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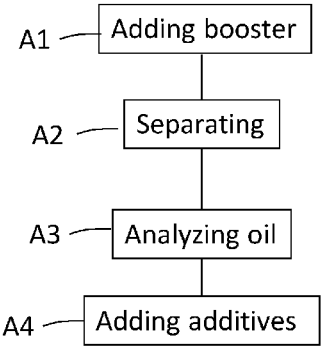

FIG. 1a

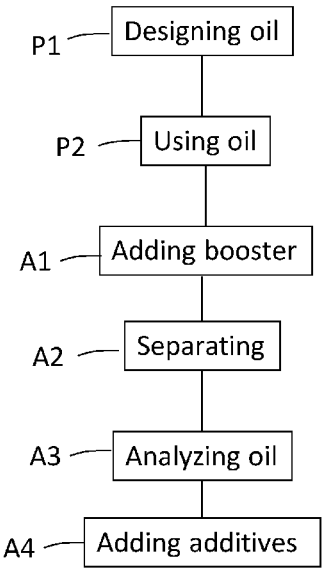

FIG. 1b

(57) Abstract: A method for circular use of industrial oil and an oil recovery system, said method comprising reconditioning of a used industrial oil, said reconditioning comprising the steps of: - adding a liquid separation booster to a used industrial oil, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific additive in the oil; - separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific additive in the oil.

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A method and system for circular use of industrial oil

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a method for circular use of industrial oil and to an oil recovery system.

BACKGROUND

The discussion of the background to the invention herein is intended to facilitate an understanding of the invention. However, it should be appreciated that the discussion is not an acknowledgement or admission that any aspect of the discussion was part of the common general knowledge as at the priority date of the application.

Unless the context requires otherwise, where the terms “comprise”, “comprises”, “comprised” or “comprising” are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other features, integers, steps or components, or group thereof.

Purification of contaminated oil, such as for example industrial oils, is important for the possibility to reuse the oils and therefore an important factor for the environmental future and the limited nature resources of oils. The contaminated oil can be purified, or recovered, by means of a liquid two-phase separation process, wherein a liquid separation aid is added to the oil and mixed therewith. Impurities will be captured by the separation aid and can for example accumulate in a bottom phase.

There is still a need to improve the possibility to reuse industrial oils.

SUMMARY

It is desirable to provide an improved method and system for reusing industrial oils.

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According to one aspect of the invention there is provided a method for circular use of industrial oil, said method comprising reconditioning of a used industrial oil, said reconditioning comprising the steps of:

- adding a liquid separation booster to a used industrial oil, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific functional additive in the oil, wherein said liquid separation booster is insoluble in the oil because of its polars properties, forming a two phase mixture upon mixing thus forming colloids consisting of small droplets of the liquid separation booster, which through chemical interactions absorb impurities being contaminating solids or dissolved impurities, whereby said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to polarity of the at least one specific functional additive in the industrial oil such that the at least one specific functional additive is not soluble in the separation booster;

- separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific additive in the oil;

- analyzing the used oil to identify depletion of certain functional additives in the used oil; and

- adding functional additives to the used oil, wherein the step of adding functional additives to the used oil comprises adding those functional additives which have been identified as depleted and in an amount corresponding to the identified depletion, wherein

the functional additives added to the used oil is one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, anti-wear agents, extreme pressure agents, friction

modifiers, detergents, dispersants, pour point depressants, viscosity index improvers and foam inhibitors.

According to another aspect of the invention there is provided an oil recovery system, comprising:

- at least one oil purification tank into which used industrial oil is provided for purification;
- a booster adding device connected to the oil purification tank and comprising a liquid separation booster and configured for adding a liquid separation booster to the used oil in the purification tank, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific functional additive in the oil, wherein said liquid separation booster is insoluble in the oil because of its polars properties, forming a two phase mixture upon mixing thus forming colloids consisting of small droplets of the liquid separation booster, which through chemical interactions absorb impurities being contaminating solids or dissolved impurities, whereby said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to polarity of the at least one specific functional additive in the industrial oil such that the at least one specific functional additive is not soluble in the separation booster;
- a separation device configured for separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific functional additive in the oil;
- at least one analyzing device which is configured for analyzing the used oil to identify depletion of certain functional additives in the used oil; and
- an additive providing device configured for adding functional additives to the used oil, wherein the additive providing device is configured for adding those functional additives which have been identified as depleted and in an amount corresponding to the identified depletion, wherein the functional additives added to the used oil is one or more of oxidation inhibitors, corrosion inhibitors, rust

- inhibitors, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers and foam inhibitors.

Hereby a method and a system for circular use of industrial oil is provided where impurities in a used industrial oil can be removed without the risk of removing also additives from the oil. A liquid separation booster is used which is specifically designed such that it will attract impurities but not additives. Hereby an effective reconditioning of the used industrial oil is achieved.

In some embodiments of the invention said reconditioning further comprises the step of adding additives to the used oil. The oil recovery system may comprise an additive providing device configured for adding additives to the used oil. Hereby additives which have been depleted during use of the industrial oil can be added and the industrial oil can be used and circulated even longer.

In one embodiment of the invention said reconditioning further comprises the step of analyzing the used oil to identify depletion of certain additives in the used oil before the step of adding additives to the used oil, wherein the step of adding additives to the used oil comprises adding those additives which have been identified as depleted and in an amount corresponding to the identified depletion. The oil recovery system may comprise at least one analyzing device which is configured for analyzing the used oil to identify depletion of certain additives in the used oil before adding additives to the used oil, wherein the additive providing device is configured for adding those additives which have been identified as depleted and in an amount corresponding to the identified depletion. Hereby the

reconditioning of the used industrial oil can be even more effective and the industrial oil can be used effectively for a long time.

In one embodiment of the invention said liquid separation booster is substantially insoluble in the oil, forming a two phase mixture upon mixing, and wherein said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to the polarity of the at least one specific additive in the industrial oil such that the at least one specific additive is not soluble in the separation booster. Hereby the separation booster will be passive onto, i.e. not attract, the at least one specific additive, whereby the separation booster with attracted impurities can be separated from the oil without also removing at least this specific additive. The separation booster is suitably passive onto more than one specific additive.

In one embodiment of the invention the step of separating the separation booster with attracted impurities from the used industrial oil comprises one or more of the following steps: mixing the used oil with the separation booster, warming the mixture, waiting for allowing separation booster with attracted impurities to settle in a top or bottom phase in the oil purification tank, centrifuging the mixture of used oil and separation booster, filtering the mixture of used oil and separation booster and filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase. The separation device may comprise one or more of the following: a mixing device for mixing the used oil with the separation booster, a heating device for warming the mixture, a centrifuging device configured for centrifuging the mixture of used oil and separation booster and a filtering device configured for filtering the mixture of used oil and separation booster or for filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase.

In one embodiment of the invention the method further comprises the first steps of:

- designing an industrial oil which is specifically designed for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big

difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster,

- using said specifically designed industrial oil before the used oil is reconditioned as described above by use of the dedicated separation booster.

The oil recovery system may comprise at least one oil preparation tank configured for designing an industrial oil which is specifically designed for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster.

Hereby, by designing an industrial oil which is specifically designed for being suitable to purify with this liquid separation booster the reconditioning of the industrial oil and the circular use of the industrial oil can be even more improved. By choosing base oils and additives in dependence of the separation booster to be used, i.e. base oils and additives which are not soluble in the separation booster, an effective reconditioning can be provided when using this specific separation booster and the industrial oil can be effectively used over and over again.

