

**PROCESS FOR THE PRODUCTION OF FLUIDS FROM PYROLYSIS OIL DERIVED FROM
PLASTIC RECYCLING**

5 **FIELD OF THE INVENTION**

The invention relates to a process for the production of low aromatic content fluids satisfying the requirements of pharmacopeia, from a feedstock that is a hydrotreated pyrolysis oil derived from plastic recycling.

10 **BACKGROUND ART**

Taking into account environmental issues, recycling plastic waste has become an inevitable step in the life of plastics.

Industrials are seeking to recycle and add value to plastic to give it a second life.

Plastics are typically made of polymers and a first transformation of plastics may lead to
15 pyrolysis oils.

Pyrolysis oils generally contain a relatively high content of aromatics.

One aim of the present invention is to provide a process for preparing a fluid comprising less than 300 ppm by weight of aromatic compounds and from 25 to 43%wt of n-paraffins, satisfying the requirements of pharmacopeia and that comes from a feed derived from the chemical recycling of plastic
20 waste.

Another aim of the invention is to provide a paraffinic fluid that satisfies the pharmacopeia requirements, in particular the French and European pharmacopeia.

SUMMARY OF THE INVENTION

25 The invention is directed to a process for preparing a fluid having a boiling range below 100°C, said process comprising:

- a step of catalytic hydrogenation of a pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars,

said pyrolysis oil comprising, based on the total weight of the pyrolysis oil:

- 30
- from 700 ppm to 3000 ppm by weight of aromatic compounds,
 - from 40 to 50%wt of normal paraffinic compounds,
 - from 40 to 50%wt of isoparaffinic compounds, and
 - from 2 to 15%wt of naphthenic compounds,

said fluid comprising less than 700 ppm by weight of aromatic, based on the total weight of the fluid.

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Preferably, the pyrolysis oil comprises, based on the total weight of the pyrolysis oil:

- from 42 to 48%wt of normal paraffinic compounds, and
- from 42 to 48%wt of isoparaffinic compounds, and

- from 5 to 10%wt of naphthenic compounds.

According to an embodiment, the weight ratio isoparaffins/n-paraffins in the pyrolysis oil ranges from 0.5 to 1.5.

- 5 preferably, the pyrolysis oil has an aromatic content of from 900 to 2800 ppm, preferably from 1000 to 2700 ppm of aromatic compounds, based on the total weight of the pyrolysis oil.

- According to an embodiment of the invention, the catalytic hydrogenation is performed in the presence of a catalyst selected from nickel, nickel tungstate, nickel molybdenum, molybdenum, cobalt molybdenate, nickel molybdenate on silica and/or alumina carriers or zeolites, preferably selected from
10 nickel-based catalysts preferably supported on silica and/or alumina carrier.

According to an embodiment of the invention, the process comprises a preliminary step of preparing a pyrolysis oil by a process comprising at least one depolymerizing step of plastic waste.

Preferably, the plastic waste is selected from polyolefins, polypropylene, polyethylene and polystyrene.

- 15 According to an embodiment of the invention, the process further comprises a fractionation step, performed before and/or after the catalytic hydrogenation step in order to provide at least one cut having a boiling range below 100°C.

Preferably, the fractionation step is performed after the catalytic hydrogenation step to obtain at least one fluid selected from:

- 20
- a fluid having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
 - a fluid having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
 - a fluid having a final boiling point in the range from more than 240°C and up to 300°C,
25 preferably from 250 to 280°C.

The present invention is also directed to a fluid having a boiling range below 100°C and having an initial boiling point and a final boiling point in the range from 50 to 350°C, the fluid comprising, based on the total weight of the fluid:

- 30
- from 23 to 63%wt of normal paraffinic compounds, and
 - from 33 to 63%wt of isoparaffinic compounds, and
 - from 2 to 15%wt of naphthenic compounds, and
 - less than 700 ppm by weight of aromatic compounds.

- 35 According to an embodiment, the fluid of the invention is obtainable by the process according to the invention.

Preferably, the fluid comprises less than 300 ppm by weight of aromatic compounds, preferably less than 20 ppm by weight of aromatic compounds.

According to an embodiment, the fluid of the invention has a weight ratio isoparaffins/n-paraffins ranging from 1/2 to 3/1.

Preferably, the fluid of the invention is selected from:

- 5 - a fluid having an initial boiling point in the range from 30°C to 90°C and a final boiling point in the range from 100 to 180°C,
- a fluid having an initial boiling point in the range from 100°C to 180°C and a final boiling point in the range from more than 190°C and up to 240°C, and
- 10 - a fluid having an initial boiling point in the range from 200°C to 270°C and a final boiling point in the range from more than 240°C and up to 300°C,

preferably from:

- a fluid having an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
- a fluid having an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
- 15 - a fluid having an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
- a fluid having an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.

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Finally, the invention is also directed to the use of the fluid according to the invention, as drilling fluids, as industrial solvents, as cutting fluids, as rolling oils, as electro-discharge machining fluids, as rust preventatives in industrial lubricants, as dilution oils, as viscosity reducers in formulations based on plasticized polyvinyl chloride, as crop protection fluids, as white oils, in particular in coating fluids, in metal extraction, in the mining industry, in explosives, in mold release formulations for concrete, in adhesives, in printing inks, in metal working fluids, in sealing products or polymer formulations based on silicone, in resins, in pharmaceutical products, in cosmetic formulations, in paint compositions, in polymers used in water treatment, in paper manufacture or in printing pastes or cleaning solvents.

30 An advantage of the present invention is that it allows providing a fluid from a pyrolysis oil originating from the chemical recycling of plastic, said fluid further satisfying strict requirements of pharmacopeia.

The inventors surprisingly found that a pharmacopeia quality fluid can be obtained from the recycling of plastic.

35 In particular, the invention allows to provide a new fluid that is a paraffinic fluid comprising isoparaffins (iP) and n-paraffins (nP) in a weight ratio iP/nP preferably ranging from 0.5 to 3, a limited amount of naphthenes preferably of at most 15%wt and a low amount of aromatics, preferably less than 700 ppm by weight or even less than 300 ppm by weight.

