ\text{ C.})+90.$$

The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

[0011] Additionally provided is a process for producing an automatic transmission fluid comprising: a) providing a lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90;

b) blending the lubricant base oil fraction with an automatic transmission fluid additive package; and c) isolating an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver. The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

[0012] Further provided is a process for producing an automatic transmission fluid comprising: a) performing a Fischer-Tropsch synthesis to provide a product stream; b) isolating from the product stream a waxy feed; c) hydroisomerizing the waxy feed using a shape selective intermediate pore size molecular sieve comprising a noble metal hydrogenation component under conditions of about 316° C. to about 399° C.; d) isolating an isomerized oil; e) hydrofinishing the isomerized oil to provide a Fischer-Tropsch derived lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90;

f) blending the Fischer-Tropsch derived lubricant base oil with an automatic transmission fluid additive package; and g) isolating an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver. The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

[0013] In addition, provided is a process for producing an automatic transmission fluid comprising: a) performing a Fischer-Tropsch synthesis to provide a product stream; b) isolating from the product stream a waxy feed; c) hydroisomerizing the waxy feed using a shape selective intermediate pore size molecular sieve comprising a noble metal hydrogenation component under conditions of about 316° C. to about 399° C.; d) isolating an isomerized oil; e) vacuum distilling the isomerized oil to provide a lubricant base oil; 0 hydrofinishing the lubricant base oil to provide a Fischer-Tropsch derived lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90;

g) blending the Fischer-Tropsch derived lubricant base oil with an automatic transmission fluid additive package; and h) isolating an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver. The intermediate pore size molecular sieve selected from the group consisting of SAPO-11, SAPO-31, SAPO-41, SM-3, ZSM-22, ZSM-23, ZSM-35, ZSM-48, ZSM-57, SSZ-32, offretite, ferrierite, and combinations thereof and the noble metal hydrogenation component is selected from the group consisting of platinum, palladium, and combinations thereof. The automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

DETAILED DESCRIPTION OF THE INVENTION

[0014] As described herein, an ATF was formulated using Gas-to-Liquids (GTL) lubricant base oils. As a result of the inherently high Viscosity Index of the GTL lubricant base oils, the ATF could be formulated with minimal polymeric Viscosity Index improver, for example, no polymeric Viscosity Index improver. Typically a Viscosity Index improver modifies the viscometric characteristics of lubricants by reducing the rate of thinning with increasing temperature and the rate of thickening with low temperatures. The problem of viscosity reduction in service as a result of degradation of the Viscosity Index improver is avoided by the absence of this additive. Moreover, the ATFs as described herein exhibit improved fuel economy due to the high viscosity index of the lubricant base oil used in formulating the ATFs.

Definitions and Terms

[0015] The following terms will be used throughout the specification and will have the following meanings unless otherwise indicated.

[0016] "Fischer-Tropsch derived" means that the product, fraction, or feed originates from or is produced at some stage by a Fischer-Tropsch process.

[0017] "Brookfield Viscosity", or the low-temperature, low-shear-rate viscosity of automotive fluid lubricants at low temperatures, is measured according to ASTM D2983-04a.

[0018] "Kinematic viscosity" is a measurement of the resistance to flow of a fluid under gravity. Many lubricant base oils, ATFs made from them, and the correct operation of equipment depends upon the appropriate viscosity of the fluid being used. Kinematic viscosity is determined by ASTM D445-06. The results are reported in centistokes (mm^2/s).

[0019] "Viscosity Index" (VI) is an empirical, unitless number indicating the effect of temperature change on the kinematic viscosity of the oil. Liquids change viscosity with temperature, becoming less viscous when heated; the higher the Viscosity Index of an oil, the lower its tendency to change viscosity with temperature. High Viscosity Index lubricants are needed wherever relatively constant viscosity is required at widely varying temperatures. For example, in an automobile, engine oil must flow freely enough to permit cold starting, but must be viscous enough after warm-up to provide full lubrication. Viscosity index may be determined as described in ASTM D2270-04.

[0020] The "Viscosity Index Factor" of a lubricant base oil is an empirical number derived from kinematic viscosity of the lubricant base oil. The Viscosity Index Factor of a lubricant base oil is calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90.

The lubricant base oils used in the ATFs of the present invention have a Viscosity Index greater than the Viscosity Index Factor.

Lubricant Base Oil

[0021] The lubricant base oils used in the ATFs of the present invention are made by process comprising providing a waxy feed and then hydroisomerizing the waxy feed as described herein. In some embodiments, the waxy feed is hydroisomerized using a shape selective intermediate pore size molecular sieve comprising a noble metal hydrogenation component under conditions of about 316° C. to 399° C.

[0022] In certain embodiments, the lubricant base oil is a Gas-to-Liquids (GTL) lubricant base oil, for example, the waxy feed is Fischer-Tropsch derived. The lubricant base oil is optionally made by a Fischer-Tropsch synthesis process followed by hydroisomerization of the waxy fractions of the Fischer-Tropsch syncrude.

[0023] The lubricant base oils used in the ATFs of the present invention in certain embodiments have a Viscosity Index greater than a Viscosity Index greater than a Viscosity Index Factor of the lubricant base oil as calculated by the following equation:

Viscosity Index Factor=28×ln(Kinematic Viscosity at 100° C.)+90.