In one embodiment of the invention said steps of reconditioning a used oil are performed inline a system which is using the industrial oil, such that reconditioning is performed in a closed circuit circulation system of the industrial oil. The oil recovery system may be designed as an inline system, so that the oil recovery system is integrable in a closed circuit circulation system of the industrial oil.

In one embodiment of the invention the method is performed offline and the method comprises retrieving used industrial oil from an industrial plant, reconditioning the used industrial oil and returning the reconditioned oil to an industrial plant for further use and possibly a first optional step of delivering a specifically designed industrial oil to an industrial plant. The oil recovery system may be provided as an offline system in which industrial oil from different industries can be reconditioned.

In one embodiment of the invention the method comprises the steps of:

- designing an industrial oil for use in a specific system or in a specific type of system, wherein said industrial oil is designed for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives to meet required technical specifications for use in the specific system or type of system, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster;
- using the designed oil in the specific system or the specific type of system;
- removing the designed oil from the system after use a specific time;
- purifying the removed used oil with the dedicated separation booster;
- analyzing the removed used oil to identify depletion of certain additives in the oil;
- adding to the removed used oil those additives which have been identified as depleted during the use and in an amount corresponding to the identified depletion; and
- returning purified oil which also has been topped up with additives for further use in the specific system or specific type of system it initially was designed for.

In one embodiment of the invention the oil recovery system comprises:

- at least one oil preparation tank configured for designing an industrial oil for use in a specific system or in a specific type of system and for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives to meet required

technical specifications for use in the specific system or type of system, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster;

- at least one oil component tank connectable to at least one of said at least one oil preparation tank , wherein said at least one oil component tank comprises one or more base oil tanks;
- an additive providing device connected to said at least one oil preparation tank, wherein said additive providing device is configured for providing functional additives which are chosen to meet required technical specifications for use in the specific system or type of system;
- at least one used oil tank which is configured for holding used industrial oil which has been returned to the oil recovery system after use in the specific system or specific type of system;
- at least one oil purification tank connectable to the at least one used oil tank, wherein said purification tank is configured for purifying the used industrial oil by use of a separation booster which was dedicated for this specific industrial oil;
- at least one analyzing device which is configured for identifying depletion of certain additives in a used industrial oil which has been returned to the oil recovery system after use in the specific system or specific type of system;

wherein said additive providing device further is configured for adding to the returned used oil those additives which have been identified as depleted during the use and in an amount corresponding to the depletion identified by the at least one analyzing device.

Hereby with such a method and in such a plant an industrial oil can be designed for use in a specific system or specific type of system and designed such that it is suitable to purify with a dedicated separation booster. Hereby used oil which is returned to the plant can be optimally recovered, both by purifying the oil and by adding depleted additives to the oil. The fact that the industrial oil is specifically designed from the beginning for a specific system and for a specific separation booster will improve the recovery efficiency a lot because both the base oils and the additives can be chosen to be compatible with the separation booster. Hereby an industrial oil which is designed according to the invention can be recovered between uses and be used over and over again in a specific system or in a specific type of system. Hereby oil

consumption will be decreased and the nature resources of oil can be saved. Furthermore the oil recovery method as used in this invention is environmental friendly and does not produce emissions harmful for the environment as is the case for example for a re-refining process for used oil. Even further with the method for circular use of industrial oil according to the invention also additives provided in the industrial oil will be reused in contrast to when a used oil is recovered in a re-refining process where remaining additives are removed. In the method according to the invention any remaining additives in the used industrial oil are kept in the oil and new additives are added for compensating any possibly additives which were consumed during use. This is possible because the designed oil is always used in the same system or same type of system as it was initially designed for. Furthermore, in the method for circular use of industrial oil according to the invention the oil product is not ranked down to waste after use but is instead kept in an oil class which is a product class during the whole recirculation process. This is possible because the used oil is not mixed with other used oil products but kept for its initial purpose.

In one embodiment of the invention the step of analyzing the removed used oil further comprises analyzing the removed used oil to identify amount of contaminations in the oil and possibly repeating the purifying step if the identified amount of contaminations is above a predefined threshold.

In one embodiment of the invention the method comprises providing a top up additive package for each designed industrial oil for use in a specific system or type of system, wherein said top up additive package comprises functional additives to meet required technical specifications for use in the specific system or type of system.

In one embodiment of the invention the step of purifying the removed used oil comprises:

- mixing the used oil with the separation booster in an oil purification tank;
- warming the mixture; and
- waiting for allowing booster and contaminations to settle in a top or bottom phase in the oil purification tank.

In one embodiment of the invention the step of purifying further comprises a step of filtering the used oil.

In one embodiment of the invention the step of filtering comprises adding cellulose fibers to a part of the used oil and circulating this part of the used oil with added cellulose fibers over a

carrier paper for building a depth filter and then filter the rest of the used oil through the depth filter.

In one embodiment of the invention the step of designing an industrial oil comprises:

- providing a concentrated industrial oil comprising functional additives to meet required technical specifications for use in the specific system or type of system;
- delivering said concentrated industrial oil to an oil recovery system; and
- finalizing an industrial oil for use in a specific system or specific type of system by mixing said concentrated industrial oil with at least one base oil at the oil recovery system.

In one embodiment of the invention the steps of purifying the removed used oil and adding additives to the removed used oil and at least parts of the step of designing the industrial oil are performed at an oil recovery system.

In one embodiment of the invention the step of analyzing the used oil to identify depletion of certain additives in the oil comprises analyzing amount of specific additives in the oil which specific additives have been predefined for this specific system or specific type of system.

In one embodiment of the invention the additives added to the removed used oil can be one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, metal deactivators, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers, foam inhibitors, adhesion promotors, emulators and bactericides.

In one embodiment of the invention said at least one oil component tank comprise at least one oil concentrate tank comprising a concentrated industrial oil comprising functional additives to meet required technical specifications for use in a specific system or type of system, whereby an industrial oil for use in a specific system or specific type of system can be prepared in the oil preparation tank by mixing said concentrated industrial oil provided from the oil concentrate tank with at least one base oil provided from at least one base oil tank.

In one embodiment of the invention the at least one oil purification tank comprises:

- a booster adding device configured for adding a separation booster to the used oil in the purification tank; and
- a mixing device for mixing the returned used oil with the separation booster.

In one embodiment of the invention an outlet from the purification tank is connected to an inlet of at least one of the at least one oil preparation tanks, possibly through a filtering device.

In one embodiment of the invention the additive adding device is configured for adding additives which can be one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, metal deactivators, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers, foam inhibitors, adhesion promotors, emulators and bactericides.

In one embodiment of the invention said analyzing device is configured for analyzing the removed used oil to identify amount of contaminations in the oil.

In one embodiment of the invention a return line is provided from at least one oil preparation tank to at least one oil purification tank such that oil can be returned to the oil purification tank for further purification if the identified amount of contaminations is above a predefined threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a and 1b are flow charts of methods according to two embodiments of the invention.

Figure 2 is a schematic view of an oil recovery system according to one embodiment of the invention.

Figure 3 is a flow chart of a method according to another embodiment of the invention.

Figure 4 is a schematic view of an oil recovery system according to another embodiment of the invention.

