of droplets which trickle inside a duct, to the point that it is not certain that the functional component be supplied with sufficient oil flow rate so that the measurements which it carries out are correct.

US-A-2007/0084271 teaches determination of the basicity index of a lubricant by means of a signal generator coupled with a current sensor. Considering the equipment used, this approach is complex to apply and sensitive to perturbations.

These problems are not only posed on two-stroke or four-stroke propulsion engines of ships but also on other secondary engines also loaded onboard ships, for example for accessories of the hoist type. Such problems are also posed for gearboxes for equipment onboard ships or of fixed installations, such as a tidal turbine or a wind turbine. Generally, the monitoring of basicity of a lubricant is important for all lubricated equipment and known techniques are not very suitable for automation.

These are the drawbacks which embodiments of the invention seek to remedy by proposing a novel installation for following up the evolution of the basicity of a lubricant circulating in a piece of equipment which is adapted for operating in a simple and autonomous way, which notably discharges the onboard personnel of a ship from repeated and elaborated tasks.

According to a first aspect of the invention, there is provided an installation for following up the evolution of the basicity of a lubricant circulating in a piece of equipment, this installation comprising at least one conduit for circulating the lubricant, this conduit being connected, upstream to the relevant piece of equipment and, downstream to a pan for recovering the lubricant, as well as at least the one sensor for determining in the basicity index of the lubricant. This installation further comprises a first controlled valve for interrupting the circulation of a lubricant in the conduit, and a buffer tank for accumulating lubricant. The installation comprises a first bypass line connected to the conduit, upstream from the first valve, on the one hand and to the buffer tank on the other hand, a second controlled valve for interrupting the circulation of the lubricant in the first bypass, a second line for discharging the lubricant, from the buffer tank to the recovery pan, this second line being positioned downstream from the first bypass line and a third controlled valve for interrupting the circulation of the lubricant in the second discharge line. Further the sensor is positioned on the second discharge line and allows determination of the basicity index of the lubricant at the outlet of the buffer tank.

The buffer tank is used for accumulating an amount of lubricant sufficient for allowing proper supply of the basicity index sensor.

The lubricant in accordance with embodiments of the present invention comprises at least one lubricating base oil. Generally, the lubricating base oils may be oils of mineral, synthetic or vegetable origin as well as mixtures thereof. The mineral or synthetic oils generally used

belong to one of the groups I to V according to the classes defined in the API classification (or their equivalents according to the ATIEL classification) as summarized below. The API classification is defined in American Petroleum Institute 1509 "Engine oil Licensing and Certification System" 17th edition, September 2012. The ATIEL classification is defined in "The ATIEL Code of Practice", number 18, November 2012.

	Content of saturated substances	Sulfur content	Viscosity index
Group I mineral oils	< 90 %	> 0.03 %	80 ≤ VI < 120
Group II hydrocracked oils	≥ 90 %	≤ 0.03 %	80 ≤ VI < 120
Group III hydrocracked or hydro-isomerized oils	≥ 90 %	≤ 0.03 %	≥ 120
Group IV	PAO (Poly alpha olefins)		
Group V	Esters and other bases not included in the bases of group I to IV		

The mineral oils of Group I may be obtained by distillation of selected naphthenic or paraffinic crude oils and then by purification of the distillates obtained by methods such as extraction with a solvent, de-waxing with a solvent or catalytic de-waxing, hydrotreatment or hydrogenation. The oils of Groups II and III are obtained by more elaborate purification methods, for example by a combination of treatment selected from hydrotreatment, hydrocracking, hydrogenation and catalytic de-waxing. Examples of synthetic base oils of Group IV and V include polyisobutenes, alkylbenzenes and poly-alpha-olefins such as polybutenes or further esters.

In lubricants, the lubricating base oils may be used alone or as a mixture. For example, mineral oil may be combined with synthetic oil.

