

Method for Purifying a Synthetic Crude Oil Stream

The present invention relates to methods for purifying a synthetic crude oil stream and to methods for producing a synthetic crude oil product stream from an organic material.

Synthetic crude oil, sometimes also referred to as syncrude, can be obtained from different processes. For example, synthetic crude oil may be shale oil, which is obtained from oil shale by pyrolysis. Another source is hydrocarbons obtained from oil sand, in particular bitumen, from which synthetic crude oil can be obtained by upgrading. In addition, synthetic crude oil can also be produced from plastic material, for example plastic waste, by cracking.

Synthetic crude oils typically contain different impurities, which can have adverse effects on refining processes and refinery systems or can make the crude oil completely unsuitable for certain refining processes. The type and content of the impurities can vary greatly depending on the source and method for obtaining the synthetic crude oil.

A particularly big problem in the further processing of synthetic crude oils is the so-called gum formation. Pyrolysis oils usually contain different chemical compounds that can tend to form deposits. Such deposits can subsequently clog or otherwise damage refinery systems, increase the cleaning effort and shorten the life of systems.

The problem of gum formation in connection with synthetic crude oils has not yet been satisfactorily solved. There is still a need for methods to reduce the tendency of synthetic crude oils to form gum. It is therefore an object of the present invention to provide methods for reducing the gum formation of synthetic crude oils.

The present invention therefore relates to a method for purifying a synthetic crude oil stream, the method comprising the following steps:

- Providing the synthetic crude oil stream, wherein the synthetic crude oil stream contains diene compounds and has a diene number of at least 0.1 g/100 g;

- Contacting the synthetic crude oil stream with a sulfur stream containing at least one sulfur compound to form a mixture, thereby converting at least a portion of the diene compounds into diene-free products; and
- obtaining therefrom a synthetic crude oil product stream, wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream.

In a further aspect, the invention relates to a method for producing a synthetic crude oil product stream from an organic material, preferably plastic material, comprising the following steps:

- Providing the organic material, wherein the organic material comprises diene compounds;
- Adding a sulfur-containing composition containing at least one sulfur compound to form a mixture;
- Feeding the mixture into a depolymerization reactor and depolymerizing the organic material, wherein at least a portion of the diene compounds react with the at least one sulfur compound and are converted into diene-free products; and
- obtaining therefrom a synthetic crude oil product stream, wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream.

In a further aspect, the invention relates to a method for producing a synthetic crude oil product stream from an organic material, preferably plastic material, comprising the following steps:

- Providing the organic material, wherein the organic material comprises diene compounds and at least one sulfur source;
- Feeding the organic material into a depolymerization reactor and depolymerizing the organic material, wherein a sulfur compound is obtained from the at least one sulfur source and wherein at least a portion of the diene compounds react with the sulfur compound and are converted into diene-free products; and
- obtaining therefrom a synthetic crude oil product stream, wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream.

In connection with the present invention, it has been found that synthetic crude oils have an increased tendency to form gum, in particular when they have a high content of diene compounds. Reactive dienes can therefore act as gum formers and

lead to harmful deposits in refinery systems. For example, dienes can sometimes undergo Diels-Alder reactions and thus lead to crosslinking between molecules and ultimately to deposits. In addition, dienes can form stable complexes with catalysts in hydrotreating units. It has therefore been found to be advantageous within the scope of the invention to reduce the diene content of synthetic crude oils.

In the method according to the invention, this is achieved by reacting the synthetic crude oil stream with a sulfur stream containing at least one sulfur compound in order to convert the diene compounds into soluble diene-free products. The diene-free products can then be dissolved in the crude oil stream. The reaction products therefore do not have to be removed before further processing, for example in a hydrotreating unit. The present invention therefore makes it possible, in simplified terms, to render problematic diene compounds at least partially harmless in a single step, without further purification steps for removing the diene compounds or reaction products thereof being necessary. Instead, the diene-free products can simply remain in the synthetic crude oil product stream. The synthetic crude oil product stream has a lower diene content and is therefore less prone to gum formation. The "synthetic crude oil product stream" may also be referred to as the "purified synthetic crude oil stream".