In certain embodiments, the lubricant base oils used in the ATFs of the present invention have a difference between the Viscosity Index and the Viscosity Index Factor of the lubricant base oil of greater than 5, and in other embodiments, a difference between the Viscosity Index and the Viscosity Index Factor of the lubricant base oil of greater than 15.

Waxy Feed

[0024] Suitable waxy feeds have high levels of n-paraffins and are low in oxygen, nitrogen, sulfur, and elements such as aluminum, cobalt, titanium, iron, molybdenum, sodium, zinc, tin, and silicon. The waxy feeds useful in this invention have greater than 40 weight percent n-paraffins, less than 1 weight percent oxygen, less than 25 ppm total combined nitrogen and sulfur, and less than 25 ppm total combined aluminum, cobalt, titanium, iron, molybdenum, sodium, zinc, tin, and silicon. In certain embodiments, the waxy feeds have greater than 50 weight percent n-paraffins, less than 0.8 weight percent oxygen, less than 20 ppm total combined nitrogen and sulfur, and less than 20 ppm total combined aluminum, cobalt, titanium, iron, molybdenum, sodium, zinc, tin, and silicon. In other embodiments, the waxy feeds have greater than 75 weight percent n-paraffins, less than 0.8 weight percent oxygen, less than 20 ppm total combined nitrogen and sulfur, and less than 20 ppm total combined aluminum, cobalt, titanium, iron, molybdenum, sodium, zinc, tin, and silicon.

[0025] Waxy feeds useful in this invention are expected to be plentiful and relatively cost competitive in the near future as large-scale Fischer-Tropsch synthesis processes come into production. The Fischer-Tropsch synthesis process provides a way to convert a variety of hydrocarbonaceous resources into products usually provided by petroleum. In preparing hydrocarbons via the Fischer-Tropsch process, a hydrocarbonaceous resource, such as, for example, natural gas, coal, refinery fuel gas, tar sands, oil shale, municipal waste, agricultural waste, forestry waste, wood, shale oil, bitumen, crude oil, and fractions from crude oil, is first converted into synthesis gas which is a mixture comprising carbon monoxide and hydrogen. The synthesis gas is further processed into syncrude. Syncrude prepared from the Fischer-Tropsch process comprises a mixture of various solid, liquid, and gaseous hydrocarbons. Those Fischer-Tropsch products which boil within the range of lubricating base oil contain a high proportion of wax which makes them ideal candidates for processing into base oil. Accordingly, Fischer-Tropsch wax represents an excellent feed for preparing high quality base oils according to the process of the invention. Fischer-Tropsch wax is normally solid at room temperature and, consequently, displays poor low temperature properties, such as pour point and cloud point. However, following hydroisomerization of the wax, Fischer-Tropsch derived base oils having excellent low temperature properties may be prepared.

Fischer-Tropsch Synthesis

[0026] The Fischer-Tropsch synthesis process provides a way to convert a variety of hydrocarbonaceous resources into products usually provided by petroleum. In preparing hydrocarbons via the Fischer-Tropsch process, a hydrocarbonaceous resource, such as, for example, natural gas, coal, refinery fuel gas, tar sands, oil shale, municipal waste, agricultural waste, forestry waste, wood, shale oil, bitumen, crude oil, and fractions from crude oil, is first converted into synthesis gas which is a mixture comprising carbon monoxide and hydrogen. The feedstock for the Fischer-Tropsch process may come from a wide variety of hydrocarbonaceous resources, including biomass, natural gas, coal, shale oil, petroleum, municipal waste, derivatives of these, and combinations thereof.

[0027] In Fischer-Tropsch chemistry, syngas is converted to liquid hydrocarbons by contact with a Fischer-Tropsch catalyst under reactive conditions. Typically, methane and optionally heavier hydrocarbons (ethane and heavier) can be sent through a conventional syngas generator to provide synthesis gas. Generally, synthesis gas contains hydrogen and carbon monoxide, and may include minor amounts of carbon dioxide and/or water. The presence of sulfur, nitrogen, halogen, selenium, phosphorus and arsenic contaminants in the syngas is undesirable. For this reason and depending on the quality of the syngas, in some embodiments sulfur and other contaminants may be removed from the feed before performing the Fischer-Tropsch chemistry. Means for removing these contaminants are well known to those of skill in the art. For example, ZnO guardbeds may be used to remove sulfur impurities. Means for removing other contaminants are well known to those of skill in the art. It also may be desirable to purify the syngas prior to the Fischer-Tropsch reactor to remove carbon dioxide produced during the syngas reaction and any additional sulfur compounds not already removed. This can be accomplished, for example, by contacting the syngas with a mildly alkaline solution (e.g., aqueous potassium carbonate) in a packed column.

[0028] In the Fischer-Tropsch process, contacting a synthesis gas comprising a mixture of H_2 and CO with a Fischer-Tropsch catalyst under suitable temperature and pressure reactive conditions forms liquid and gaseous hydrocarbons. The Fischer-Tropsch reaction is typically conducted at temperatures of about 149° C. to about 371° C.), optionally about 204° C. to about 288° C.); pressures of about 10-600 psia, (0.7-41 bars), optionally about 30-300 psia, (2-21 bars); and catalyst space velocities of about 100-10,000 cc/g/hr, optionally about 300-3,000 cc/g/hr. Examples of conditions for performing Fischer-Tropsch type reactions are well known to those of skill in the art.