In the context of the present invention, unless specified otherwise, the boiling range, the initial boiling point and the final boiling point are determined using the method EN ISO 3405.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

5 The present invention relates to a process for preparing a fluid having a boiling range below 100°C, said process comprising:

- a step of catalytic hydrogenation of a hydrocarbon pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars,

said pyrolysis oil comprising, based on the total weight of the pyrolysis oil:

- 10
 - from 700 ppm to 3000 ppm by weight of aromatic compounds,
 - from 40 to 50%wt of normal paraffinic compounds,
 - from 40 to 50%wt of isoparaffinic compounds, and
 - from 2 to 15%wt of naphthenic compounds,

said fluid comprising less than 700 ppm by weight of aromatic, based on the total weight of the fluid.

15

According to an embodiment, the process further comprises a step of preparing the hydrocarbon pyrolysis oil, preferably by a process comprising at least one depolymerizing step of plastic waste, the plastic waste being preferably a plastic polymer.

20 A fractionation can be performed before or after the catalytic hydrogenation step in order to obtain the desired cut, typically defined by narrow boiling point range. If performed before the catalytic hydrogenation, the fractionation is performed on the pyrolysis oil.

Within the meaning of the present invention, the "boiling range" refers to the difference between the final boiling point and the initial boiling point.

25 Within the meaning of the present invention, the initial boiling point is necessarily different and lower than the final boiling point.

Pyrolysis oil (also named "feed" or "feedstock"):

The pyrolysis oil comprises from 700 ppm to 3000 ppm by weight of aromatic compounds, preferably from 900 to 2800 ppm, more preferably from 1000 to 2700 ppm of aromatic compounds.

30 The aromatic content can be measured by UV spectrometry for amounts of aromatics lower than 350 ppm and by HPLC (IP391 standard) for amounts of aromatics of 350 ppm or more.

Within the meaning of the present invention, the expression "aromatic compounds" encompasses monoaromatic and polyaromatic compounds.

35 According to an embodiment, the feed comprises monoaromatic compounds and polyaromatic compounds. According to a particular embodiment, the aromatic compounds of the feed consist in monoaromatic compounds and diaromatic compounds.

The feed comprises from 40 to 50%wt of normal paraffinic compounds, preferably from 42 to 48%wt of normal paraffinic compounds, based on the total weight of the feed.

Within the meaning of the present invention, the expression "normal paraffinic compounds" encompasses paraffins having a linear (straight) hydrocarbon chain.

According to an embodiment, the feed comprises from 40 to 50%wt of isoparaffinic compounds, preferably from 42 to 48%wt of isoparaffinic compounds, based on the total weight of the feed.

5 Within the meaning of the present invention, the expression "isoparaffinic compounds" encompasses paraffins having a branched hydrocarbon chain.

According to an embodiment, the feed comprises from 2 to 15%wt of naphthenic compounds, preferably from 5 to 10%wt of naphthenic compounds, based on the total weight of the feed.

10 Within the meaning of the present invention, the expression "naphthenic compounds" encompasses saturated compounds comprising at least one cycle, said cycle(s) being optionally substituted by one or more alkyl group comprising for example from 1 to 10 carbon atoms.

According to a particular embodiment, the feed comprises, based on the total weight of the feed:

- from 40 to 50%wt of normal paraffinic compounds, preferably from 42 to 48%wt of normal paraffinic compounds, and
- 15 - from 40 to 50%wt of isoparaffinic compounds, preferably from 42 to 48%wt of isoparaffinic compounds, and
- from 2 to 15%wt of naphthenic compounds, preferably from 5 to 10%wt of naphthenic compounds.

Typically, the weight ratio isoparaffins/n-paraffins in the feed ranges from 0.5 to 1.5.

20 The paraffin content and the naphthene content can be measured by gas chromatography.

According to an embodiment, the feed has an initial boiling point and a final boiling point in the range from 50 to 350°C, preferably from 100 to 320°C.

The boiling point of the feed may be measured according to EN ISO 3405 standard.

25 According to an embodiment, the feed has an initial boiling point ranging from 50 to 200°C, preferably from 100 to 150°C, and/or a final boiling point ranging from 250 to 350°C, preferably from 270 to 320°C.

30 According to an embodiment, the feed comprises less than 10 ppm by weight of carbonyl, preferably less than 5 ppm by weight of carbonyl, more preferably less than 1 ppm by weight of carbonyl. The carbonyl content can be measured by SMS 2894.

35 According to an embodiment, the feed is substantially free of heteroatoms, in particular, the feed comprises typically less than 1%wt of heteroatoms, preferably less than 1000 ppm by weight of heteroatoms, more preferably less than 100 ppm by weight of heteroatoms, even more preferably less than 10 ppm by weight of heteroatoms.

Within the meaning of the present invention, the "heteroatoms" means any atoms that are not carbon atoms or hydrogen atoms.

According to a preferred embodiment, the feed is selected from pyrolysis oils, the pyrolysis oils being selected from oils originating from the chemical recycling of plastic waste, in particular from the depolymerisation of plastic waste.

Among plastic, mention may be made of polyolefins, polypropylene, polyethylene and polystyrene.

The inventors surprisingly found that very pure fluids can be obtained from such pyrolysis oils coming from chemical recycling of plastic waste.

Preliminary step for preparing the pyrolysis oil

According to an embodiment of the process for preparing the fluid of the invention, the process comprises a preliminary step for preparing the pyrolysis oil, said step comprising preferably at least one depolymerisation step of a plastic waste. The pyrolysis oil used in the process of the invention can be prepared according to the process detailed in document US 9,080,107. Typically, the process for preparing the pyrolysis oil comprises a depolymerisation step of plastic waste and a hydrotreating step of the depolymerisation product to obtain a pyrolysis oil comprising from 700 ppm to 3000 ppm of aromatics. According to this embodiment, the pyrolysis oil is thus hydrotreated.