The use of sulfur-containing compounds to remove olefins from hydrocarbon products is generally known from the prior art. For example, WO 2021/021449 A1 describes methods for removing olefins from light hydrocarbon streams by mercaptanization with hydrogen sulfide in the presence of a catalyst. Olefins are to be converted into mercaptans, which are then oxidized in a so-called MEROX process step and finally separated. However, WO 2021/021449 A1 relates neither to the treatment of synthetic crude oils nor to the diene compounds that are particularly problematic in connection with gum formation.

The present invention is also based on a completely different approach. It has been found that diene compounds contained in a synthetic crude oil stream can be converted directly into diene-free products by reaction with sulfur compounds, which are soluble in the synthetic crude oil stream and can remain

therein. It is thus even possible to further process the obtained synthetic crude oil product stream directly, for example in a hydrotreating unit, without additional purification or separation steps being necessary.

Further methods associated with the processing or purification of crude oil streams, in particular the conversion of diene compounds, or related topics are known from WO 2021/204818 A1, WO 2021/201932 A1, US 4,059,504 A, US 3,238,269 A, US 3,595,780 A, US 5,417,844 A and US 4,734,540 A. The hydrogenation of diene compounds is known in particular from the prior art. In this process, diene compounds are typically reduced with hydrogen (H_2) in the presence of a catalyst.

As described above, the present invention takes a different approach. In connection with the invention, the contacting of the synthetic crude oil stream with the sulfur stream preferably takes place in the absence of hydrogen (H_2). In particular, it is preferred in all aspects of the invention that the sulfur compound undergoes addition reactions with double bonds of the diene compounds, whereby at least a portion of the diene compounds are converted into diene-free products.

In the method according to the invention for producing a synthetic crude oil product stream from an organic material, sulfur compounds are added to the organic material even before the depolymerization, or a sulfur source is already contained in the organic material. This makes it possible to convert diene compounds into diene-free products even during pyrolysis, which are present dissolved in the synthetic crude oil product stream obtained therefrom. This has the advantage, among other things, that the high temperatures during the depolymerization can also be used for the reaction of the diene compounds and that no subsequent separate addition of sulfur compounds is necessary.

It is particularly advantageous if a sulfur source is already contained in the organic material. In this case, the sulfur compound may be released by the high temperatures during the depolymerization. Thus, if an organic material is selected or assembled that already contains a sulfur source in addition to the diene compounds, this has the advantage that no separate addition of a sulfur-containing composition is required.

The sulfur source may be any substance from which a sulfur compound as defined herein, such as a thiol or hydrogen sulfide, can be obtained during the depolymerization. In one embodiment, the sulfur source may be elemental sulfur. In a preferred embodiment, the sulfur source is sulfur-containing polymers, preferably vulcanized plastics. Under the conditions of depolymerization, hydrogen sulfide, but also mercaptans can be formed from such sulfur sources, which can subsequently react with the diene compounds contained in the organic material, as described herein.

In a preferred embodiment, the concentration of the sulfur source (preferably the sulfur-containing polymers, in particular the vulcanized plastics) in the organic material is at least 0.05 % (w/w), more preferably at least 0.1 % (w/w), more preferably at least 0.2 % (w/w), more preferably at least 0.5 % (w/w), more preferably at least 1 % (w/w), more preferably at least 2 % (w/w), more preferably at least 5 % (w/w), more preferably at least 10 % (w/w). The concentration is preferably from 0.05 to 60 % (w/w), more preferably from 0.1 to 50 % (w/w), more preferably from 0.2 to 40 % (w/w), more preferably from 0.5 to 35 % (w/w), more preferably from 1 to 30 % (w/w), more preferably from 2 to 25 % (w/w), more preferably from 5 to 20 % (w/w), more preferably from 10 to 15 % (w/w). Higher concentrations of the sulfur source have the advantage that a larger amount of sulfur compounds is obtained during the depolymerization and that the reaction with the diene compounds is therefore favored further.

Preferred embodiments of the method according to the invention for purifying a synthetic crude oil stream and the method according to the invention for producing a synthetic crude oil product stream from an organic material are described together below. Thus, preferred embodiments described with respect to a method, for example for the diene content or for the sulfur compounds, are also preferred for the other methods.

The diene compounds contained in the synthetic crude oil stream or in the organic material are preferably compounds containing conjugated or cumulative carbon-carbon double bonds, in particular conjugated carbon-carbon double bonds. Such compounds tend in particular to form gum, for example by Diels-Alder reactions, and can be removed particularly well by the method

according to the invention.