[0029] The products of the Fischer-Tropsch synthesis process may range from C_1 to C_{200+} with a majority in the C_5 to C_{100+} range. The reaction can be conducted in a variety of reactor types, such as fixed bed reactors containing one or more catalyst beds, slurry reactors, fluidized bed reactors, or a combination of different type reactors. Such reaction processes and reactors are well known and documented in the literature.

[0030] The slurry Fischer-Tropsch process utilizes superior heat (and mass) transfer characteristics for the strongly exothermic synthesis reaction and is able to produce relatively high molecular weight, paraffinic hydrocarbons when using a cobalt catalyst. In the slurry process, a syngas comprising a mixture of hydrogen and carbon monoxide is bubbled up as a third phase through a slurry which comprises a particulate Fischer-Tropsch type hydrocarbon synthesis catalyst dispersed and suspended in a slurry liquid comprising hydrocarbon products of the synthesis reaction which are liquid under the reaction conditions. The mole ratio of the hydrogen to the carbon monoxide may broadly range from about 0.5 to about 4, but is more typically within the range of from about 0.7 to about 2.75 and optionally from about 0.7 to about 2.5. An example of a useful Fischer-Tropsch process is taught in EP 0609079, also completely incorporated herein by reference for all purposes.

[0031] In general, Fischer-Tropsch catalysts contain a Group VIII transition metal on a metal oxide support. The catalysts may also contain a noble metal promoter(s) and/or crystalline molecular sieves. Suitable Fischer-Tropsch catalysts comprise one or more of Fe, Ni, Co, Ru and Re. A useful Fischer-Tropsch catalyst comprises effective amounts of cobalt and one or more of Re, Ru, Pt, Fe, Ni, Th, Zr, Hf, U, Mg and La on a suitable inorganic support material, optionally one which comprises one or more refractory metal oxides. In general, the amount of cobalt present in the catalyst is between about 1 and about 50 weight percent of the total catalyst composition. The catalysts can also contain basic oxide promoters such as ThO_2, La_2O_3, MgO, and TiO_2, promoters such as ZrO_2, noble metals (Pt, Pd, Ru, Rh, Os, Ir), coinage metals (Cu, Ag, Au), and other transition metals such as Fe, Mn, Ni, and Re. Suitable support materials include alumina, silica, magnesia and titania or mixtures thereof. Some supports for cobalt containing catalysts comprise titania. Useful catalysts and their preparation are known and illustrated in U.S. Pat. No. 4,568,663, which is intended to be illustrative but non-limiting relative to catalyst selection.

[0032] Certain catalysts are known to provide chain growth probabilities that are relatively low to moderate, and the reaction products include a relatively high proportion of low molecular (C_{2-8}) weight olefins and a relatively low proportion of high molecular weight (C_{30+}) waxes. Certain other catalysts are known to provide relatively high chain growth probabilities, and the reaction products include a relatively low proportion of low molecular (C_{2-8}) weight olefins and a relatively high proportion of high molecular weight (C_{30+}) waxes. Such catalysts are well known to those of skill in the art and can be readily obtained and/or prepared.

[0033] The product from a Fischer-Tropsch process contains predominantly paraffins. The products from Fischer-Tropsch reactions generally include a light reaction product and a waxy reaction product. The light reaction product (i.e., the condensate fraction) includes hydrocarbons boiling below about 371° C. (e.g., tail gases through middle distillate fuels), largely in the C_5-C_{20} range, with decreasing amounts up to about C_{30}. The waxy reaction product (i.e., the wax fraction) includes hydrocarbons boiling above about 316° C. (e.g., vacuum gas oil through heavy paraffins), largely in the C_{20+} range, with decreasing amounts down to C_{10}.

[0034] Both the light reaction product and the waxy product are substantially paraffinic. The waxy product generally comprises greater than 70 weight % normal paraffins, and often greater than 80 weight % normal paraffins. The light reaction product comprises paraffinic products with a significant proportion of alcohols and olefins. In some cases, the light reaction product may comprise as much as 50 weight %, and even higher, alcohols and olefins. It is the waxy reaction product (i.e., the wax fraction or waxy feed) that is used as a feedstock to a process for providing the lubricant base oil used in the ATFs according to the present invention.

[0035] The lubricant base oils used in the ATFs according to the present invention are prepared from the waxy fractions of the Fischer-Tropsch syncrude by a process including hydroisomerization. The lubricant base oils used in the ATFs according to the present invention may be manufactured at a site different from the site at which the components of the ATFs are received and blended.

Hydroisomerization

[0036] The waxy feeds are subjected to a process comprising hydroisomerization to provide the lubricant base oils used in the ATFs according to the present invention.

[0037] Hydroisomerization is intended to improve the cold flow properties of the lubricant base oil by the selective addition of branching into the molecular structure. Hydroisomerization ideally will achieve high conversion levels of the waxy feed to non-waxy iso-paraffins while at the same time minimizing the conversion by cracking. In some embodiments, the conditions for hydroisomerization in the present invention are controlled such that the conversion of the compounds boiling above about 371° C. in the wax feed to compounds boiling below about 371° C. is maintained between about 10 and 50 weight %, optionally between 15 and 45 weight %.