According to a particular embodiment, the process for preparing the pyrolysis oil comprises the steps:

- a) continuously feeding plastic waste is into an extruder;
- b) melting the plastic waste in the extruder;
- c) depolymerizing the melt in a thermolysis reactor;
- d) conducting depolymerization product vapors into a preliminary separation unit;
- e) separating the vapors in the preliminary separation unit by an introductory separation;
- f) hydrotreating the product to obtain a pyrolysis oil comprising from 700 ppm to 3000 ppm of aromatics;
- g) conducting the hydrotreated fractions to a secondary separation unit.

According to this embodiment, the pyrolysis oil is thus hydrotreated.

Preferably, the plastic is selected from polyolefins, polypropylene, polyethylene and polystyrene. Preferably, the feed for the hydrogenation is originating from the recycling of a single plastic, for example, from the recycling of a plastic waste consisting of polyolefins or from the recycling of a plastic waste consisting of polypropylene or from the recycling of a plastic waste consisting of polyethylene or from the recycling of a plastic waste consisting of polystyrene.

Hydrogenation step

The pyrolysis oil as defined above is hydrogenated. Preferably, the hydrogenation step is performed on a hydrotreated pyrolysis oil. The pyrolysis oil can optionally be pre-fractionated.

Hydrogen that is used in the hydrogenation unit is typically a high purity hydrogen, e.g. with a purity of more than 99%, albeit other grades can be used.

According to a particular embodiment, the catalyst consists in nickel as metallic compound.

The hydrogenation conditions are typically the following:

- Pressure: 20 to 150 bars, preferably 30 to 140 bars, and most preferably 40 to 120 bars; and/or
- Temperature: 100 to 220°C, preferably 110 to 200°C and most preferably 120 to 180°C; and/or
- Liquid hourly space velocity (LHSV): 0.2 to 5 hr⁻¹, preferably 0.4 to 3 hr⁻¹, and most preferably 0.5 to 1.5 hr⁻¹; and/or
- Hydrogen treat rate: adapted to the above conditions, which can be up to 200 Nm³/ton of feed.

According to a particular embodiment, the hydrogenation is performed at a temperature from 130°C to 180°C and a pressure from 50 to 100 bars.

This step of hydrogenation of the process of the invention can take place in one or more reactors. The reactor can comprise one or more catalytic beds. Catalytic beds are usually fixed beds.

The hydrogenation step of the invention can be carried out in several stages. There can be two or three stages, preferably three stages, preferably in three separate reactors. The first stage will typically operate up to about 90%wt of hydrogenation of aromatics present in the pyrolysis oil. In the second stage the hydrogenation of the aromatics continues, and up to 99%wt of aromatics can be hydrogenated. The third stage is a finishing stage, allowing an aromatic content as low as 300 ppm by weight or even less such as below 100 ppm, more preferably less than 50 ppm by weight.

According to a preferred embodiment, the hydrogenation is performed in three stages, preferably in three separate reactors. Those three stages allow providing a fluid having a very low aromatic content, wherein the optionally remaining aromatic compounds consists in monoaromatic compounds.

Hydrogenation takes place using a catalyst. Typical hydrogenation catalysts include but are not limited to: nickel, platinum, palladium, rhenium, rhodium, nickel tungstate, nickel molybdenum, molybdenum, cobalt molybdenate, nickel molybdenate on silica and/or alumina carriers or zeolites.

According to a preferred embodiment, the hydrogenation step is carried out in the presence of a nickel catalyst supported on alumina carrier. A preferred catalyst is Ni-based and is supported on an alumina carrier, having a specific surface area varying between 100 and 200 m²/g of catalyst.

In the case wherein the hydrogenation takes place in three reactors, the catalysts can be present in varying or substantially equal amounts in each reactor, e.g. for three reactors according to weight ratios of catalyst in reactor 1/reactor 2/reactor 3 of 0.05-0.5/0.10-0.70/0.25-0.85, preferably 0.07-0.25/0.15-0.35/0.4-0.78 and most preferably 0.10-0.20/0.20-0.32/0.48-0.70.

It is also possible that one of the reactor wherein the hydrogenation step is implemented be made of twin reactors operated alternatively in a swing mode. This may be useful for catalyst charging and discharging: since the reactor may comprise the catalyst that is poisoned first (substantially all the sulphur is trapped in and/or on the catalyst) it should be changed often.

It may be necessary to insert quenches on the recycle to cool effluents between the reactors or catalytic beds to control reaction temperatures and consequently thermodynamic equilibrium of the hydrogenation reaction. In a preferred embodiment, there is no such intermediate cooling or quenching.

In case the hydrogenation step makes use of 2 or 3 reactors, the first reactor will act as a heteroatom trap, such as a sulphur trap as well as any other contaminants (heteroatoms). This first reactor will thus trap substantially all the sulphur. The catalyst will thus be saturated quickly and may be renewed from time to time. When regeneration or rejuvenation is not possible for such saturated catalyst the first reactor is considered as a sacrificial reactor which size and catalyst content both depend on the catalyst renewal frequency.

In an embodiment the resulting product and/or separated gas is/are at least partly recycled to the inlet of the hydrogenation stages. This dilution helps, if this were to be needed, maintaining the exothermicity of the reaction within controlled limits, especially at the first stage. Recycling also allows heat-exchange before the reaction and also a better control of the temperature.

According to an embodiment, the process of the invention further comprises a step of recycling a part of the hydrogenated pyrolysis oil obtained at the exit of the hydrogenation step in order to be mixed with the pyrolysis oil as defined in the invention, before the hydrogenation step.

Within the meaning of the invention, the expression "a part of the hydrogenated pyrolysis oil" means a proportion in the volume of the hydrogenated pyrolysis oil, "the part" will not be obtained by any specific treatment or specific separation on this recycle.

The stream exiting the hydrogenation unit contains the hydrogenated product and hydrogen. Flash separators are used to separate effluents into gas, mainly remaining hydrogen, and liquids, mainly hydrogenated hydrocarbons. The process can be carried out using three flash separators, one of high pressure, one of medium pressure, and one of low pressure, very close to atmospheric pressure.