DETILED DESCRIPTION OF EMBODIMENTS

Figure 1a is a flow chart of a method for circular use of industrial oil according to one embodiment of the invention. The method comprises reconditioning of a used industrial oil and said reconditioning comprises the steps of:

A1: Adding a liquid separation booster to a used industrial oil, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific additive in the oil. The separation booster may suitably be passive onto, i.e. not attract more than one specific additive or even most of the additives provided in the oil or even all additives provided in the oil.

A2: Separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific additive in the oil. The step of separating the separation booster with attracted impurities from the used industrial oil may comprise one or more of the following steps: mixing the used oil with the separation booster, warming the mixture, waiting for allowing separation booster with attracted impurities to settle in a top or bottom phase in the oil purification tank, centrifuging the mixture of used oil and separation booster, filtering the mixture of used oil and separation booster and filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase.

Hereby a method for circular use of industrial oil is provided where impurities in a used industrial oil can be removed without the risk of removing also additives from the oil. A liquid separation booster is used which is specifically designed such that it will attract impurities but not additives. Hereby an effective reconditioning of the used industrial oil is achieved.

The liquid separation booster is substantially insoluble in the oil, forming a two phase mixture upon mixing, and wherein said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to the polarity of the at least one specific additive in the industrial oil such that the at least one specific additive is not soluble in the separation booster.

A separation booster which is used for the purification of oil in this invention is substantially insoluble in the oil, forming a two phase mixture upon mixing and in some embodiments having a density different from that of the oil to be purified. Said separation booster attracts impurities in the oil during mixing of oil and separation booster.

The use of a separation aid, also called a chemical booster or separation booster, for capturing impurities in contaminated oil has been described before as discussed above. A liquid separation booster/aid is added to the oil and mixed therewith and impurities in the oil will be

captured by the separation aid and will accumulate in a phase which can be separated, for example a bottom phase.

The separation aid will by chemical interactions absorb contaminating solids, or dissolved impurities in the contaminated target oil. The separation aid should be liquid at the temperature at which the process is carried out. The separation aid composition should be substantially insoluble in the contaminated target oil, forming a two-phase liquid mixture upon mixing with the contaminated oil. The liquid separation aid can also have a density different from that of the contaminated oil to be purified.

The separation aid is not soluble in the contaminated target oil because of its polar properties and thus colloids consisting of small droplets of the liquid separation aid composition are formed by the stirring, which through chemical interactions (hydrophilic, hydrophobic, and charge interactions) may absorb unwanted solid or the dissolved impurities in the contaminated target oil. In instances where the separation aid has a higher density than the oil the separation aid will at a gravity separation form a lower phase together with the solid and/or dissolved impurities. In instances where the separation aid has a lower density than the contaminated target oil, it will form an upper phase on gravity separation.

The liquid separation aid/booster for use in the invention can generally be made up based on the following components: a) a polar polymer; b) a hydrotrope/solubilizer; and, c) a co-tenside.

Suitable separation aids with the properties described above, that can be used in the inventive process, may e.g. constitute a composition comprising a mixture of polar polymers such as polyethylene glycols, polypropylene glycols or similar polyalkylene glycols, organic surface active components with nonionic, anionic, cationic and amphoteric properties with the ability to enhance the solubility of solid or dissolved impurities in to the separation aid.

One example of a separation aid which can be used in this invention comprise: a) at least one polar polymer not soluble in oil and with a higher density than the oil, such as polyethylene glycol with an average molecular weight of 190-210 g/mole, e.g. Carbowax PEG 200 (Dow Chemical Company); b) at least one surface active hydrotrope/solubilizer, such as anionic sulfonic acids, phosphate ester-based substances or non-ionic surfactants from the poly-glycoside family, such as Simulsol SL 4, Simulsol SL 7 G and Simulsol AS 48 (Seppic, Air

Liquide group); c) at least one amphoteric Co-surfactant, such as an propionate type e.g. Ampholak YJH-40 (Akzo Nobel) which is a sodium caprylimino dipropionate.

In some embodiments of the invention said reconditioning further comprises the step of:

A4: Adding additives to the used oil. Hereby additives which have been depleted during use of the industrial oil can be added and the industrial oil can be used and circulated even longer.

In some embodiments of the invention the reconditioning further comprises a step of analyzing which is performed before the step of adding additives:

A3: Analyzing the used oil to identify depletion of certain additives in the used oil, wherein the step of adding additives (A4) to the used oil comprises adding those additives which have been identified as depleted and in an amount corresponding to the identified depletion. This step of analyzing (A3) is performed before the step A4 of adding additives.

A flow chart for another embodiment of the invention is shown in Figure 1b. Steps A1-A4 are the same as described in relation to Figure 1a and will not be described again but in this embodiment there are a few initial steps performed before the steps A1-A4. The method for circular use of industrial oil comprises in this embodiment of the invention the first steps (performed before steps A1-A4) of:

P1: Designing an industrial oil which is specifically designed for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster.

The types of base oils are chosen for being suitable to purify with a dedicated separation booster. Hereby the base oils are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils are not soluble in the separation booster. Also the densities of the base oils can be chosen to be different from the density of the separation booster in order to improve separation efficiency. Examples of base oils which can be used are described by the American Petroleum Institute base oil

classification as Base Oil Group I, Base Oil Group II, Base Oil Group III, Base Oil group IV and Base Oil group V. These base oils are provided in any required mixture to enhance the oil properties for the use in a specific system or a specific type of system. In order to design an oil product that can withstand long and repeated use in a circular system, the choice of base oils is also based on quality and stability characteristics of each oil, such as oxidation-, thermal- and hydrolytic stability. There is the possibility of either choose a more refined oil (Group 3 instead of Group 1 and 2), synthetic instead of mineral oil or higher quality within a specific Base Oil Group.

The design of the oil comprises furthermore as said above the addition of specific functional additives to the mixture of specific base oils in order to enhance the oil properties for use in a specific system or specific type of system. Specific functional additives can comprise one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, metal deactivators, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers, foam inhibitors, adhesion promotors, emulators and bactericides. The design of the oil comprises a durable stable mixture of the base oil mixture enhanced by a suitable mixture of additives for use in the specific system or specific type of system. The additives are chosen such that they are suitable for use together with the dedicated separation booster, i.e. additives are chosen having a sufficiently big difference in polarity compared to the polarity of the separation booster such that the additives are not soluble in the separation booster.

P2: Using said specifically designed industrial oil before the used oil is reconditioned as described above according to the steps A1-A4 by use of the dedicated separation booster.

According to some embodiments of the invention said steps of reconditioning a used oil (A1-A4) are performed inline a system which is using the industrial oil, such that reconditioning is performed in a closed circuit circulation system of the industrial oil.

According to some embodiments of the invention the method is instead performed offline and the method comprises retrieving used industrial oil from an industrial plant, reconditioning the used industrial oil as described above according to steps A1-A4 and returning the reconditioned oil to an industrial plant for further use and possibly a first optional step of delivering a specifically designed industrial oil to an industrial plant.

Figure 2 shows schematically an oil recovery system 101 according to one embodiment of the invention. The oil recovery system 101 comprises at least one oil purification tank 109 into which used industrial oil is provided for purification. The oil recovery system 101 comprises further a booster adding device 121 connected to the oil purification tank 109 and configured for adding a liquid separation booster to the used oil in the oil purification tank 109, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific additive in the used oil. The oil recovery system 101 comprises further a separation device configured for separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific additive in the oil. The separation device may comprise one or more of the following: a mixing device 124a for mixing the used oil with the separation booster, a heating device 124b for warming the mixture, a centrifuging device (not shown) configured for centrifuging the mixture of used oil and separation booster and a filtering device 111 configured for filtering the mixture of used oil and separation booster or for filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase.