[0038] According to the present invention, hydroisomerization is conducted using a shape selective intermediate pore size molecular sieve. Hydroisomerization catalysts useful in the present invention comprise a shape selective intermediate pore size molecular sieve and optionally a catalytically active metal hydrogenation component on a refractory oxide support. The phrase "intermediate pore size", as used herein, means an effective pore aperture in the range of from about 3.9 to about 7.1 Å when the porous inorganic oxide is in the calcined form. The shape selective intermediate pore size molecular sieves used in the practice of the present invention are generally 1-D 10-, 11- or 12-ring molecular sieves. In some embodiments of the invention, the molecular sieves are of the 1-D 10-ring variety, where 10-(or 11- or 12-) ring molecular sieves have 10 (or 11 or 12) tetrahedrally-coordinated atoms (T-atoms) joined by oxygens. In the 1-D molecular sieve, the 10-ring (or larger) pores are parallel with each other, and do not interconnect. Note, however, that 1-D 10-ring molecular sieves which meet the broader definition of the intermediate pore size molecular sieve but include intersecting pores having 8-membered rings may also be encompassed within the definition of the molecular sieve of the present invention. The classification of intrazeolite channels as 1-D, 2-D and 3-D is set forth by R. M. Barrer in Zeolites, Science and Technology, edited by F. R. Rodrigues, L. D. Rollman and C. Naccache, NATO ASI Series, 1984 which classification is incorporated in its entirety by reference (see particularly page 75).

[0039] Some shape selective intermediate pore size molecular sieves used for hydroisomerization are based upon aluminum phosphates, such as SAPO-11, SAPO-31, and SAPO-41. SM-3 is an example of a shape selective intermediate pore size SAPO, which has a crystalline structure falling within that of the SAPO-11 molecular sieves. The preparation of SM-3 and its unique characteristics are described in U.S. Pat. Nos. 4,943,424 and 5,158,665. Other shape selective intermediate pore size molecular sieves used for hydroisomerization are zeolites, such as ZSM-22, ZSM-23, ZSM-35, ZSM-48, ZSM-57, SSZ-32, offretite, and ferrierite.

[0040] A useful intermediate pore size molecular sieve is characterized by selected crystallographic free diameters of the channels, selected crystallite size (corresponding to selected channel length), and selected acidity. Desirable crystallographic free diameters of the channels of the molecular sieves are in the range of from about 3.9 to about 7.1 Å, having a maximum crystallographic free diameter of not more than 7.1 and a minimum crystallographic free diameter of not less than 3.9 Å. Optionally, the maximum crystallographic free diameter is not more than 7.1 and the minimum crystallographic free diameter is not less than 4.0 Å. In some embodiments the maximum crystallographic free diameter is not more than 6.5 and the minimum crystallographic free diameter is not less than 4.0 Å. The crystallographic free diameters of the channels of molecular sieves are published in the "Atlas of Zeolite Framework Types", Fifth Revised Edition, 2001, by Ch. Baerlocher, W. M. Meier, and D. H. Olson, Elsevier, pp 10-15, which is incorporated herein by reference.

[0041] An intermediate pore size molecular sieve which is useful in the present invention is described, for example, in U.S. Pat. Nos. 5,135,638 and 5,282,958, the contents of which are hereby incorporated by reference in their entirety. In U.S. Pat. No. 5,282,958, such an intermediate pore size molecular sieve has a crystallite size of no more than about 0.5 microns and pores with a minimum diameter of at least about 4.8 Å and with a maximum diameter of about 7.1 Å. The catalyst has sufficient acidity so that 0.5 grams thereof when positioned in a tube reactor converts at least 50% of hexadecane at 370° C., a pressure of 1200 psig, a hydrogen flow of 160 ml/min, and a feed rate of 1 ml/hr. The catalyst also exhibits isomerization selectivity of 40 percent or greater (isomerization selectivity is determined as follows: 100×(weight % branched C_{16} in product)/(weight % branched C_{16} in product+weight % C_{13-} in product) when used under conditions leading to 96% conversion of normal hexadecane (n-C_{16}) to other species.

[0042] If the crystallographic free diameters of the channels of a molecular sieve are unknown, the effective pore size of the molecular sieve can be measured using standard adsorption techniques and hydrocarbonaceous compounds of known minimum kinetic diameters. See Breck, Zeolite Molecular Sieves, 1974 (especially Chapter 8); Anderson et al. J. Catalysis 58, 114 (1979); and U.S. Pat. No. 4,440,871, the pertinent portions of which are incorporated herein by reference. In performing adsorption measurements to determine pore size, standard techniques are used. It is convenient to consider a particular molecule as excluded if does not reach at least 95% of its equilibrium adsorption value on the molecular sieve in less than about 10 minutes ($p/p_o=0.5$ at 25° C.). Intermediate pore size molecular sieves will typically admit molecules having kinetic diameters of 5.3 to 6.5 Å with little hindrance.

[0043] Hydroisomerization catalysts useful in the present invention comprise a catalytically active hydrogenation metal. The presence of a catalytically active hydrogenation metal leads to product improvement, especially Viscosity Index and stability. Typical catalytically active hydrogenation metals include chromium, molybdenum, nickel, vanadium, cobalt, tungsten, zinc, platinum, and palladium. If platinum and/or palladium is used, the total amount of active hydrogenation metal is typically in the range of 0.1 to 5 weight percent of the total catalyst, usually from 0.1 to 2 weight percent, and not to exceed 10 weight percent.

[0044] The refractory oxide support may be selected from those oxide supports, which are conventionally used for catalysts, including silica, alumina, silica-alumina, magnesia, titania and combinations thereof.