The hydrogen gas that is collected on top of the flash separators can be recycled to the inlet of the hydrogenation unit or at different levels in the hydrogenation units between the reactors.

Because the final separated product is at about atmospheric pressure, it is possible to feed directly the optional fractionation stage, which is preferably carried out under vacuum pressure that is at about between 10 to 50 mbars, preferably about 30 mbars.

Advantageously, the hydrogenation step is performed under the conditions mentioned above until dearomatized fluids with a very low content of aromatics are obtained, preferably with aromatic content less than 300 ppm by weight, preferentially less than 100 ppm by weight and more preferentially less than 50 ppm by weight, and even more preferably less than 20 ppm by weight.

The hydrogenated fluid has an aromatic content that is lower than the aromatic content of the pyrolysis oil. Advantageously, hydrogenation is performed under the conditions mentioned above until a conversion rate of the aromatic compounds comprised between 95 and 100%, preferably between 98 and 99.99%, is obtained.

The hydrogenation step can be followed by measuring the aromatic content by UV spectrometry or by high performance liquid chromatography (HPLC). HPLC is preferably used when the aromatic amount is higher than 0.1%wt, alternatively, samples can be diluted in order to be able to measure the aromatic content by UV spectrometry when the aromatic content of the samples is too high.

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The hydrogenated product has substantially the same initial boiling point and the same final boiling point as the feed (before hydrogenation), as well as substantially the same density.

10 The optional fractionation stage can be operated such that various hydrocarbon fluids can be withdrawn simultaneously from the fractionation column, and the boiling range of which can be predetermined.

Therefore, fractionation can take place before hydrogenation on the pyrolysis oil, after hydrogenation, or both. The fractionation is typically performed by distillation.

15 The hydrogenation reactors, the separators and the fractionation unit can thus be connected directly, without having to use intermediate tanks. By adapting the feed, especially the initial and final boiling points of the feed, it is possible to produce directly, without intermediate storage tanks, the final products with the desired initial and final boiling points. Moreover, this integration of hydrogenation and fractionation allows an optimized thermal integration with reduced number of equipment and energy savings.

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According to an embodiment, the fractionation step is performed in order to obtain at least one hydrocarbon cut, preferably at least two hydrocarbon cuts, more preferably at least three hydrocarbon cut, (also named "fluid"), the hydrocarbon cut being selected from:

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- a cut having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
 - a cut having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
 - a cut having a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C.

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According to an embodiment, the fractionation step is performed in order to obtain at least one hydrocarbon cut, preferably at least two hydrocarbon cuts, more preferably at least three hydrocarbon cuts, the hydrocarbon cut being selected from:

- 35
- a cut having an initial boiling point in the range from 30°C to 90°C and a final boiling point in the range from 100 to 180°C,
 - a cut having an initial boiling point in the range from 100°C to 180°C and a final boiling point in the range from more than 190°C and up to 240°C, and

- a cut having an initial boiling point in the range from 200°C to 270°C and a final boiling point in the range from more than 240°C and up to 300°C.

According to an embodiment, the fractionation step is performed in order to obtain the following

5 hydrocarbon cuts:

- a cut having an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
- a cut having an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
- 10 - a cut having an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
- a cut having an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.

15 According to an embodiment, the process of the invention comprises:

- i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds and from 40% to 50% by weight of normal paraffin compounds, based on the total weight of the pyrolysis oil;
 - 20 ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the hydrogenated product;
 - iii) a fractionation of the hydrogenated product in order to provide at least one fluid comprising 25 less than 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the fluid, said fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C,
- wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the 30 extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the hydrotreated fractions to a secondary separation unit.

35 According to an embodiment, the process of the invention comprises:

- i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds

and from 40% to 50% by weight of normal paraffin compounds, based on the total weight of the pyrolysis oil;

5 ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the hydrogenated product;

10 iii) a fractionation of the hydrogenated product in order to provide at least two fluids preferably at least three fluids, each fluid comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds and from 33 to 63% by weight of isoparaffinic compounds, based on the total weight of the fluid, each fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, the fluids being selected from:

- a fluid having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
- 15 - a fluid having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
- a fluid having a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C,

20 wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the hydrotreated fractions to a secondary separation unit.

25 According to an embodiment, the process of the invention comprises:

 i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds and from 40% to 50% by weight of normal paraffin compounds, based on the total weight of the pyrolysis oil;

30 ii) a fractionation of the pyrolysis oil in order to provide at least one pyrolysis oil cut having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C;

 iii) a catalytic hydrogenation of the pyrolysis oil cut at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a fluid comprising less than 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the fluid, the fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C;

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optionally vi) a further fractionation of the fluid obtained at the end of step iii) in order to reduce the width of the boiling range of the fluid,

wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the hydrotreated fractions to a secondary separation unit.

10 According to an embodiment, the process of the invention comprises:

i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds, from 42% to 48% by weight of normal paraffin compounds, from 42 to 48% by weight of isoparaffinic compounds and from 5 to 10% by weight of naphthenic compounds, based on the total weight of the pyrolysis oil;

15 ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the hydrogenated product;

20 iii) a fractionation of the hydrogenated product in order to provide at least one fluid comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the fluid, said fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C,

25 wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the hydrotreated fractions to a secondary separation unit.

30 According to an embodiment, the process of the invention comprises:

i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds, from 42% to 48% by weight of normal paraffin compounds, from 42 to 48% by weight of isoparaffinic compounds and from 5 to 10% by weight of naphthenic compounds, based on the total weight of the pyrolysis oil;

ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the hydrogenated product;

iii) a fractionation of the hydrogenated product in order to provide at least two fluids, preferably at least three fluids, each fluid comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the fluid, each fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C, the fluid being selected from:

- a fluid having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
- a fluid having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
- a fluid having a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C,

wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the hydrotreated fractions to a secondary separation unit.