The oil recovery system 101 may further comprise an additive providing device 115 configured for adding additives to the used oil and at least one analyzing device 107 which is configured for analyzing the used oil to identify depletion of certain additives in the used oil before adding additives to the used oil, wherein the additive providing device 115 is configured for adding those additives which have been identified as depleted and in an amount corresponding to the identified depletion. The oil purification tank 109 comprises also an inlet 102 for receiving used oil to be purified and an outlet 102b for forwarding purified oil which possibly also has been topped up with new additives. The outlet 102b may be via a filtering device 111. In some embodiments of the invention the oil recovery system 101 comprises one oil purification tank 109a and a separate top up tank 109b whereby purified oil is forwarded from the oil purification tank 109a, possible via a filtering device 111, to the top up tank 109b. In this embodiment (also illustrated in Fig. 2, but with dotted lines), the analyzing device 107 and the additive providing device 115 are connected to the top up tank 109b instead of to the oil purification tank 109a.

In some embodiments, but not necessarily the oil recovery system 101 further comprises at least one oil preparation tank 113 configured for designing an industrial oil which is specifically designed for being suitable to purify with a dedicated separation booster, which separation booster being substantially insoluble in the oil, forming a two phase mixture upon

mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster.

Said oil recovery system 101 may be designed as an inline system, so that the oil recovery system is integrable in a closed circuit circulation system of the industrial oil.

Alternatively said oil recovery system 101 is provided as an offline system in which industrial oil from different industries can be reconditioned.

The oil recovery system may also comprise or may be connectable to a control system 125 which can be connected to for example the booster adding device 121, the at least one analyzing device 107 and the additive providing device 115 for controlling these functions. The control system 125 may also be connected to the separation device and to pumps and valves in the oil recovery system such that flows can be controlled in the oil recovery system 101.

Figure 3 is a flow chart of a method for circular use of industrial oil according to one embodiment of the invention. The method steps are described in order below:

S1: Designing an industrial oil for use in a specific system or in a specific type of system. The designing of the oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives to meet required technical specifications for use in the specific system or type of system. The types of base oils are chosen for being suitable to purify with a dedicated separation booster. Hereby the base oils are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils are not soluble in the separation booster. Also the densities of the base oils can be chosen to be different from the density of the separation booster in order to improve separation efficiency. Examples of base oils which can be used are described by the American Petroleum Institute base oil classification as Base Oil Group I, Base Oil Group II, Base Oil Group III, Base Oil group IV and Base Oil group V. These base oils are provided in any required mixture to enhance the oil properties for the use in a specific system or a specific type of system. In order to design an oil product that can withstand long and repeated use in a circular

system, the choice of base oils is also based on quality and stability characteristics of each oil, such as oxidation-, thermal- and hydrolytic stability. There is the possibility of either choose a more refined oil (Group 3 instead of Group 1 and 2), synthetic instead of mineral oil or higher quality within a specific Base Oil Group.

The design of the oil comprises furthermore as said above the addition of specific functional additives to the mixture of specific base oils in order to enhance the oil properties for use in a specific system or specific type of system. Specific functional additives can comprise one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, metal deactivators, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers, foam inhibitors, adhesion promotors, emulators and bactericides. The design of the oil comprises a durable stable mixture of the base oil mixture enhanced by a suitable mixture of additives for use in the specific system or specific type of system. The additives are chosen such that they are suitable for use together with the dedicated separation booster, i.e. additives are chosen having a sufficiently big difference in polarity compared to the polarity of the separation booster such that the additives are not soluble in the separation booster.

S2: Using the designed oil in the specific system or the specific type of system.

S3: Removing the designed oil from the system after use a specific time. This could be a preset time which is based on previous experience or it could be based on oil quality measurements provided in the system.

S4: Purifying the removed used oil with the dedicated separation booster. The step of purifying comprises suitably mixing the used oil with the separation booster in an oil purification tank 9. In some embodiments of the invention the content in the purification tank 9 is also warmed for improving purification and in some embodiments of the invention the mixture of used oil and separation booster is allowed to separate into different phases in this step of the purification. For example the booster and contaminations can settle in a bottom or a top of the oil purification tank if the booster has a different density than the oil. The step of purifying can in some embodiments also comprise a step of filtering the used oil. Possibly the mixture of used oil and separation booster can be filtered almost directly after mixing without waiting for the separation booster and contaminants to separate, for example by settle to a bottom part of the purification tank. In that case the separation booster together with captured

contaminants will be trapped in the filter. In another embodiment the mixture of used oil and separation booster will first be allowed to settle such that the separation booster with captured contaminations from the oil will separate into a separate phase, for example a bottom phase, and then the other phase comprising purified used oil is filtered in order to filter out any possible remaining contaminations. The step of filtering may comprise a step of building a depth filter from a cellulose fiber powder. This can be done by adding cellulose fibers to either a part of the used oil with separation booster mixed in it or a part of a purified used oil where most of the separation booster and contaminants have been separated out already and circulating this part of the used oil with added cellulose fibers over a carrier layer whereby a depth filter is built on the carrier layer. Thereafter the rest of the used oil is filtered through this depth filter. Another type of filter can of course also be used for the filtering step. Either a depth filter, for example a commercially available cellulose depth filter, or another type of filter.

S5: Analyzing the removed used oil to identify depletion of certain additives in the oil. This step can comprise analyzing amount of specific additives in the oil which specific additives have been predefined for this specific system or specific type of system.

S6: Adding to the removed used oil those additives which have been identified as depleted during the use and in an amount corresponding to the identified depletion.

S7: Returning purified oil which also has been topped up with additives for further use in the specific system or specific type of system it initially was designed for.

In one embodiment of the invention the step of analyzing the removed used oil, S5, further comprises analyzing the removed used oil to identify amount of contaminations in the oil and possibly repeating the purifying step, S4, if the identified amount of contaminations is above a predefined threshold. Alternatively the amount of contaminations is analyzed before the step of purification such that an amount of separation booster to use can be adopted according to the analyzed amount of contaminations of the used oil. If no analyze of amount of contaminations is done before the purifying step an amount of separation booster can be based on volume of oil to purify.

In one embodiment of the invention the method comprises providing a top up additive package for each designed industrial oil for use in a specific system or type of system. Said top up additive package comprises functional additives to meet required technical

specifications for use in the specific system or type of system. This top up additive package can be used in step S6 for adding to the removed used oil those additives which have been identified as depleted during the use. The amount of top up additive package to add to the used oil should then be adopted according to the identified depletion of additives in step S5.

In one embodiment of the invention the step of designing an industrial oil, S1, comprises:

- providing a concentrated industrial oil comprising functional additives to meet required technical specifications for a specific system or type of system;
- delivering said concentrated industrial oil to an oil recovery system (1); and
- finalizing an industrial oil for use in a specific system or specific type of system by mixing said concentrated industrial oil with at least one base oil at the oil recovery system.

The step of providing a concentrated industrial oil comprises designing the concentrated industrial oil for being suitable to purify with a dedicated separation booster as described above. The concentrated industrial oil can in some embodiments of the invention and for use in some systems or type of systems comprise the same set up of functional additives as the top up additive package used for topping up a used oil as described above. The concentrated industrial oil and the top up additive package can actually be the same product but just added in different amounts during design of the oil and during top up of the used oil.