[0045] The conditions for hydroisomerization will depend on the properties of feed used, the catalyst used, whether or not the catalyst is sulfided, the desired yield, and the desired properties of the lubricant base oil. Conditions under which the hydroisomerization process of the current invention may be carried out include temperatures from about 260° C. to about 413° C., optionally about 316° C. to about 399° C., or about 316° C. to about 371° C.; and pressures from about 15 to 3000 psig, optionally 100 to 2500 psig. The hydroisomerization pressures in this context refer to the hydrogen partial pressure within the hydroisomerization reactor, although the hydrogen partial pressure is substantially the same (or nearly the same) as the total pressure. The liquid hourly space velocity during contacting is generally from about 0.1 to 20 hr^{-1}, for example, from about 0.1 to about 5 hr^{-1}. The hydrogen to hydrocarbon ratio falls within a range from about 1.0 to about 50 moles H_2 per mole hydrocarbon, for example, from about 10 to about 20 moles H_2 per mole hydrocarbon. Suitable conditions for performing hydroisomerization are described in U.S. Pat. Nos. 5,282,958 and 5,135,638, the contents of which are incorporated by reference in their entirety.

[0046] Hydrogen is present in the reaction zone during the hydroisomerization process, typically in a hydrogen to feed ratio from about 89 liter H_2/liter feed to about 5343 liter H_2/liter feed, optionally from about 178 liter H_2/liter feed to about 1781 liter H_2/liter feed. Hydrogen may be separated from the product and recycled to the reaction zone.

Hydrotreating

[0047] The waxy feed to the hydroisomerization process may be hydrotreated prior to hydroisomerization. Hydrotreating refers to a catalytic process, usually carried out in the presence of free hydrogen, in which the primary purpose is the removal of various metal contaminants, such as arsenic, aluminum, and cobalt; heteroatoms, such as sulfur and nitrogen; oxygenates; or aromatics from the feed stock. Generally, in hydrotreating operations cracking of the hydrocarbon molecules, i.e., breaking the larger hydrocarbon molecules into smaller hydrocarbon molecules, is minimized, and the unsaturated hydrocarbons are either fully or partially hydrogenated.

[0048] Catalysts used in carrying out hydrotreating operations are well known in the art. See, for example, U.S. Pat. Nos. 4,347,121 and 4,810,357, the contents of which are hereby incorporated by reference in their entirety, for general descriptions of hydrotreating, hydrocracking, and of typical catalysts used in each of the processes. Suitable catalysts include noble metals from Group VIIIA (according to the 1975 rules of the International Union of Pure and Applied Chemistry), such as platinum or palladium on an alumina or siliceous matrix, and Group VIII and Group VIB, such as nickel-molybdenum or nickel-tin on an alumina or siliceous matrix. U.S. Pat. No. 3,852,207 describes a suitable noble metal catalyst and mild conditions. Other suitable catalysts are described, for example, in U.S. Pat. Nos. 4,157,294 and 3,904,513. The non-noble hydrogenation metals, such as nickel-molybdenum, are usually present in the final catalyst composition as oxides, but are usually employed in their reduced or sulfided forms when such sulfide compounds are readily formed from the particular metal involved. Some non-noble metal catalyst compositions contain in excess of about 5 weight percent, optionally about 5 to about 40 weight percent molybdenum and/or tungsten, and at least about 0.5, and generally about 1 to about 15 weight percent of nickel and/or cobalt determined as the corresponding oxides. Catalysts containing noble metals, such as platinum, contain in excess of 0.01 percent metal, for example, between 0.1 and 1.0 percent metal. Combinations of noble metals may also be used, such as mixtures of platinum and palladium.

[0049] Typical hydrotreating conditions vary over a wide range. In general, the overall liquid hourly space velocity (LHSV) is about 0.25 to 2.0, optionally about 0.5 to 1.5. The hydrogen partial pressure is greater than 200 psia, often ranging from about 500 psia to about 2000 psia. Hydrogen recirculation rates are typically greater than about 9 liter H_2/liter feed, for example, between about 178 liter H_2/liter feed to about 891 liter H_2/liter feed. Temperatures in the reactor will range from about 149° C. to about 399° C., for example, ranging from about 230° C. to about 385° C.

Hydrofinishing

[0050] Hydrofinishing is a hydrotreating process that may be used as a step following hydroisomerization to provide the lubricant base oils used in the ATFs of the present invention. Hydrofinishing is intended to improve oxidation stability, UV stability, and appearance of the lubricant base oils by removing traces of aromatics, olefins, color bodies, and solvents. As used in this disclosure, the term UV stability refers to the stability of the lubricant base oil or the ATFs when exposed to UV light and oxygen. Instability is indicated when a visible precipitate forms, usually seen as floc or cloudiness, or a darker color develops upon exposure to ultraviolet light and air. A general description of hydrofinishing may be found in U.S. Pat. Nos. 3,852,207 and 4,673,487. The lubricant base oils used in the ATFs of the present invention may be hydrofinished to improve product quality and stability. During hydrofinishing, overall LHSV is about 0.25 to 2.0 hr^{-1}, optionally about 0.5 to 1.0 hr^{-1}. The hydrogen partial pressure is greater than 200 psia, for example, ranging from about 500 psia to about 2000 psia. Hydrogen recirculation rates are typically greater than about 9 liter H_2/liter feed, for example, between about 178 liter H_2/liter feed and about 891 liter H_2/liter feed. Temperatures range from about 149° C. to about 399° C., for example, ranging from 230° C. to 316° C.