According to an embodiment, the process of the invention comprises:

i) a step for preparing a pyrolysis oil comprising at least one step of depolymerisation of a plastic waste to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds, from 42% to 48% by weight of normal paraffin compounds, from 42 to 48% by weight of isoparaffinic compounds and from 5 to 10% by weight of naphthenic compounds, based on the total weight of the pyrolysis oil;

ii) a fractionation of the pyrolysis oil in order to provide at least one pyrolysis oil cut having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C;

iii) a catalytic hydrogenation of the pyrolysis oil cut at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a fluid comprising less than 300 ppm by weight of aromatic compounds, from 23% to 63% by weight of normal paraffin compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds,

based on the total weight of the fluid, the fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C;

optionally vi) a further fractionation of the fluid obtained at the end of step iii) in order to reduce the width of the boiling range of the fluid,

- 5 wherein step i) is preferably performed in an inert gas atmosphere and preferably comprises the following steps: continuously feeding plastic waste into an extruder, melting the plastic waste in the extruder to obtain a melt, depolymerizing the melt in a thermolysis reactor, conducting depolymerization product vapors into a preliminary separation unit, separating the vapors into fractions in the preliminary separation unit by an introductory separation, hydrotreating the obtained fractions, and conducting the
- 10 hydrotreated fractions to a secondary separation unit.

According to an embodiment, the process of the invention comprises:

- i) a step for preparing a pyrolysis oil in an inert gas atmosphere, said step i) comprising:
- 15 a) continuously feeding plastic waste is into an extruder;
- b) melting the plastic waste in the extruder;
- c) depolymerizing the melt in a thermolysis reactor;
- d) conducting depolymerization product vapors into a preliminary separation unit;
- e) separating the vapors in the preliminary separation unit by an introductory separation;
- 20 f) hydrotreating to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds and from 40% to 50% by weight of normal paraffin compounds, based on the total weight of the pyrolysis oil;
- g) conducting the hydrotreated fractions to a secondary separation unit,
- ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than
- 25 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the hydrogenated product;
- iii) a fractionation of the hydrogenated product in order to provide at least one fluid comprising less than 300 ppm by weight of aromatic compounds and from 23% to 63% by weight of normal paraffin compounds, based on the total weight of the fluid, said fluid having a difference between the final boiling
- 30 point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C.

According to an embodiment, the process of the invention comprises:

- i) a step for preparing a pyrolysis oil in an inert gas atmosphere, said step i) comprising:
- 35 a) continuously feeding plastic waste is into an extruder;
- b) melting the plastic waste in the extruder;
- c) depolymerizing the melt in a thermolysis reactor;
- d) conducting depolymerization product vapors into a preliminary separation unit;
- e) separating the vapors in the preliminary separation unit by an introductory separation;

f) hydrotreating to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds, from 40 to 50% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the pyrolysis oil;

5 g) conducting the hydrotreated fractions to a secondary separation unit,

ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the hydrogenated product;

10 iii) a fractionation of the hydrogenated product in order to provide at least one fluid comprising less than 300 ppm by weight of aromatic compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the fluid, said fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C.

According to an embodiment, the process of the invention comprises:

i) a step for preparing a pyrolysis oil in an inert gas atmosphere, said step i) comprising:

20 a) continuously feeding plastic waste is into an extruder;
b) melting the plastic waste in the extruder;
c) depolymerizing the melt in a thermolysis reactor;
d) conducting depolymerization product vapors into a preliminary separation unit;
e) separating the vapors in the preliminary separation unit by an introductory separation;
25 f) hydrotreating to provide a pyrolysis oil comprising from 700 ppm to 3000 ppm by weight of aromatic compounds, from 40 to 50% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the pyrolysis oil;

g) conducting the hydrotreated fractions to a secondary separation unit,

30 ii) a catalytic hydrogenation of the pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars to provide a hydrogenated product comprising less than 300 ppm by weight of aromatic compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the hydrogenated product;

35 iii) a fractionation of the hydrogenated product in order to provide at least two fluids preferably at least three fluids, each fluid comprising less than 300 ppm by weight of aromatic compounds, from 33 to 63% by weight of isoparaffinic compounds and from 2 to 15% by weight of naphthenic compounds, based on the total weight of the fluid, each fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably from 10 to 95°C, the fluids being selected from:

- a fluid having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
- a fluid having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
- 5 - a fluid having a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C.

Fluid of the invention

The present invention is also directed to the fluid obtainable by the process of the invention, as well as to a fluid as such.

The present invention is thus directed to a fluid having a difference between the final boiling point and the initial boiling point that is less than 100°C, an aromatic content of less than 700 ppm by weight, and a normal paraffin content from 23 to 63% by weight, based on the total weight of the fluid.

The fluid of the invention has a difference between the final boiling point and the initial boiling point that is less than 100°C, preferably ranging from 10 to 95°C.

Preferably, the fluid of the invention has an initial boiling point and a final boiling point in the range from 30 to 350°C, preferably from 50 to 320°C, more preferably from 50 to 300°C.

According to an embodiment, the fluid is derived from a pyrolysis oil, in particular the fluid is obtainable by a step of catalytic hydrogenation of a hydrotreated pyrolysis oil.

Using pyrolysis oil to prepare the fluid according to the invention allows to increase the content of the paraffins, notably the n-paraffins in the fluid in comparison to the use of a fossil oil, especially when the initial and final boiling points of the pyrolysis oil and the fossil oil are comparable. The inventors thus surprisingly highlighted the impact that the process using pyrolysis oil can have on the composition of the fluid.

Preferably, the initial boiling point of the fluid of the invention is less than 300°C, preferably less than 280°C.

Preferably, if the initial boiling point ranges from 200 to 300°C, then the amount of isoparaffins ranges from 33 to 47%wt based on the total weight of the fluid and the amount of n-paraffins ranges from 39 to 63%wt based on the total weight of the fluid.

The inventors specifically found that the pyrolysis oil origin of the fluid allows to obtain this specific combination of boiling points and isoparaffins content.

According to an embodiment, the fluid of the invention has a boiling range below 100°C and a final boiling point selected from:

- a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
- 35 - a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
- a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C.