The person skilled in the art is familiar with methods for determining the diene number. Preferably, the diene number is determined according to the ASTM UOP326-07 standard.

The synthetic crude oil stream has a diene number of at least 0.1 g/100 g, preferably at least 0.2 g/100 g, more preferably at least 0.3 g/100 g, more preferably at least 0.4 g/100 g, more preferably at least 0.5 g/100 g, more preferably at least 0.6 g/100 g, more preferably at least 0.7 g/100 g, more preferably at least 0.8 g/100 g, more preferably at least 0.9 g/100 g, more preferably at least 1.0 g/100 g, more preferably at least 1.1 g/100 g, more preferably at least 1.2 g/100 g, more preferably at least 1.3 g/100 g, more preferably at least 1.4 g/100 g, more preferably at least 1.5 g/100 g, more preferably at least 1.6 g/100 g, more preferably at least 1.7 g/100 g, more preferably at least 1.8 g/100 g, more preferably at least 1.9 g/100 g, more preferably at least 2.0 g/100 g. The synthetic crude oil stream or in the organic material preferably has a diene number in the range from 0.1 g/100 g to 15 g/100 g, more preferably from 1.0 g/100 g to 12 g/100 g, in particular from 1.5 g/100 g to 10 g/100 g. With regard to the method according to the invention for producing a synthetic crude oil product stream from an organic material, it is also preferred if the organic material has a diene number of at least 0.1 g/100 g. It is particularly preferred if the organic material has a diene number, as described here for the synthetic crude oil stream, i.e. the preferred values described as for the synthetic crude oil stream are also preferred for the organic material.

The synthetic crude oil product stream preferably has a lower diene number than the synthetic crude oil stream or the organic material. The synthetic crude oil product stream preferably has a diene number of less than 5 g/100 g, more preferably less than 4 g/100 g, more preferably less than 3 g/100 g, more preferably less than 2 g/100 g, more preferably less than 1.5 g/100 g, more preferably less than 1 g/100 g, more preferably less than 0.9 g/100 g, more preferably less than 0.8 g/100 g, more preferably less than 0.7 g/100 g, more preferably less than 0.6 g/100 g, more preferably less than 0.5 g/100 g. The synthetic crude oil product stream preferably has a diene number in

the range from 0.01 g/100 g to 5g/100 g, more preferably from 0.1 g/100 g to 2 g/100 g, in particular from 0.2 g/100 g to 1 g/100 g.

The at least one sulfur compound is preferably selected from the group consisting of thiols, thioketones, thioethers, thio-carboxylic acids, mercaptocarboxylic acids, and hydrogen sulfide. Thiols are particularly preferred. Thiols can react with dienes in an addition reaction and form thioethers, which can remain dissolved in the synthetic crude oil stream. The diene is thus removed and, for example, can no longer enter into Diels-Alder reactions that could lead to gum formation. Similarly, the other sulfur compounds mentioned can also react with dienes to form soluble diene-free and low-reactive products. Hydrogen sulfide is also suitable as a sulfur compound in the context of the method according to the invention. However, hydrogen sulfide has the disadvantage that the addition reaction with a diene produces a free thiol, which in turn can continue to react and can therefore also contribute to the crosslinking of molecules and the formation of deposits to a certain extent. Thiols, thioketones, thioethers, thiocarboxylic acids and mercaptocarboxylic acids have therefore proven to be particularly advantageous.

It is particularly preferred if the at least one sulfur compound is selected from the group consisting of methyl mercaptan, ethyl mercaptan, n-propyl mercaptan, isopropyl mercaptan, phenyl mercaptan, ethanedithiol, propanedithiol, mercaptoethanol, mercaptopropanol, thioacetic acid, mercaptoacetic acid, cysteine, methionine, thiourea and hydrogen sulfide. For the reasons given above, hydrogen sulfide is less preferred among the compounds mentioned. The other compounds mentioned, on the other hand, all have the advantage that no free thiols are formed during the reaction with dienes, which can enter into undesirable further reactions. In connection with the invention, it is therefore particularly preferred if the at least one sulfur compound is selected from the group consisting of methyl mercaptan, ethyl mercaptan, n-propyl mercaptan, isopropyl mercaptan, phenyl mercaptan, ethanedithiol, propanedithiol, mercaptoethanol, mercaptopropanol, thioacetic acid, mercaptoacetic acid, cysteine, methionine and thiourea.