[0051] Suitable hydrofinishing catalysts include noble metals from Group VIIIA (according to the 1975 rules of the International Union of Pure and Applied Chemistry), such as platinum or palladium on an alumina or siliceous matrix, and unsulfided Group VIIIA and Group VIB, such as nickel-molybdenum or nickel-tin on an alumina or siliceous matrix. U.S. Pat. No. 3,852,207 describes a suitable noble metal catalyst and mild conditions. Other suitable catalysts are described, for example, in U.S. Pat. Nos. 4,157,294 and 3,904,513. The non-noble metal (such as nickel-molybdenum and/or tungsten, and at least about 0.5, and generally about 1 to about 15 weight percent of nickel and/or cobalt determined as the corresponding oxides. The noble metal (such as platinum) catalyst contains in excess of 0.01 percent metal, for example, between 0.1 and 1.0 percent metal. Combinations of noble metals may also be used, such as mixtures of platinum and palladium. Clay treating to remove impurities is an alternative final process step to provide the lubricant base oils used in the ATFs of the present invention.

Solvent Dewaxing

[0052] The process to make the lubricant base oils used in the ATFs of the present invention may also include a solvent dewaxing step following the hydroisomerization process. Solvent dewaxing optionally may be used to remove small amounts of remaining waxy molecules from the lubricant base oil after hydroisomerization. Solvent dewaxing is done by dissolving the lubricant base oil in a solvent, such as methyl ethyl ketone, methyl iso-butyl ketone, or toluene, or precipitating the wax molecules as discussed in Chemical Technology of Petroleum, 3rd Edition, William Gruse and Donald Stevens, McGraw-Hill Book Company, Inc., New York, 1960, pages 566 to 570. Solvent dewaxing is also described in U.S. Pat. Nos. 4,477,333, 3,773,650 and 3,775,288.

Additive Package

[0053] The formulated ATF will typically include an additive package, which is a combination of several additives to provide an ATF with desirable properties. Such additives typically include viscosity index improvers, fluidity modifiers, pour point depressants foam inhibitors, dispersants, detergents, antiwear agents, oxidation inhibitors, corrosion inhibitors, detergents, and friction modifiers. Often there is more than one representative of each class present, so the total number of additive components used to make an ATF is usually in the 10 to 20 range. Such additives are described in "Handbook of Lubrication and Technology" Volume 1, edited by George E. Totten, CRC Press, Boca Raton, Fla., 2006. The formulated ATF may comprise greater than 1 wt % of the additive package. In other embodiments, the formulated ATF may comprise greater than 5 wt % of the additive package and in further embodiments greater than 10 wt % of the additive package. As defined herein, the additive package does not include any Viscosity Index improver.

ATF Formulation

[0054] The ATF of the present invention may comprise less than 1.0 wt % Viscosity Index improver, optionally less than 0.5 wt % Viscosity Index improver, and in certain embodiments no Viscosity Index improver. The ATF of the present invention has a kinematic viscosity at −7° C. of less than 300 mm^2/s, optionally less than 250 mm^2/s, and in certain embodiments less than 200 mm^2/s, and in other embodiments less than 150 mm^2/s. The ATF of the present invention has a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s, optionally between 5.0 and 6.0 mm^2/s. The ATF of the present invention has a high VI, often greater than 150, and in certain embodiments greater than 200. The ATF of the present invention has a low Brookfield viscosity. Typically it has a Brookfield viscosity at −40° C. of less than 10,000, for example, less than 6,000 mPas. The ATF of the present invention optionally comprises less than 0.5 wt % pour point depressant.

[0055] Generally VI improvers are oil soluble organic polymers, typically olefin homo- or co-polymers or derivatives thereof, of number average molecular weight of about 15000 to 1 million atomic mass units (amu). VI improvers are generally added to lubricating oils at concentrations from about 0.1 to 10 wt %. They function by thickening the lubricating oil to which they are added more at high temperatures than low, thus keeping the viscosity change of the lubricant with temperature more constant than would otherwise be the case. The change in viscosity with temperature is commonly represented by the viscosity index (VI), with the viscosity of oils with large VI (e.g. 140) changing less with temperature than the viscosity of oils with low VI (e.g. 80).

[0056] Major classes of VI improvers include: polymers and copolymers of methacrylate and acrylate esters; ethylene-propylene copolymers; styrene-diene copolymers; and polyisobutylene, VI improvers are often hydrogenated to remove residual olefin. VI improver derivatives include dispersant VI improver, which contain polar functionalities such as grafted succinimide groups.

[0057] Pour point depressants are often needed for oils that have a tendency to form wax crystals at low temperature. Pour point depressants are high molecular weight polymers that tend to prevent the growth and aggregation of wax crystals. Examples of pour point depressants are alkylated wax naphthalenes, styrene ester polymers, ethylene vinyl acetate copolymers, polyfumarates, and polyalkylmethacrylates.

[0058] The ATFs of the present invention exhibit improved fuel economy due to the high Viscosity Index of the lubricant base oils used in the ATFs. The high Viscosity Index of the lubricant base oils used in the ATFs provides an ATF of the present invention that avoids having too low a viscosity at higher operating temperatures and too high a viscosity at lower operating temperatures. Since the ATFs of the present invention do not exhibit too high viscosity at lower operating temperatures, the ATFs of the present invention have improved fuel economy.