According to an embodiment, the fluid of the invention has a boiling range below 100°C and an initial boiling point and a final boiling point selected from:

- an initial boiling point in the range from 30°C to 90°C and a final boiling point in the range from 100 to 180°C,
- 5 - an initial boiling point in the range from 100°C to 180°C and a final boiling point in the range from more than 190°C and up to 240°C, and
- an initial boiling point in the range from 200°C to 270°C and a final boiling point in the range from more than 240°C and up to 300°C.

10 According to an embodiment, the fluid of the invention has a boiling range below 100°C and an initial boiling point and a final boiling point selected from:

- an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
- an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
- 15 - an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
- an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.

20 The fluid of the invention comprises less than 700 ppm by weight of aromatic compounds, preferably less than 300 ppm by weight of aromatic compounds, preferentially less than 100 ppm by weight of aromatic compounds and more preferentially less than 50 ppm by weight of aromatic compounds, and even more preferably less than 20 ppm by weight of aromatic compounds.

25 Preferably, the fluid of the invention comprises less than 1 ppm of polyaromatic compounds (HAP). In particular, the fluid of the invention satisfies European pharmacopeia requirements for the HAP content.

The fluid of the invention comprises from 33 to 63%wt of isoparaffinic compounds, based on the total weight of the fluid.

30 The fluid of the invention comprises from 2 to 15%wt of naphthenic compounds, based on the total weight of the fluid.

According to a particular embodiment, the fluid comprises, based on the total weight of the feed:

- from 23 to 63%wt of normal paraffinic compounds, and
- from 33 to 63%wt of isoparaffinic compounds, and
- 35 - from 2 to 15%wt of naphthenic compounds.

Preferably, the weight ratio isoparaffins/n-paraffins in the fluid ranges from 1/2 to 3/1.

Preferably, the fluid is substantially free of heteroatoms, in particular, the fluid comprises typically less than 1%wt of heteroatoms, preferably less than 1000 ppm by weight of heteroatoms, more

preferably less than 100 ppm by weight of heteroatoms, even more preferably less than 10 ppm by weight of heteroatoms.

Preferably, the fluid of the invention has a density at 15°C ranging from 0.7000 to 0.8500 g/mL,
5 preferably from 0.7200 to 0.8000 g/mL.

Preferably, the fluid of the invention has a viscosity at 40°C ranging from 1.0 to 5.0 mm²/s,
preferably from 1.1 to 2.5 mm²/s, more preferably from 1.2 to 2.0 mm²/s.

According to an embodiment, the fluid comprises, preferably consists in, based on the total
10 weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and
- from 33 to 63% by weight of isoparaffinic compounds; and
- from 2 to 15% by weight of naphthenic compounds; and
- less than 300 ppm by weight of aromatic compounds.

15

According to an embodiment, the fluid comprises, preferably consists in, based on the total
weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and
- from 33 to 63% by weight of isoparaffinic compounds; and
- 20 - from 2 to 15% by weight of naphthenic compounds; and
- less than 100 ppm by weight of aromatic compounds.

According to an embodiment, the fluid comprises, preferably consists in, based on the total
25 weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and
- from 33 to 63% by weight of isoparaffinic compounds; and
- from 2 to 15% by weight of naphthenic compounds; and
- less than 50 ppm by weight of aromatic compounds; and

30 wherein the fluid comprises less than 1 ppm by weight of polyaromatic compounds.

According to an embodiment, the fluid comprises, preferably consists in, based on the total
weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and
- 35 - from 33 to 63% by weight of isoparaffinic compounds; and
- from 2 to 15% by weight of naphthenic compounds; and
- less than 100 ppm by weight of aromatic compounds; and

wherein the fluid comprises less than 1 ppm by weight of polyaromatic compounds.

Preferably, the fluid of the invention also has an extremely low sulphur content, less than 5 ppm, preferably less than 3 ppm and more preferentially less than 0.5 ppm, at a level too low to be detectable by means of conventional analyzers that can measure very low sulphur contents.

- 5 The fluid of the invention preferably has a pour point of less than -10°C , preferably less than -20°C , measured according to ASTM D97 standard.

According to an embodiment, the fluid comprises, preferably consists in, based on the total weight of the fluid:

- 10 - from 23 to 63% by weight of normal paraffin compounds; and
 - from 33 to 63% by weight of isoparaffinic compounds; and
 - from 2 to 15% by weight of naphthenic compounds; and
 - less than 100 ppm by weight of aromatic compounds,

the fluid being selected from one of the following cuts:

- 15 - a cut having an initial boiling point in the range from 30°C to 90°C and a final boiling point in the range from 100 to 180°C ,
 - a cut having an initial boiling point in the range from 100°C to 180°C and a final boiling point in the range from more than 190°C and up to 240°C , and
 - a cut having an initial boiling point in the range from 200°C to 270°C and a final boiling point
20 in the range from more than 240°C and up to 300°C .

According to an embodiment, the fluid of the invention comprises, preferably consists in, based on the total weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and
25 - from 33 to 63% by weight of isoparaffinic compounds; and
 - from 2 to 15% by weight of naphthenic compounds; and
 - less than 100 ppm by weight of aromatic compounds,

the fluid being selected from one of the following cuts:

- a cut having a final boiling point in the range from 100 to 180°C , preferably from 120 to
30 170°C ,
 - a cut having a final boiling point in the range from more than 180°C and up to 240°C , preferably from 190°C to 230°C , and
 - a cut having a final boiling point in the range from more than 240°C and up to 300°C , preferably from 250 to 280°C .

35

According to an embodiment, the fluid comprises, preferably consists in, based on the total weight of the fluid:

- from 23 to 63% by weight of normal paraffin compounds; and

- from 33 to 63% by weight of isoparaffinic compounds; and
- from 2 to 15% by weight of naphthenic compounds; and
- less than 100 ppm by weight of aromatic compounds; and

wherein the fluid comprises less than 1 ppm by weight of polyaromatic compounds,

5 wherein the fluid is selected from one of the following cuts:

- a cut having an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
- a cut having an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
- 10 - a cut having an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
- a cut having an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.