It has proven advantageous if the contacting of the

synthetic crude oil stream with the sulfur stream takes place at a temperature of at least 80 °C, preferably at least 100 °C, more preferably at least 120 °C, more preferably at least 140 °C, more preferably at least 160 °C, more preferably at least 180 °C, more preferably at least 200 °C, more preferably at least 220 °C, more preferably at least 240 °C. In particular, it is preferred if the contacting of the synthetic crude oil stream with the sulfur stream takes place at a temperature in the range from 80 to 450 °C, preferably from 100 to 400 °C, more preferably from 120 to 350 °C, more preferably from 140 to 300 °C, more preferably from 160 to 260 °C, more preferably from 180 to 220 °C. A higher temperature can promote the reaction between the diene compounds and the sulfur compounds and therefore lead to an even greater reduction in the diene content.

Preferably, the contacting of the synthetic crude oil stream with the sulfur stream takes place at the specified temperature for a period of at least 0.5 minutes, preferably at least 1 minute, more preferably at least 2 minutes, even more preferably at least 5 minutes, most preferably at least 12 minutes. The provision of a longer duration allows a more complete course of the reactions between the diene compounds and the sulfur compounds, so that the diene content can be reduced even more. In particular, it is therefore preferred if the duration is between 0.5 and 180 minutes, preferably between 1 and 120 minutes, more preferably between 2 and 60 minutes, even more preferably between 5 and 30 minutes, most preferably between 12 and 20 minutes.

In a preferred embodiment, the contacting takes place in the presence of at least one radical initiator and/or catalyst. The presence of a radical initiator and/or a catalyst can promote the addition of sulfur compounds to double bonds and thus lead to an even more thorough removal of diene compounds. In particular, a free-radical initiator and/or a catalyst has the advantage that a lower activation energy has to be applied and that the reactions of the diene compounds therefore also proceed rapidly when the contacting of the synthetic crude oil stream with the sulfur stream takes place at lower temperatures. Preferably, the at least one radical initiator and/or catalyst is selected from the group consisting of UV light,

azobis(isobutyronitrile), dibenzoyl peroxide, amine compounds and heavy metal salts.

The concentration of the sulfur compounds in the sulfur stream is preferably at least 0.01 % (w/w), more preferably at least 0.5 % (w/w), more preferably at least 2 % (w/w), more preferably at least 10 % (w/w). A higher concentration of sulfur compounds can favor the reaction with diene compounds.

It is further preferred if the concentration of the sulfur compounds in the mixture formed from the synthetic crude oil stream and the sulfur stream is at least 0.05 % (w/w), preferably at least 0.1 % (w/w), more preferably at least 1 % (w/w). In particular, it is preferred if the concentration of the sulfur compounds in the mixture formed from the synthetic crude oil stream and the sulfur stream is in the range from 0.05 to 10 % (w/w), preferably from 0.1 to 5 % (w/w), more preferably from 0.2 to 2 % (w/w).

In a preferred embodiment, the volumetric mixing ratio between the synthetic crude oil stream and the sulfur stream is from 1000:1 to 10:1, preferably 200:1 to 50:1. A mixing ratio in this range has proven to be particularly well suited as it can ensure a sufficient concentration of sulfur compounds without excessively diluting the synthetic crude oil stream.

In a preferred embodiment of the method according to the invention for purifying a synthetic crude oil stream or for producing a synthetic crude oil stream from an organic material, the synthetic crude oil product stream is fed to a liquid-gas separation. Preferably, at least a portion of unused sulfur compounds is separated via the gas phase. This has the advantage, among other things, that the sulfur content in the synthetic crude oil product stream is reduced, even if high amounts of the sulfur compounds are used. It is particularly advantageous if at least a portion of the sulfur compounds separated off via the gas phase are recycled into the sulfur stream. This makes it possible to make even better use of the sulfur compounds. In addition, this allows a higher concentration of sulfur compounds in the mixture of synthetic crude oil stream and sulfur stream, which in turn favors the reaction of the diene compounds.