EXAMPLES

[0059] The invention will be further explained by the following illustrative examples that are intended to be non-limiting.

[0060] Oils A-D of Table 1 comprised Group III lubricant base oils and various VI improvers.

[0061] The fuel economy test was a variation on the standard European fuel economy test, with the principle difference being that the test chamber was held at −7° C. (the temperature at which emission tests are run on gasoline-powered vehicles) rather than the standard+20° C. The test was a "rolling road" test, using a complete car, in this case a BMW 525d, in a chassis dynamometer, and relates to the cold-start and warm-up phase of the European driving cycle. Previous experience indicated that "cold starts" are a very important contributor to fuel economy and that discrimination between oils was more likely to be seen by running at this temperature (the observed correlation between measured fuel economy and oil viscosity at −7° C. seems to confirm the validity of this assumption). The fuel economy values are a composite of the results from the City and Extra-Urban driving cycles (the other two cycles of the standard test, steady-state driving at 90 and 120 km/hour, were not run). The fuel economy results (given in percentage versus reference) were correlated with kinematic viscosity at −7° C. to give the following relationship:

$$F.E.=0.0134*KV+3.9501.$$

[0062] Three different lubricant base oils were prepared from a hydrotreated Fischer-Tropsch wax by hydroisomerization dewaxing the Fischer-Tropsch wax over a Pt/SAPO-11 catalyst, hydrofinishing, and vacuum distilling the product into three different grades. The Fischer-Tropsch wax was composed of several different hydrotreated Fischer-Tropsch waxes, all made using a Co-based Fischer-Tropsch catalyst, and all of which had <10 ppm Sulfur, <10 ppm Nitrogen, <0.50 wt % Oxygen, >85 wt % N-Paraffins (by gas chromatography), and according to ASTM D6352 T_{10} Boiling Range Distribution of about 288° C. to about 371° C., T_{90} Boiling Range Distribution of about 538° C. to about 582° C., and T_{90}-T_{10} Boiling Range Distribution of >154° C. The different lubricant base oils were used to formulate Oils 1-2 in Table 2.

TABLE 1

	Reference	Oil A	Oil B	Oil C	Oil D
Kinematic viscosity @ 100° C., mm^2/s	7.47	7.48	5.54	7.67	5.26
Kinematic viscosity @ 40° C., mm^2/s	34.0	36.9	24.9	34.1	19.6
Kinematic viscosity @ −7° C., mm^2/s	312	400	239	296	129
Brookfield viscosity @ −40° C., mPa-s	18400	16800	5580	7430	2520
Viscosity Index	196	176	171	206	225
Ravenfield viscosity @ 150° C., mPas	2.02	2.60	2.02	2.15	1.55
Cold Cranking Simulator @ −25° C., mPas	1365	1773	<1300	<1300	<1300
Viscosity after shearing (KRL 20 hrs)					
Kinematic Viscosity @ 100° C., mm^2/s	4.7	6.6	5.14	5.13	3.6
Change	−37%	−7%	−33%	−12%	−32%
Vehicle Fuel Economy @ −7° C., %	0.00, +0.1, −0.4	−1.7, −1.2	+0.5	+0.2	+2.3

TABLE 2

	Oil 1	Oil 2	Oil 3	Oil 4	Oil 5	Oil 6
GTL Lubricant Base Oil(s)	84.7%	84.7%	—	—	—	—
Group III Lubricant Base Oil(s)	—	—	84.7%	84.7%	84.7%	—

TABLE 2-continued

	Oil 1	Oil 2	Oil 3	Oil 4	Oil 5	Oil 6
Poly Alpha Olefin(s) (PAO)	—	—	—	—	—	84.7%
Additive Package	15%	15%	15%	15%	15%	15%
Pour Point Depressant	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Kinematic viscosity @ 100° C., mm^2/s	5.31	5.32	5.38	5.50	5.39	5.33
Kinematic viscosity @ 40° C., mm^2/s	23.5	24.4	26.2	27.7	26.8	26
Kinematic viscosity @ −7° C., mm^2/s	220	248	302	343	324	301
Brookfield viscosity @ −40° C., mPas	5740	5200	8400	12800	12800	5580
Viscosity Index	170	160	146	140	141	145
Expected fuel economy versus reference, %	+1.0	+0.6	−0.1	−0.6	−0.4	−0.1

[0063] Oils 1-6 comprised the same Additive Package and Pour Point Depressant, no VI improver, and were formulated to a target kinematic viscosity at 100° C. of 5.4 mm^2/s. For oils with the same kinematic viscosity at 100° C., an oil with a higher VI will have a lower viscosity at temperatures below 100° C. The GTL lubricant base oil of Oil 1 had a kinematic viscosity at 100° C. of 4.039 mm^2/s, and a VI of 150. Oil 2 comprised a mixture of two GTL lubricant base oils, 60% of one which had a kinematic viscosity at 100° C. of 3.081 mm^2/s and a VI of 124, and 24.7% of one which had a kinematic viscosity at 100° C. of 7.969 mm^2/s and a VI of 162.