15 The invention is also directed to a combination of two or more fluids, each fluid being as defined in the invention. According to the combination of fluids of the invention, the fluids can differ notably by their boiling points. As an example, the combination of fluids can be at least two fluids selected from:

- a fluid having an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
- 20 - a fluid having an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
- a fluid having an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
- a fluid having an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.

25

Moreover, the fluid of the invention has remarkable properties in terms of aniline point or solvent power, molecular weight, vapor pressure, viscosity, defined evaporation conditions for systems for which drying is important and defined surface tension.

30

The fluids according to the invention can be used, alone or in a mixture, as drilling fluids, as industrial solvents, as cutting fluids, as rolling oils, as electro-discharge machining fluids, as rust preventatives in industrial lubricants, as dilution oils, as viscosity reducers in formulations based on plasticized polyvinyl chloride, as crop protection fluids, as white oils.

35

The fluids according to the invention can also be used, alone or in a mixture, in coating fluids, in metal extraction, in the mining industry, in explosives, in mold release formulations for concrete, in adhesives, in printing inks, in metal working fluids, in sealing products or polymer formulations based

on silicone, in resins, in pharmaceutical products, in cosmetic formulations, in paint compositions, in polymers used in water treatment, in paper manufacture or in printing pastes or cleaning solvents.

The invention is also directed to the use of the fluid according to the invention, as drilling fluids, as industrial solvents, as cutting fluids, as rolling oils, as electro-discharge machining fluids, as rust preventatives in industrial lubricants, as dilution oils, as viscosity reducers in formulations based on plasticized polyvinyl chloride, as crop protection fluids, as white oils, in particular in coating fluids, in metal extraction, in the mining industry, in explosives, in mold release formulations for concrete, in adhesives, in printing inks, in metal working fluids, in sealing products or polymer formulations based on silicone, in resins, in pharmaceutical products, in cosmetic formulations, in paint compositions, in polymers used in water treatment, in paper manufacture or in printing pastes or cleaning solvents.

The invention also relates to the use of a pyrolysis oil obtained by recycling plastic waste in order to prepare a fluid comprising less than 300 ppm by weight of aromatic compounds.

The invention also relates to the use of a pyrolysis oil obtained by recycling plastic waste in order to prepare a fluid comprising less than 300 ppm by weight of aromatic compounds, from 23 to 63% by weight of normal paraffin compounds, from 33 to 63%wt of isoparaffinic compounds, from 2 to 15%wt of naphthenic compounds, based on the total weight of the fluid.

Typically, the fluid is obtained by catalytic hydrogenation of the pyrolysis oil.

The characteristics defined for the process of the invention and for the fluid of the invention also apply to the use of a pyrolysis oil of the invention.

The following example illustrates the invention without limiting it.

EXAMPLES

Example 1: Preparation of the pyrolysis oil

The pyrolysis oil used in this example is a pyrolysis oil obtained by depolymerization of a plastic waste. Table 1 below show the characteristic of the pyrolysis oil.

Table 1

	standard	Pyrolysis oil
Initial point	Simdist ASTM D2887	59.7°C
10%	Simdist ASTM D2887	131.8°C
50%	Simdist ASTM D2887	224°C
90%	Simdist ASTM D2887	303.1°C
Final point	Simdist ASTM D2887	347.1°C
Aromatic content	IP 391	2600 ppm

Kinematic viscosity at 40°C	ASTM D445	1,428 mm ² /s
Pour point	ASTM D97	-24,0°C
Density at 15°C	ASTM D4052	770,3 kg/m ³
Sulphur content	ASTM D 5453	0,1 ppm
Carbonyl content	SMS* 2894	0,3 ppm

* SMS = Swedish Standard Method

Elemental analysis of the pyrolysis oil show that the pyrolysis oil contains less than detection limit (0,1 ppm) of Cu, Fe, Si, Zn, Al, Sn, Pb, Ca, Na, Ca, Ni, Ag, B, Ba, Mg, Mn, Mo, P, Ti, V, Cr, measured by ASTM D711.

Analysis of the pyrolysis oil by UOP 588 standard show that the pyrolysis oil comprises less than 0.1 ppm (below detection limit) of chloride.

Analysis of the pyrolysis oil shows that it contains monoaromatic compounds and diaromatic compounds.

Table 2 shows the composition of the pyrolysis oil obtained by a gas chromatography of the pyrolysis oil, expressed in % by weight, wherein:

- nP means normal paraffins,
- iP means isoparaffins,
- N means naphthalene, that may include isonaphthalene and polynaphthalene.

Table 2: compositions of the pyrolysis oil

	nP	iP	N
C7	1.25	0.39	1.08
C8	2.24	2.04	0.78
C9	2.73	10.5	4.39
C10	3.41	1.32	0.60
C11	4.39	7.89	0.64
C12	4.55	1.83	1.09
C13	4.47	8.82	
C14	5.75	3.1	
C15	5.86	3.11	
C16	4.13	3.05	
C17	3.39	0.57	
C18	2.41	2.77	
C19	1.14		
C20	0.33		

Example 2: catalytic hydrogenation

The pyrolysis oil detailed in example 1 was hydrogenated using a nickel catalyst supported on alumina carrier with the conditions detailed in table 3.

5

Table 3: hydrogenation conditions

	1	2	3	4
Temperature (°C)	130	150	170	150
Pressure (bar)	50	50	50	100
LHSV (h ⁻¹)	1	1	1	1
H ₂ /HC (NI/I)	100	100	100	100

The hydrogenation conditions are performed until reaching a content of aromatic compounds of less than 100 ppm by weight. Analysis is also performed to control the amount of polyaromatic compounds. The analysis of the hydrogenated product shows that the product is free of polyaromatic compounds.

10

The hydrogenated product has an initial boiling point of 57°C and a final boiling point of 344°C, measured according to ASTM D2887.

The hydrogenated product has a density at 15°C of 0.7689 kg/m³, measured according to NF EN ISO 12185 (or ASTM D4052).

15

The hydrogenated product is then fractionated by distillation in order to provide the four fluids C1, C2, C3 and C4 detailed in table 4.