In a preferred embodiment of the method according to the invention for purifying a synthetic crude oil stream or for producing a synthetic crude oil stream from an organic material,

the synthetic crude oil product stream is fed into a hydrotreating unit. It has been found that the reduction of the diene content in the synthetic crude oil stream is particularly advantageous, especially in the course of hydrogenation in a hydrotreating unit, since dienes in such systems can form stable complexes with catalysts. The use of the method according to the invention in combination with a hydrogenation can thus considerably improve the service life of the hydrotreating units and in particular of the catalysts used.

In connection with the invention, a "synthetic crude oil stream" is preferably understood to mean a material stream containing a synthetic crude oil or a fraction of a synthetic crude oil. Preferably, the synthetic crude oil stream consists of synthetic crude oil or a fraction thereof. Within the scope of the invention, it is particularly preferred if the synthetic crude oil stream comprises, in particular consists of, a pyrolysis oil or a fraction thereof. The pyrolysis oil is preferably a pyrolysis oil obtained from biomass, in particular wood, and/or plastic. The method according to the invention has proven to be particularly suitable if the synthetic crude oil stream is a hydrocarbon mixture obtained from the depolymerization of biomass or plastic material, in particular plastic material. The synthetic crude oil stream is therefore preferably a plastic pyrolysate or a fraction thereof, or a biomass pyrolysate, in particular wood pyrolysate, or a fraction thereof. However, the method according to the invention is also well suited for other synthetic crude oils and fractions thereof. In further preferred embodiments, the synthetic crude oil stream therefore comprises, preferably consists of, shale oil or upgraded bitumen.

In a particularly preferred embodiment of the method for purifying a synthetic crude oil stream, the synthetic crude oil stream is therefore generated by depolymerization of plastic material, in particular plastic waste. The person skilled in the art is familiar with the production of a synthetic crude oil stream by depolymerization of plastic material. Such methods are known, for example, from WO 2012/149590 A1 and US 6,060,631 A. Likewise, for the method for producing a synthetic crude oil product stream from an organic material, it is preferred if the organic material is plastic material, in particular plastic

waste.

Preferably, the plastic material comprises polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), polyethylene terephthalate (PET), polyamide (PA), styrene-acrylonitrile (SAN), and/or acrylonitrile-butadiene-styrene (ABS). The methods according to the invention have proven to be particularly suitable for purifying pyrolysis oils from the plastic materials mentioned.

In a preferred embodiment of the methods for producing a synthetic crude oil product stream from an organic material, the organic material is depolymerized at a temperature of at least 250 °C, preferably at least 300 °C, more preferably at least 350 °C. The organic material is preferably depolymerized at a temperature in the range from 250 to 550 °C, preferably from 300 to 500 °C, more preferably from 350 to 450 °C, more preferably from 400 to 440 °C. It has been shown that these temperatures are both well suited for the depolymerization of the organic material, in particular plastic material, and at the same time promote the reaction of the dienes with sulfur compounds.

All parameters mentioned herein refer, unless otherwise indicated, to SATP conditions according to IUPAC ("Standard Ambient Temperature and Pressure"), in particular to a temperature of 25 °C and a pressure of 101,300 Pa.

Unless otherwise indicated, all percentages (%) herein refer to percentages by weight.

Unless otherwise indicated, all mixing ratios specified herein relate to volumetric mixing ratios, i.e. to volume ratios (volume:volume).

The present invention is illustrated by the following Figure, to which, of course, it is not limited.

Figure 1 shows a method flow diagram of a preferred embodiment of the method according to the invention for purifying a synthetic crude oil stream.

In the embodiment shown in Figure 1, the synthetic crude oil stream 1 is obtained by depolymerization of plastic material. The plastic material is compacted, degassed and melted in an extruder 12. The plastic melt emerging from the extruder 12 is

mixed in a static mixer 13 with an external solvent 14, preferably heavy oil, and/or with already cracked plastic material, which is recycled as recycling stream 15, in order to reduce the viscosity of the plastic melt. The resulting mixture is introduced into a depolymerization reactor 16, in which the plastic material is depolymerized, preferably at a temperature between 400 °C and 440 °C. Cracked plastic material is obtained as the top product of a column 17. After separating a gas stream 18 in a further column 19, the synthetic crude oil stream 1 is obtained, the synthetic crude oil stream 1 having a diene number of at least 0.1 g/100 g. Subsequently, the synthetic crude oil stream 1 is brought into contact with a sulfur stream 2 containing at least one sulfur compound, preferably a thiol. At least a portion of the diene compounds contained in the synthetic crude oil stream 1 react with the sulfur compounds and are converted to diene-free products. From this, a synthetic crude oil product stream 3 is obtained, in which the diene-free products are present in dissolved form.