Figure 4 is a schematic view of an oil recovery system 1 according to one embodiment of the invention. The method described above in relation to Figure 3 can be performed, at least in parts in such an oil recovery system 1.

The oil recovery system 1 comprises at least one oil preparation tank 13 in which an industrial oil can be designed for use in a specific system or in a specific type of system and for being suitable to purify with a dedicated separation booster as described above. At least one of the oil preparation tanks 13 can be connected to and can be provided with content from one or more oil component tanks 3, 4. In the embodiment shown in Figure 4 only one of the two oil preparation tanks 13 is connected to the oil component tanks 3,4, however in another embodiment all the oil preparation tanks can be connected to the oil component tanks 3,4. The oil component tanks can be one or more base oil tanks 3 comprising one or more different base oils which can be provided into the oil preparation tank 13 when an oil is designed. The oil component tanks can also comprise an oil concentrate tank 4 comprising a concentrated

industrial oil which has been provided to the oil recovery system 1. Hereby an industrial oil for use in a specific system or specific type of system can be prepared in an oil preparation tank 13 by mixing said concentrated industrial oil provided from the oil concentrate tank 4 with one or more base oils provided from one or more base oil tanks 3. Such a concentrated industrial oil can be prepared on beforehand at another location and be adapted for different systems or type of systems already. The concentrated industrial oil comprises functional additives suitably mixed in a small amount of oil. The additives are chosen to meet required technical specifications for a specific system or type of system as described above. Hereby a final preparation of an industrial oil at the oil recovery system 1 can be facilitated. The number of oil component tanks 3,4, such as base oil tanks 3 and oil concentrate tanks 4 can of course be varied. The base oil tanks 3 and the oil concentrate tanks 4 need not be stationary parts of an oil recovery system 1 but can instead be any vessels, such as single use vessels or reusable vessels used for delivering the base oil and oil concentrate products to the plant.

The oil recovery system 1 comprises furthermore an additive providing device 15 which is connected to said at least one oil preparation tank 13. In the embodiment as shown in Figure 4 two oil preparation tanks 13 are shown and both are connected to the additive providing device 15. Hereby functional additives can be provided into the oil preparation tanks 13. Said additive providing device 15 is configured for providing functional additives which are chosen to meet required technical specifications for use in the specific system or type of system. Hereby said additive providing device 15 can comprise a number of different functional additives, such as for example oxidation inhibitors, corrosion inhibitors, rust inhibitors, metal deactivators, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers, foam inhibitors, adhesion promotors, emulators and bactericides. Different additives can be provided to the oil preparation tanks 13 for different industrial oils to be prepared. This can be controlled from a control system 25 and can be dependent on sensor measurements as will be further described below. In some embodiments the additive providing device 15 and the oil concentrate tank 4 can be combined into one. The additive providing device 15 can be used for topping up a used oil in dependence of how much additives have been consumed during the use. In some systems this top up of used oil will require the same mixture of functional additives as was provided in an initially provided oil concentrate for the initial design of the oil. Hereby the additive providing device 15 and the oil concentrate tank 4 can in some embodiments be combined. A top up additive package, which may be the same as the oil concentrate used for

designing the oil, can in some embodiments of the invention be provided to the oil recovery system 1 for being used by the additive providing device 15 for topping up used oil. A dosage of additives and/or top up additive package needed for topping up used oil need to be controlled in dependence of measured additive depletion in used oil which will be described below.

The oil recovery system 1 comprises furthermore at least one used oil tank 5 which is configured for receiving used industrial oil which has been returned to the oil recovery system 1 after use in the specific system or specific type of system. These used oil tanks need not be stationary parts of the oil recovery system but can instead be for example a transport vessel used for delivering the used oil to the plant.

According to the invention industrial oil which is specifically designed for a specific system or specific type of system is produced in an oil preparation tank 13 at the oil recovery system 1. This specifically designed industrial oil is then delivered from the oil recovery system 1 to a system which it was designed for and the oil is used in this system for either a predefined time period or until tests indicate that the oil needs recovery, i.e. the oil comprise too much impurities or too little additives which are needed in this system. The used oil is then returned to the oil recovery system 1 for recovery. The used oil can be received in a used oil tank 5 at the plant or alternatively transport vessels used for delivering the used oil are directly connected to the plant and act as used oil tanks 5 according to the schematic illustration in Figure 4. In this embodiment four different used oil tanks 5 are provided however another number of tanks can of course be provided.

The oil recovery system 1 comprises furthermore at least one oil purification tank 9 connected to the at least one used oil tank 5. In this embodiment two oil purification tanks 9 are provided however another number of oil purification tanks can of course be provided. Each used oil tank 5 should be connected to at least one oil purification tank 9. The oil purification tank 9 is configured for purifying the used industrial oil by use of a separation booster which was dedicated for this specific industrial oil.

In one embodiment of the invention the oil purification tank 9 comprises:

- a booster adding device 21 configured for adding a separation booster to the used oil in the purification tank 9;
- a mixing device for mixing the returned used oil with the separation booster; and

- a heating device for warming the mixture, whereby booster and contaminations can settle in a separate phase, for example a separable bottom or top phase in the oil purification tank.

However, in another embodiment of the invention it will not be necessary to wait for letting a separation booster together with contaminations to settle into a bottom or top phase. In this embodiment the mixture of used oil and separation booster is directly filtered in a filter 11 as will be further described below.

In the embodiment shown in Figure 4 a booster adding device 21 is shown connected to the two oil purification tanks 9. The booster adding device 21 is furthermore connected to a control system 25. The addition of booster into the oil purification tanks 9 can hereby be controlled by the control system 25, possibly in dependence of the volume of used oil to be purified or in dependence of a measurement of amount of contaminations in the used oil. This will be further described below.

The oil purification tanks 9 are in this embodiment connected through a filter 11 each to the oil preparation tanks 13. Hereby for example an upper part of the purified oil in the oil purification tanks 9, i.e. without the booster and contaminants which in this example have been settled to the bottom of the oil purification tanks 9, can be transferred to the oil preparation tanks 13 through a filter 11. If no filter is used in the system the oil preparation tank 13 and the oil purification tank 9 can be combined into one tank. However the filter 11 is suitable in order to further improve the recovery of the oil. The filtering device 11 can for example be a depth filtering device using cellulose fibers which can be added to a part of the returned used oil for circulation over a carrier paper before the rest of the used oil is filtered through the depth filter. In an embodiment of the invention where separation booster is added in the oil purification tank and a mixture of the used oil and separation booster is directly filtered without a first separation, the whole mixture is filtered and separation booster with captured contaminations will get trapped in the filter. A depth filter as described above may in this embodiment be especially suitable. Aggregates of separation booster and attached contaminations will effectively get trapped in the depth filter and furthermore any possible contaminations which may not have been captured by the separation booster will also effectively get trapped in the depth filter by the combined effect of cellulose fibers and separation booster in the filter.

In the embodiment where separation booster and contaminants, i.e. sludge which has been settled to for example the bottom of the oil purification tanks 9, such sludge can be removed through a sludge outlet 29 in the bottom part of the oil purification tanks 9.