The cylinder oils for two-stroke marine engines are generally characterized by a viscosimetric grade SAE-40 to SAE-60, generally SAE-50 equivalent to a kinematic viscosity at 100°C comprised between 16.3 and 21.9 mm^2/s measured according to the ASTM D445 standard. The oils of grade SAE-40 have a kinematic viscosity of 100°C comprised between 12.5 and 16.3 cSt measured according to the ASTM D445 standard. The oils of grade SAE-50 have a kinematic viscosity at 100°C comprised between 16.3 and 21.9 cSt measured according to the ASTM D445 standard. The oils of grade SAE-60 have a kinematic viscosity at 100°C comprised between 21.9 and 26.1 cSt measured according to the ASTM D445 standard. The lubricants in accordance with embodiments of the invention preferably have a kinematic viscosity measured according to the ASTM D445 standard at 100°C ranging from 12.5 to 26.1 cSt, preferentially from 16.3 to 21.9 cSt. In order to obtain such a viscosity, these lubricants may further comprise one or several additives. Typically, a conventional formulation of a lubricant for marine engines, for example two-stroke

According to advantageous but non-mandatory aspects, an installation according to embodiments of the invention may incorporate one or several of the following features, taken in any technically admissible combination:

- The installation comprises means for gas pressurization of the inner volume of the buffer tank,

- The gas pressurization means comprise a source of compressed air and a set of valves or a pneumatic distributor for selectively having the inner volume of the buffer tank communicate with the compressed air source or with the ambient atmosphere.

- The installation comprises means for detecting the lubricant level in the buffer tank.

- The means for detecting the lubricant level in the tank comprise a gas pressure sensor in the inner volume of the buffer tank.

- The installation further comprises a density, viscosity, humidity and temperature sensor also positioned on the second discharge line, as well as a sensor for the dissolved iron content of the lubricant present in the buffer tank.

According to a second aspect of the invention, there is provided an automated method for following up the evolution of the basicity of a lubricant circulating in a piece of equipment, by means of an installation as mentioned above. This method comprises steps:

a) closing the first valve

b) opening the second valve and closing the third valve for supplying the buffer tank from an amount of lubricant accumulated in the conduit upstream from the first valve

c) opening the third valve for having the lubricant present in the buffer tank circulate through the second discharge line, in contact with the sensor for determining the basicity index of the lubricant.

d) using an output signal of this sensor for determining the alkalinity of the lubricant.

Advantageously, such a method may incorporate one or several of the following features, taken in any technically admissible combination:

- when the installation comprises means for gas pressurization of the contents of the buffer tank, a step e) after step b) and before step c) is provided and consisting of gas pressurizing the buffer tank, with a pressure comprised between 6 and 12 bars, preferably between 7 and 10 bars, still preferably equal to 7 bars.

- Step c) is interrupted while a residual amount of lubricant remains in the buffer tank.

- The method includes a step f) after step d) and consisting of unclogging a filter integrated to the first discharge line, by having the lubricant circulate from the buffer tank to the conduit.

According to a third aspect of the invention, there is provided a method for following up the operation of a piece of equipment loaded on board a ship, this method comprising the determination, onboard the ship, of the basicity index of a lubricant of the relevant piece of equipment by applying an automated method as mentioned above.

The invention will be better understood and other advantages thereof will become more clearly apparent in the light of the description which follows of three embodiments of an installation according to its principle, only given as an example and made with reference to the appended drawings wherein:

- Fig. 1 is a schematic illustration of the principle of an installation according to the invention as loaded onboard a ship,
- Fig. 2 is a schematic illustration at a smaller scale of the fluid portion of the installation of Fig. 1 in a first configuration of use,
- Figs. 3 to 5 are views similar to Fig. 2 when the installation is in a second, third and fourth configuration of use,
- Fig. 6 is a view similar to Fig. 1 for an installation according to a second embodiment of the invention,
- Figs. 7 to 11 and 13 to 18 are views similar to Fig. 2 for the installation of Fig. 6 in different configurations of use,
- Fig. 12 is a view at a larger scale of the detail XII in Fig. 11, and
- Fig. 19 is a view similar to Fig. 1 for an installation according to a third embodiment of the invention.