Claims:

1. A method of purifying a synthetic crude oil stream (1), the method comprising the following steps:
 - Providing the synthetic crude oil stream (1), wherein the synthetic crude oil stream (1) contains diene compounds and has a diene number of at least 0.1 g/100 g;
 - Contacting the synthetic crude oil stream (1) with a sulfur stream (2) containing at least one sulfur compound to form a mixture, thereby converting at least a portion of the diene compounds into diene-free products; and
 - obtaining therefrom a synthetic crude oil product stream (3), wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream (3).
2. The method according to claim 1, wherein contacting the synthetic crude oil stream (1) with the sulfur stream (2) occurs at a temperature of at least 80 °C.
3. The method according to claim 1 or 2, wherein the contacting is in the presence of at least one radical initiator and/or catalyst, preferably wherein the at least one radical initiator and/or catalyst is selected from the group consisting of UV light, azobis(isobutyronitrile), dibenzoyl peroxide, amine compounds and heavy metal salts.
4. The method according to any one of claims 1 to 3, wherein the concentration of the sulfur compounds in the mixture formed from the synthetic crude oil stream (1) and the sulfur stream (2) is at least 0.05 % (w/w).
5. The method according to any one of claims 1 to 4, wherein the concentration of the sulfur compounds in the mixture formed from the synthetic crude oil stream (1) and the sulfur stream (2) is in the range of 0.05 to 10 % (w/w).
6. The method according to any one of claims 1 to 5, wherein the volumetric mixing ratio between the synthetic crude oil stream (1) and the sulfur stream (2) is from 1000:1 to 10:1.

7. The method according to any one of claims 1 to 6, wherein the synthetic crude oil stream (1) is generated by depolymerization of plastic material, in particular plastic waste.

8. A method for producing a synthetic crude oil product stream (3) from an organic material, preferably plastic material, comprising the following steps:

- Providing the organic material, wherein the organic material comprises diene compounds;
- Adding a sulfur-containing composition containing at least one sulfur compound to form a mixture;
- Feeding the mixture into a depolymerization reactor (16) and depolymerizing the organic material, wherein at least a portion of the diene compounds react with the at least one sulfur compound and are converted into diene-free products; and
- obtaining therefrom a synthetic crude oil product stream (3), wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream (3).

9. A method for producing a synthetic crude oil product stream (3) from an organic material, preferably plastic material, comprising the following steps:

- Providing the organic material, wherein the organic material comprises diene compounds and at least one sulfur source;
- Feeding the organic material into a depolymerization reactor (16) and depolymerizing the organic material, wherein a sulfur compound is obtained from the at least one sulfur source and wherein at least a portion of the diene compounds react with the sulfur compound and are converted into diene-free products; and
- obtaining therefrom a synthetic crude oil product stream (3), wherein the diene-free products are present in a dissolved state in the synthetic crude oil product stream (3).

10. The method according to any one of claims 1 to 9, wherein the at least one sulfur compound is selected from the group consisting of thiols, thioketones, thioethers, thiocarboxylic acids, mercaptocarboxylic acids, and hydrogen sulfide.

11. The method according to any one of claims 1 to 10, wherein the at least one sulfur compound is selected from the group

consisting of methyl mercaptan, ethyl mercaptan, n-propyl mercaptan, isopropyl mercaptan, phenyl mercaptan, ethanedithiol, propanedithiol, mercaptoethanol, mercaptopropanol, thioacetic acid, mercaptoacetic acid, cysteine, methionine and thiourea.

12. The method according to any one of claims 1 to 11, wherein the plastic material comprises polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), polyethylene terephthalate (PET), polyamide (PA), styrene-acrylonitrile (SAN), and/or acrylonitrile-butadiene-styrene (ABS).

13. The method according to any one of claims 8 to 12, wherein the depolymerizing of the organic material takes place at a temperature of at least 250 °C.

14. The method according to any one of claims 8 to 13, wherein the depolymerizing of the organic material takes place at a temperature in the range of 250 to 550 °C.

15. The method according to any one of claims 1 to 14, wherein the synthetic crude oil product stream (3) containing the diene-free products is fed into a hydrotreating unit.