The oil recovery system 1 comprises furthermore at least one analyzing device 7 which is configured for identifying depletion of certain additives in a used industrial oil which has been returned to the oil recovery system 1 after use in the specific system or specific type of system. In the embodiment as shown in Figure 4 the analyzing device 7 is provided in the oil preparation tanks 13. Analyzing devices can however also be provided in the oil purification tanks 9 or in the used oil tanks 5. The analyzing devices 7 can be configured for measuring content of certain additives in the oil such that depleted additives can be added to the oil again before delivery for further use. The analyzing devices 7 can however in another embodiment instead be configured for only taking samples which are transferred to another position, for example outside the plant, for analyzes of additive content in the oil.

According to the invention the additive providing device 15 is configured for adding to the returned used oil those additives which have been identified as depleted during the use and in an amount corresponding to the depletion identified by the at least one analyzing device 7. Hereby both the analyzing devices 7 and the additive providing device 15 are connected to the control system 25 such that the control system can control addition of additives in dependence of output from the analyzing device 7.

As discussed above also amount of contaminations in the used oil can be measured. This can be measured either in the used oil tanks 5, the oil purification tanks 9 and/or in the oil preparation tanks 13. If an amount of contaminations is measured by the analyzing device 7 in the oil preparation tanks 13, i.e. after the oil has been purified in the oil purification tanks 9, a return line 27 can be provided from the oil preparation tanks 13 back to the oil purification tanks, through which return line 27 oil can be returned for further purification in an oil purification tank 9 if amount of contaminations is above a predefined threshold.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for circular use of industrial oil, said method comprising reconditioning of a used industrial oil, said reconditioning comprising the steps of:

- adding a liquid separation booster to a used industrial oil, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific functional additive in the oil, wherein said liquid separation booster is insoluble in the oil because of its polar properties, forming a two phase mixture upon mixing thus forming colloids consisting of small droplets of the liquid separation booster, which through chemical interactions absorb impurities being contaminating solids or dissolved impurities, whereby said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to polarity of the at least one specific functional additive in the industrial oil such that the at least one specific functional additive is not soluble in the separation booster;

- separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific additive in the oil;

- analyzing the used oil to identify depletion of certain functional additives in the used oil; and

- adding functional additives to the used oil, wherein the step of adding functional additives to the used oil comprises adding those functional additives which have been identified as depleted and in an amount corresponding to the identified depletion, wherein

the functional additives added to the used oil is one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers and foam inhibitors.

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2. Method according to claim 1,

wherein the step of separating the separation booster with attracted impurities from the used industrial oil comprises one or more of the following steps: mixing the used oil with the separation booster, warming the mixture, waiting for allowing separation booster with attracted impurities to settle in a top or bottom phase in the oil purification tank, centrifuging the mixture of used oil and separation booster, filtering the mixture of used oil and separation booster and filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase.

3. Method according to any one of the preceding claims, further comprising the first steps of:

- designing an industrial oil which is suitable to purify with a dedicated separation booster, which separation booster being insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster,
- using said specifically designed industrial oil before the used oil is reconditioned according to any one of the claims 1-3 by use of the dedicated separation booster.

4. Method according to any one of the preceding claims, wherein said steps of reconditioning a used oil are performed inline a system which is using the industrial oil, such that reconditioning is performed in a closed circuit circulation system of the industrial oil, or

wherein the method is performed offline and wherein the method comprises retrieving used industrial oil from an industrial plant, reconditioning the used industrial oil according to any one of the claims 1 to 3 and returning the reconditioned oil to an industrial plant for further use.

5. Method according to claim 4, further comprising a first step of delivering a

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specifically designed industrial oil to an industrial plant.

6. A method for circular use of industrial oil according to any one of the preceding claims, said method comprising the steps of:
   - designing an industrial oil for use in a specific system or in a specific type of system, wherein said industrial oil is designed for being suitable to purify with a dedicated separation booster, which separation booster being insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives to meet required technical specifications for use in the specific system or type of system, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster;
   - using the designed oil in the specific system or the specific type of system;
   - removing the designed oil from the system after use a specific time;
   - purifying the removed used oil with the dedicated separation booster;
   - analyzing the removed used oil to identify depletion of certain additives in the oil;
   - adding to the removed used oil those additives which have been identified as depleted during the use and in an amount corresponding to the identified depletion; and
   - returning purified oil which also has been topped up with additives for further use in the specific system or specific type of system it initially was designed for.

7. Method according to claim 6, wherein the step of analyzing the removed used oil further comprises analyzing the removed used oil to identify amount of contaminations in the oil, wherein the method comprises providing a top up additive package for each designed industrial oil for use in a specific system or type of system, wherein said top up additive package comprises functional additives to meet required technical specifications for use in the specific system or type of system, wherein the step of purifying the removed used oil comprises:
   - mixing the used oil with the separation booster in an oil purification tank;

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- warming the mixture; and
- waiting for allowing booster and contaminations to settle in a top or bottom phase in the oil purification tank; and/or

wherein the step of purifying further comprises a step of filtering the used oil, wherein the step of filtering particularly comprises adding cellulose fibers to a part of the used oil and circulating this part of the used oil with added cellulose fibers over a carrier paper for building a depth filter and then filter the rest of the used oil through the depth filter.

8. Method according to claim 7, wherein the step of analyzing the removed used oil further comprises analyzing the removed used oil to identify amount of contaminations in the oil and repeating the purifying step if the identified amount of contaminations is above a predefined threshold.

9. Method according to claim 6 or 7, wherein the step of designing an industrial oil comprises:
- providing a concentrated industrial oil comprising functional additives to meet required technical specifications for use in the specific system or type of system;
- delivering said concentrated industrial oil to an oil recovery system; and
- finalizing an industrial oil for use in a specific system or specific type of system by mixing said concentrated industrial oil with at least one base oil at the oil recovery system,

wherein the steps of purifying the removed used oil and adding additives to the removed used oil and at least parts of the step of designing the industrial oil are performed at an oil recovery system, and/or

wherein the step of analyzing the used oil to identify depletion of certain additives in the oil comprises analyzing amount of specific additives in the oil which specific additives have been predefined for this specific system or specific type of system.

10. An oil recovery system, comprising:

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- at least one oil purification tank into which used industrial oil is provided for purification;
- a booster adding device connected to the oil purification tank and comprising a liquid separation booster and configured for adding a liquid separation booster to the used oil in the purification tank, wherein said separation booster is designed to attract impurities in the used oil and to be passive onto, i.e. not attracting, at least one specific functional additive in the oil, wherein said liquid separation booster is insoluble in the oil because of its polar properties, forming a two phase mixture upon mixing thus forming colloids consisting of small droplets of the liquid separation booster, which through chemical interactions absorb impurities being contaminating solids or dissolved impurities, whereby said separation booster attracts impurities in the oil during mixing of oil and separation booster and wherein the separation booster has a sufficiently big difference in polarity compared to polarity of the at least one specific functional additive in the industrial oil such that the at least one specific functional additive is not soluble in the separation booster;
- a separation device configured for separating out the separation booster with attracted impurities from the used industrial oil while leaving the at least one specific functional additive in the oil;
- at least one analyzing device which is configured for analyzing the used oil to identify depletion of certain functional additives in the used oil; and
- an additive providing device configured for adding functional additives to the used oil, wherein the additive providing device is configured for adding those functional additives which have been identified as depleted and in an amount corresponding to the identified depletion, wherein the functional additives added to the used oil is one or more of oxidation inhibitors, corrosion inhibitors, rust inhibitors, anti-wear agents, extreme pressure agents, friction modifiers, detergents, dispersants, pour point depressants, viscosity index improvers and foam inhibitors.