[0064] The kinematic viscosities at −7° C. of Oil 1 (220 mm^2/s) and Oil 2 (248 mm^2/s) are remarkably low, and notably lower than for an equivalent formulation using Group III lubricant base oils (Oil 3=302 mm^2/s; Oil 4=343 mm^2/s; and Oil 5=324 mm^2/s) or Poly Alpha Olefins (PAO) (Oil 6=301 mm^2/s). The kinematic viscosity at −7° C. is a significant contributor to fuel economy.

[0065] The expected fuel economy was calculated using the above relationship:

$$F.E.=0.0134*KV+3.9501.$$

[0066] While the present invention has been described with reference to specific embodiments, this application is intended to cover those various changes and substitutions that may be made by those of ordinary skill in the art without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A process for producing an automatic transmission fluid comprising:

a. providing a lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

$$\text{Viscosity Index Factor}=28\times\ln(\text{Kinematic Viscosity at }100^\circ\text{ C.})+90;$$

b. blending the lubricant base oil fraction with an automatic transmission fluid additive package; and

c. optionally blending the lubricant base oil fraction and automatic transmission fluid additive package with a Viscosity Index improver; and

d. providing an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver, wherein the automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

2. The process of claim **1** further comprising the steps of performing a Fischer-Tropsch process to provide a product stream and obtaining a lubricant base oil from the Fischer-Tropsch product stream.

3. The process of claim **2**, further comprising hydroismerizing and hydrofinishing the Fischer-Tropsch product stream to provide the lubricant base oil.

4. The process of claim **1**, wherein the blending of step (b) is performed using greater than 5 wt % automatic transmission fluid additive package.

5. The process of claim **1**, wherein the blending of step (b) is performed using greater than 10 wt % automatic transmission fluid additive package.

6. The process of claim **1**, wherein the blending of step (c) is performed using less than 0.5 wt % Viscosity Index improver.

7. The process of claim **1**, wherein the lubricant base oil fraction and automatic transmission fluid additive package are not blended with a Viscosity Index improver and the automatic transmission fluid comprises 0 wt % Viscosity Index improver.

8. The process of claim **1**, further comprising blending the lubricant base oil fraction and automatic transmission fluid additive package with pour point depressant such that the automatic transmission fluid comprises less than 0.5 wt % pour point depressant.

9. A process for producing an automatic transmission fluid comprising:

a. performing a Fischer-Tropsch synthesis to provide a product stream;

b. isolating from the product stream a waxy feed;

c. hydroisomerizing the waxy feed using a shape selective intermediate pore size molecular sieve comprising a noble metal hydrogenation component under conditions of about 316° C. to about 399° C.;

d. isolating an isomerized oil;

e. hydrofinishing the isomerized oil to provide a Fischer-Tropsch derived lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

$$\text{Viscosity Index Factor}=28\times\ln(\text{Kinematic Viscosity at }100^\circ\text{ C.})+90;$$

f. blending the Fischer-Tropsch derived lubricant base oil with an automatic transmission fluid additive package;

g. optionally blending the Fischer-Tropsch derived lubricant base oil fraction and automatic transmission fluid additive package with a Viscosity Index improver; and

g. isolating an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver, wherein the automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

10. The process of claim **9**, wherein the blending of step (g) is performed using less than 0.5 wt % Viscosity Index improver.

11. The process of claim **9**, wherein the shape selective intermediate pore size molecular sieve c is selected from the group consisting of SAPO-11, SAPO-31, SAPO-41, SM-3, ZSM-22, ZSM-23, ZSM-35, ZSM-48, ZSM-57, SSZ-32, offretite, ferrierite, and combinations thereof and the noble metal hydrogenation component is selected from the group consisting of platinum, palladium, and combinations thereof.

12. A process for producing an automatic transmission fluid comprising:

a. performing a Fischer-Tropsch synthesis to provide a product stream;
b. isolating from the product stream a waxy feed;
c. hydroisomerizing the waxy feed using a shape selective intermediate pore size molecular sieve comprising a noble metal hydrogenation component under conditions of about 316° C. to about 399° C., wherein the intermediate pore size molecular sieve is selected from the group consisting of SAPO-11, SAPO-31, SAPO-41, SM-3, ZSM-22, ZSM-23, ZSM-35, ZSM-48, ZSM-57, SSZ-32, offretite, ferrierite, and combinations thereof and the noble metal hydrogenation component is selected from the group consisting of platinum, palladium, and combinations thereof;
d. isolating an isomerized oil;
e. vacuum distilling the isomerized oil to provide a lubricant base oil;
f. hydrofinishing the lubricant base oil to provide a Fischer-Tropsch derived lubricant base oil having a Viscosity Index greater than a Viscosity Index Factor as calculated by the following equation:

$$\text{Viscosity Index Factor}=28\times\ln(\text{Kinematic Viscosity at }100^\circ\text{ C.})+90;$$

g. blending the Fischer-Tropsch derived lubricant base oil with an automatic transmission fluid additive package;
h. optionally blending the Fischer-Tropsch derived lubricant base oil fraction and automatic transmission fluid additive package with a Viscosity Index improver; and
i. isolating an automatic transmission fluid comprising less than 1.0 wt % Viscosity Index improver, wherein the automatic transmission fluid has a kinematic viscosity at −7° C. of less than 300 mm^2/s, and a kinematic viscosity at 100° C. between 5.0 and 7.0 mm^2/s.

13. The process of claim **12**, wherein the blending of step (h) is performed using less than 0.5 wt % Viscosity Index improver.

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