Table 4: Details of the fluids prepared

	C1	C2	C3	C4
Initial boiling point (°C)	52	146	216	250
Final boiling point (°C)	146	216	257	268
Density at 15°C (mg/mL)	726	764	783	794
Aromatic content (ppm)	< 50	< 50	< 50	< 50
Carbon atom number range	C6-C9	C9-C11	C11-C14	C13-C16
%wt isoparaffins	62	47	43	35
%wt n-paraffins	23	39	51	62
%wt naphthens	15	14	3	2

20

CLAIMS

1. A process for preparing a fluid having a boiling range below 100°C, said process comprising:
- a step of catalytic hydrogenation of a pyrolysis oil at a temperature ranging from 100°C to 220°C and a pressure ranging from 20 to 150 bars,
- 5 said pyrolysis oil comprising, based on the total weight of the pyrolysis oil:
- from 700 ppm to 3000 ppm by weight of aromatic compounds,
 - from 40 to 50%wt of normal paraffinic compounds,
 - from 40 to 50%wt of isoparaffinic compounds, and
- 10 - from 2 to 15%wt of naphthenic compounds,
- said fluid comprising less than 700 ppm by weight of aromatic, based on the total weight of the fluid.
2. The process according to claim 1, wherein the pyrolysis oil comprises, based on the total weight of the pyrolysis oil:
- 15 - from 42 to 48%wt of normal paraffinic compounds, and
- from 42 to 48%wt of isoparaffinic compounds, and
 - from 5 to 10%wt of naphthenic compounds.
- 20 3. The process according to claim 1 or 2, wherein the weight ratio isoparaffins/n-paraffins in the pyrolysis oil ranges from 0.5 to 1.5.
4. The process according to any one of claims 1 to 3, wherein the pyrolysis oil has an aromatic content of from 900 to 2800 ppm, preferably from 1000 to 2700 ppm of aromatic compounds,
- 25 based on the total weight of the pyrolysis oil.
5. The process according to any one of claims 1 to 4, wherein the catalytic hydrogenation is performed in the presence of a catalyst selected from nickel, nickel tungstate, nickel molybdenum, molybdenum, cobalt molybdenate, nickel molybdenate on silica and/or alumina carriers or zeolites, preferably selected from nickel-based catalysts preferably supported on silica and/or alumina carrier.
- 30 6. The process according to any one of claims 1 to 5, wherein the process comprises a preliminary step of preparing a pyrolysis oil by a process comprising at least one depolymerizing step of plastic waste.
- 35 7. The process according to claim 6, wherein the plastic waste is selected from polyolefins, polypropylene, polyethylene and polystyrene.
- 40

8. The process according to any one of claims 1 to 7, further comprising a fractionation step, performed before and/or after the catalytic hydrogenation step in order to provide at least one cut having a boiling range below 100°C.
- 5 9. The process according to claim 8, wherein the fractionation step is performed after the catalytic hydrogenation step to obtain at least one fluid selected from:
- a fluid having a final boiling point in the range from 100 to 180°C, preferably from 120 to 170°C,
 - a fluid having a final boiling point in the range from more than 180°C and up to 240°C, preferably from 190°C to 230°C, and
 - 10 - a fluid having a final boiling point in the range from more than 240°C and up to 300°C, preferably from 250 to 280°C.
- 10 10. Fluid having a boiling range below 100°C and having an initial boiling point and a final boiling point in the range from 50 to 350°C, the fluid comprising, based on the total weight of the fluid:
- 15 - from 23 to 63%wt of normal paraffinic compounds, and
 - from 33 to 63%wt of isoparaffinic compounds, and
 - from 2 to 15%wt of naphthenic compounds, and
 - less than 700 ppm by weight of aromatic compounds.
- 20 11. Fluid according to claim 10, wherein the fluid is derived from a pyrolysis oil, preferably the fluid is obtainable by a step of catalytic hydrogenation of a pyrolysis oil, more preferably wherein the fluid is obtainable by the process according to any one of claims 1 to 9.
- 25 12. Fluid according to claim 10 or 11, comprising less than 300 ppm by weight of aromatic compounds, preferably less than 20 ppm by weight of aromatic compounds.
13. Fluid according to any one of claims 10 to 12, having a weight ratio isoparaffins/n-paraffins ranging from 1/2 to 3/1.
- 30 14. Fluid according to any one of claims 10 to 13, selected from:
- a fluid having an initial boiling point in the range from 30°C to 90°C and a final boiling point in the range from 100 to 180°C,
 - a fluid having an initial boiling point in the range from 100°C to 180°C and a final boiling point in the range from more than 190°C and up to 240°C, and
 - 35 - a fluid having an initial boiling point in the range from 200°C to 270°C and a final boiling point in the range from more than 240°C and up to 300°C, preferably from:
 - a fluid having an initial boiling point in the range from 30°C to 70°C and a final boiling point in the range from 120 to 170°C,
 - 40

- a fluid having an initial boiling point in the range from 120°C to 180°C and a final boiling point in the range from 190°C to 230°C,
 - a fluid having an initial boiling point in the range from 200°C to 240°C and a final boiling point in the range from 245°C to 270°C, and
 - 5 - a fluid having an initial boiling point in the range from 240°C to 260°C and a final boiling point in the range from 260°C to 270°C.
- 15.** Use of the fluid according to any one of claims 10 to 14, as drilling fluids, as industrial solvents, as cutting fluids, as rolling oils, as electro-discharge machining fluids, as rust preventatives in
- 10 industrial lubricants, as dilution oils, as viscosity reducers in formulations based on plasticized polyvinyl chloride, as crop protection fluids, as white oils, in particular in coating fluids, in metal extraction, in the mining industry, in explosives, in mold release formulations for concrete, in adhesives, in printing inks, in metal working fluids, in sealing products or polymer formulations based on silicone, in resins, in pharmaceutical products, in cosmetic formulations, in paint
- 15 compositions, in polymers used in water treatment, in paper manufacture or in printing pastes or cleaning solvents.