11. Oil recovery system according to claim 10, wherein the separation device comprises one or more of the following: a mixing device for mixing the used oil with the separation booster, a heating device for warming the mixture, a centrifuging device configured for centrifuging the mixture of used oil and separation booster and a filtering device configured for filtering the mixture of used oil and separation booster or for filtering an oil phase after separation booster with attracted impurities has settled to a top or bottom phase.

12. Oil recovery system according to claims 10 or 11, further comprising at least one oil preparation tank configured for designing an industrial oil which is designed for being suitable to purify with a dedicated separation booster, which separation booster being insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives, wherein said base oils and additives are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster;
wherein said oil recovery system is designed as an inline system, so that the oil recovery system is integrable in a closed circuit circulation system of the industrial oil, or
wherein said oil recovery system is provided as an offline system in which industrial oil from different industries can be reconditioned.

13. Oil recovery system according to any one of the claims 10 to 12, comprising:
- at least one oil preparation tank configured for designing an industrial oil for use in a specific system or in a specific type of system and for being suitable to purify with a dedicated separation booster, which separation booster being insoluble in the oil, forming a two phase mixture upon mixing, said separation booster attracting impurities in the oil during mixing of oil and separation booster, wherein said designing of an industrial oil comprises providing a mixture of base oils and adding to the mixture of base oils functional additives to meet required technical specifications for use in the specific system or type of system, wherein said base oils and additives

are chosen to have a sufficiently big difference in polarity compared to the polarity of the separation booster such that the base oils and additives are not soluble in the separation booster;

- at least one oil component tank connectable to at least one of said at least one oil preparation tank, wherein said at least one oil component tank comprises one or more base oil tanks;
- an additive providing device connected to said at least one oil preparation tank, wherein said additive providing device is configured for providing functional additives which are chosen to meet required technical specifications for use in the specific system or type of system;
- at least one used oil tank which is configured for holding used industrial oil which has been returned to the oil recovery system after use in the specific system or specific type of system;
- at least one oil purification tank connectable to the at least one used oil tank, wherein said purification tank is configured for purifying the used industrial oil by use of a separation booster which was dedicated for this specific industrial oil;
- at least one analyzing device which is configured for identifying depletion of certain additives in a used industrial oil which has been returned to the oil recovery system after use in the specific system or specific type of system;

wherein said additive providing device further is configured for adding to the returned used oil those additives which have been identified as depleted during the use and in an amount corresponding to the depletion identified by the at least one analyzing device.

14. Oil recovery system according to claim 13, wherein said at least one oil component tank comprise at least one oil concentrate tank comprising a concentrated industrial oil comprising functional additives to meet required technical specifications for use in a specific system or type of system, whereby an industrial oil for use in a specific system or specific type of system can be prepared in the oil preparation tank by mixing said concentrated industrial oil provided from the oil concentrate tank with at least one base oil provided from at least one base oil tank

wherein the at least one oil purification tank comprises:

- a booster adding device configured for adding a separation booster to

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the used oil in the purification tank; and

- a mixing device for mixing the returned used oil with the separation booster, and/or wherein an outlet from the purification tank is connected to an inlet of at least one of the at least one oil preparation tanks.

15. Oil recovery system according to claim 14, wherein the outlet from the purification tank is connected to the inlet of at least one of the at least one oil preparation tanks, through a filtering device.

16. Oil recovery system according to any one of the claims 13 to 14, wherein said analyzing device is configured for analyzing the removed used oil to identify amount of contaminations in the oil, and/or
wherein a return line is provided from at least one oil preparation tank to at least one oil purification tank such that oil can be returned to the oil purification tank for further purification if the identified amount of contaminations is above a predefined threshold.

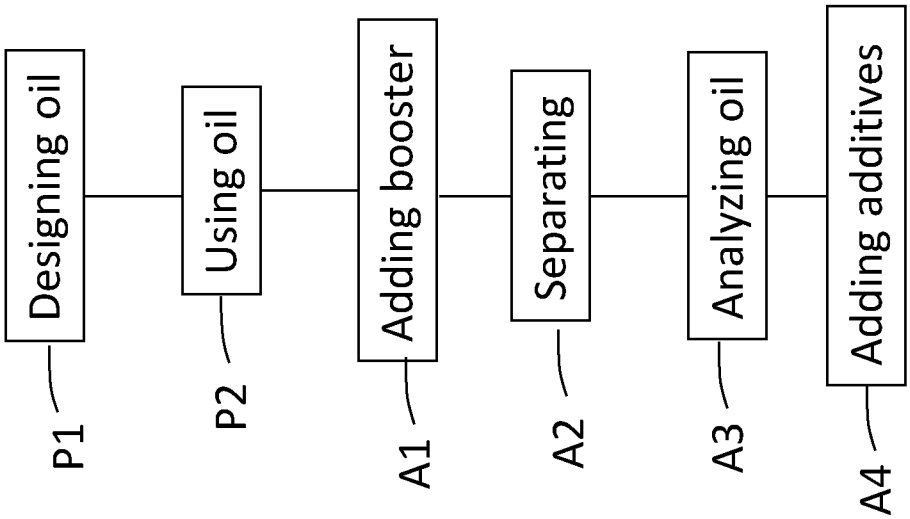
Designing oil
Using oil
Adding booster
Separating
Analyzing oil
Adding additives
P1
P2
A1
A2
A3
A4

FIG. 1b

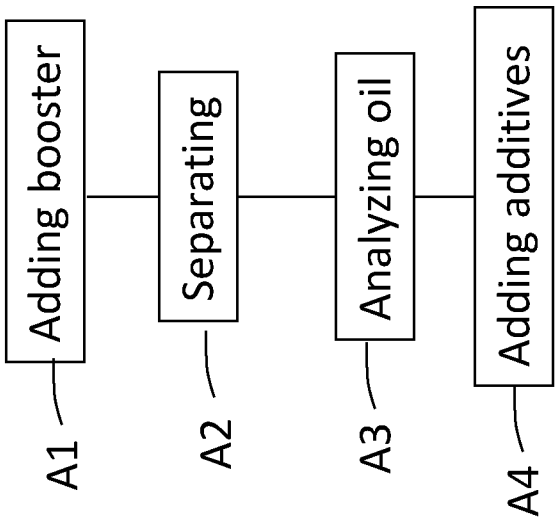
Adding booster
Separating
Analyzing oil
Adding additives
A1
A2
A3
A4