In Figs. 2 to 5 and 7 to 18, the lubricant present or circulating in a portion of the installation is illustrated in gray color.

The installation 2 illustrated in figs. 1 to 5 is loaded onboard a ship illustrated in Fig. 1 by its engine M which includes several cylinders, for example twelve or fourteen cylinders. A conduit 4 connects the engine M to a pan 6 for recovering lubricant. In practice, the engine oil flows by gravity into the conduit 4 with a pressure P4 comprised between 1.1 and 6 bars absolute. The oil flow rate in the conduit 4 may be low, to the point that the oil trickles on the internal wall of this conduit.

This conduit 4 extends vertically, from top to bottom, from the engine M towards the pan 6. In this embodiment, the oil flowing in the conduit 4 stems from at least one cylinder of the engine M.

CLAIMS

1.- An installation for following up the evolution of the basicity of a lubricant circulating in a piece of equipment, this installation comprising:

- at least one conduit for circulating the lubricant, this conduit being connected upstream to the piece of equipment and downstream to a recovery pan,
- at least one sensor for determining the basicity index of the lubricant,
- a first controlled valve for interrupting the circulation of the lubricant in the conduit,
- a buffer tank for accumulating the lubricant,

wherein the installation comprises:

- a first bypass line connected to the conduit, upstream from the first valve, on the one hand and to the buffer tank on the other hand,
- a second controlled valve for interrupting the circulation of the lubricant in the first bypass,
- a second line for discharging the lubricant, from the buffer tank to the recovery pan, this second line being positioned downstream from the first bypass line,
- a third controlled valve for interrupting the circulation of the lubricant in the second discharge line

and in that the sensor is positioned on the second discharge line and allows determination of the basicity index of the lubricant at the outlet of the buffer tank.

2.- The installation according to claim 1, wherein it comprises means for gas pressurization of the inner volume of the buffer tank.

3.- The installation according to claim 2, wherein the gas pressurization means comprise a source of compressed air and a set of or a pneumatic distributor for selectively putting the inner volume of the buffer tank in communication with a source of compressed air or the ambient atmosphere.

4.- The installation according to one of the preceding claims, wherein it comprises means for detecting the lubricant level in the buffer tank.

5.- The installation according to claim 4, wherein it comprises means for gas pressurization of the inner volume of the buffer tank and in that the means for detecting the lubricant level in the tank comprise a gas pressure sensor in the inner volume of the buffer tank.

6.- The installation according to claims 1 to 3, wherein it further comprises,

- a sensor for measuring density, viscosity, humidity and temperature also positioned on the second discharge line,
- a sensor for measuring the dissolved iron content of the lubricant present in the buffer tank.

7.- An automated method for following the evolution of the basicity of a lubricant circulating in a piece of equipment, by means of an installation according to one of the preceding claims, wherein it comprises at least steps of:

a) closing the first valve,

b) opening the second valve and closing the third valve for supplying the buffer tank from an amount of lubricant accumulated in the conduit, upstream from the first valve,

c) opening the third valve for circulating the lubricant present in the buffer tank through the second discharge line, in contact with the sensor for determining the basicity index of the lubricant,

d) using an output signal of this sensor for determining the alkalinity of the lubricant.

8.- The method according to claim 7, wherein it is applied with an installation comprising gas pressurization means for the inner volume of the buffer tank, and in that it comprises a step e) after step b) and before step c) and consisting of:

e) gas pressurizing the inner volume of the buffer tank, with a pressure comprised between 6 and 12 bars, preferably between 7 and 10 bars, still preferably 7 bars.

9.- The method according to one of claims 7 or 8, wherein step c) is interrupted, while a residual amount of lubricant remains in the buffer tank.

10. The method according to claim 9, wherein it comprises a step f) after step d) and consisting of:

f) unclogging a filter integrated to the first bypass line by having the lubricant circulate from the buffer tank to the conduit.

11. A method for following up the operation of a piece of equipment on board a ship, wherein it comprises the determination, onboard the ship, of the basicity index of a lubricant of the piece of equipment by applying a method according to one of claims 7 to 10.