FIG. 1a

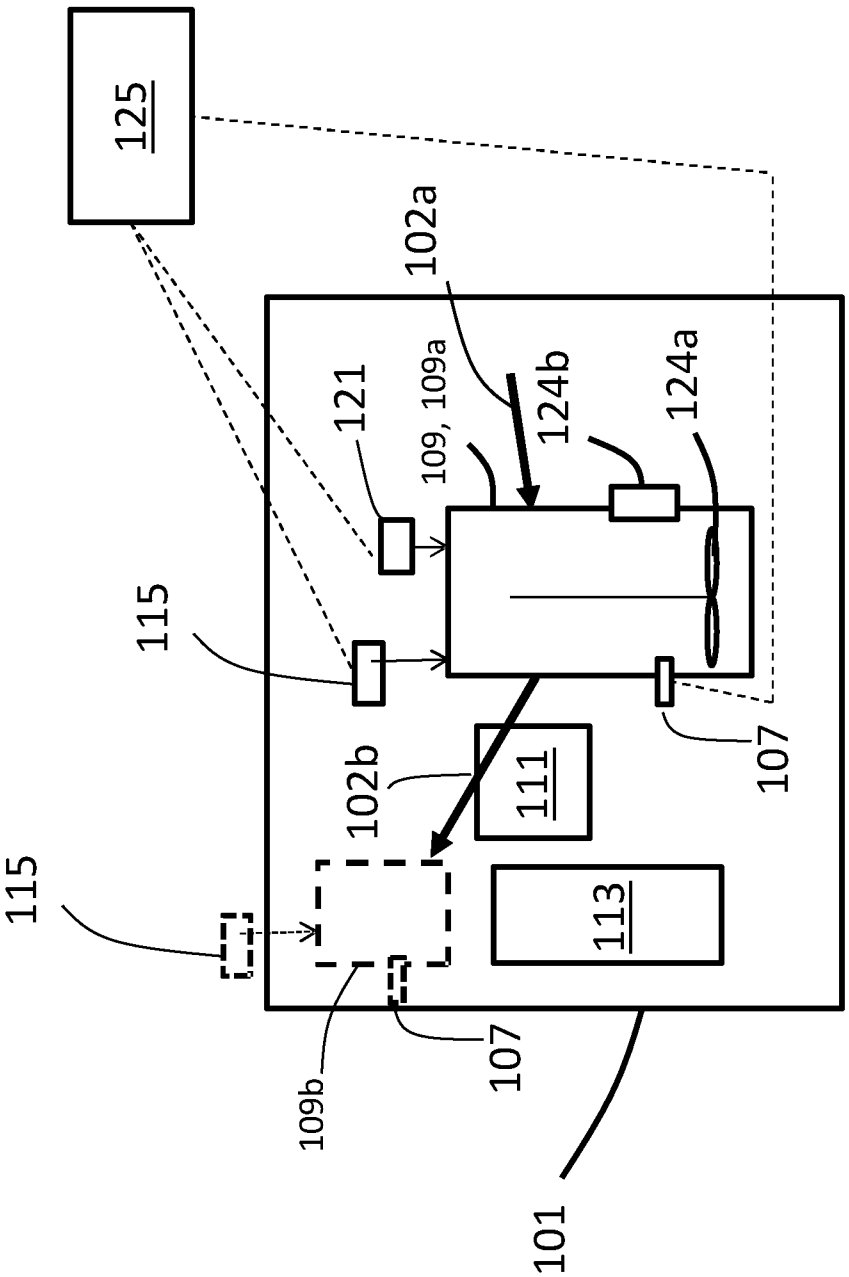
125
102a
121
109, 109a
124b
124a
115
111
102b
107
115
113
109b
107
101

FIG. 2

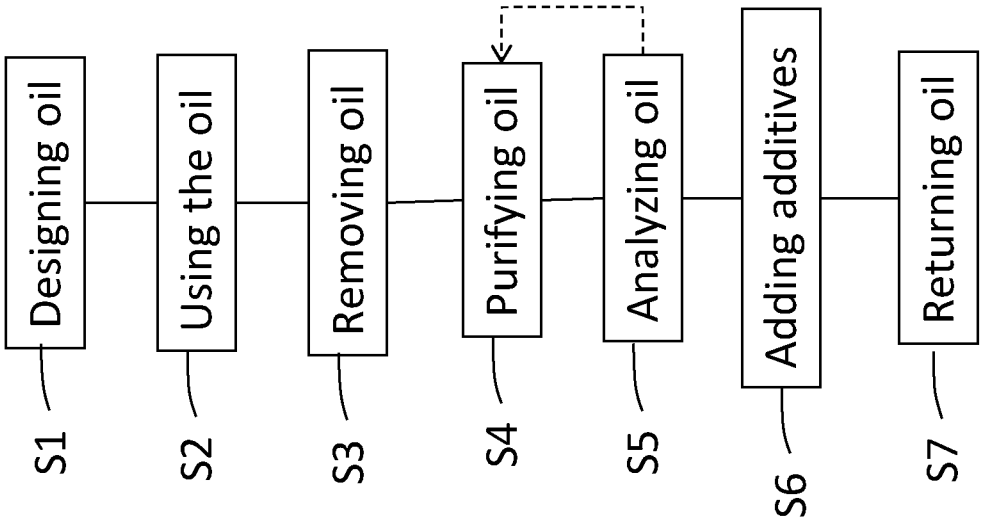
Designing oil
Using the oil
Removing oil
Purifying oil
Analyzing oil
Adding additives
Returning oil
S1
S2
S3
S4
S5
S6
S7

FIG. 3

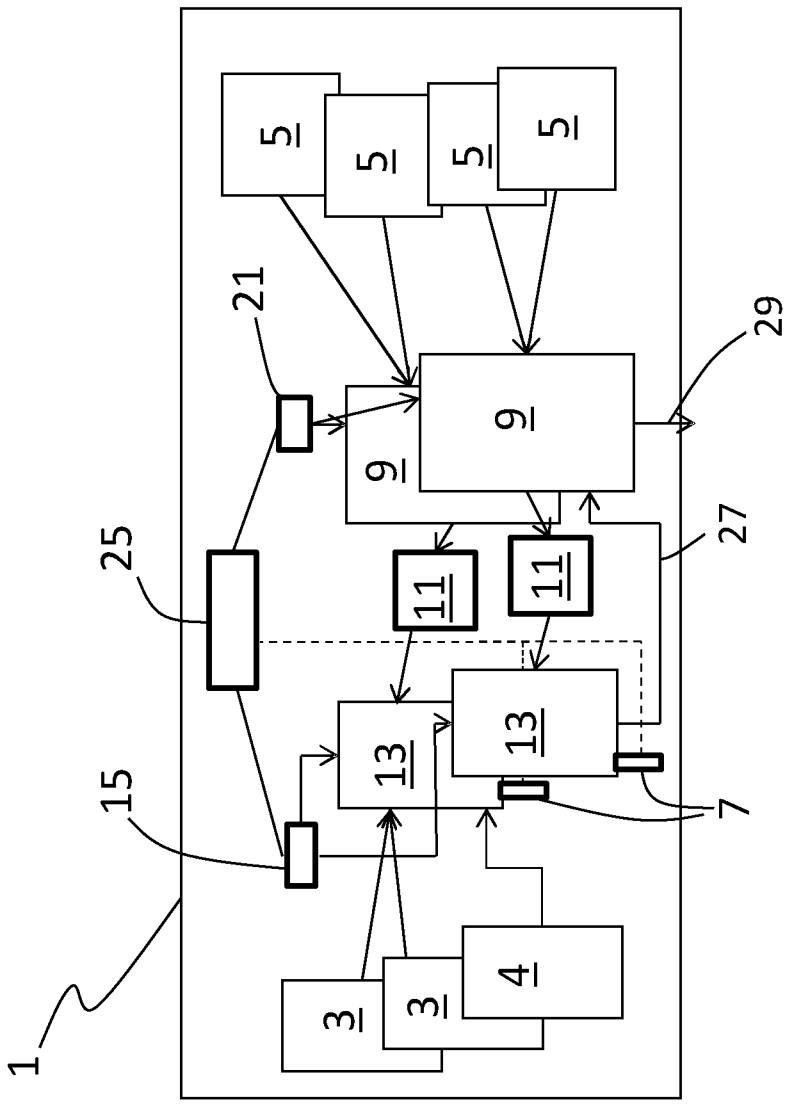

FIG. 4