even 15 ppm or 10 ppm or even 5 ppm should be complied with. This is to be achievable in particular on board ships with a minimum level of complexity.

A known system for processing heavy oil on board ships is shown in fig. 2.

Heavy oil OIL1 which is to be processed and flows in through a conduit 101 (here with a valve 102 connected therein) from a tank, which is not shown, and has a starting temperature T0 is first freed of coarse solids in a soil trap 103 such as a sieve. Then the heavy oil is passed with a pump 104 through a heat exchanger 105 in which it is heated to a temperature of up to 98°.

The heated heavy oil is passed out of the heat exchanger 105 through a conduit section 106 into a centrifuge, a three-phase separator 107 here, in which a soil/water phase W is separated from the heavy oil and flows away through an outlet 108, and in which it is cleaned to free it of a solid phase S which contains the abrasive catalyst fines and which is removed via an outlet 109. The processed heavy oil phase - the "clean oil" - OIL2 is passed out of the separator 107 through an outlet 110 for further use. It can be passed here into an intermediate tank (not shown here) or fed directly to combustion in a diesel engine. The heat exchanger 104 is preferably fed with thermal oil or saturated or hot steam (also referred to hereinafter as "HS") as thermal energy-releasing medium, from which the thermal energy serves to heat the heavy oil in countercurrent.

This method is to be improved further.

Solving this problem is the object according to embodiments of the invention.

~~The invention achieves this object by a method having the features of claim 1 and of the further independent claim 11.~~

According to a first aspect of the present invention, there is provided a method for on-ship processing of heavy oil which is to be utilized as fuel, especially for a diesel engine, having the following steps: a) providing heavy oil for processing; b) passing the heavy oil provided and for processing from step a) using at least one pump onward into a centrifuge, with heating of the heavy oil for processing before it reaches the centrifuge, at least intermittently or permanently, to a separation temperature of more than 98°C, and c) separating an aqueous phase and a sludge phase from a clean oil phase in the centrifuge.

The at least intermittent or permanent increase in the separation temperature according to ~~claim 1~~the first aspect may increase~~s~~ the separation efficiency. In this way, lower catalyst fines contents and, at the higher temperatures of more than 100°C or more than 105°C or more than 110°C or even more than 115°C, even lower catalyst fines contents in each case can be achieved in the clean oil.

An additional particularly advantageous feature is the optional heating in two stages. Firstly, in this way, the increase in the temperature to the very high separation temperature need not be effected until immediately before the actual separating operation. In addition, the multistage and especially two-stage heating of the heavy oil for processing may allow~~s~~ the "clean oil" which has been heated to the separation temperature and conducted out of the at least one centrifuge, especially the (three-phase) separator, to be utilized for flow through a heat exchanger in order to release heat in countercurrent to the "feed fuel" to

be cleaned, in order to heat it to a first temperature ~~T1~~, but one which is still lower than the separation temperature ~~T2~~. This may reduce~~s~~ the amount of heat needed overall for heating of the heavy oil to the separation temperature ~~T2~~, and may keep~~s~~ the clean oil temperature in the downstream pipelines below the temperature ~~T2~~ of otherwise possibly more than 100°C.

Embodiments of ~~The~~ the invention ~~of claim 11~~ additionally may achieve~~s~~ optimized closed-loop control of a generic method ~~but also of a method of the invention as claimed in any of claims 1 to 10~~.

Thus provided is a ~~an advantageous method as claimed in any of the preceding claims or~~ method for on-ship processing of heavy oil which is to be utilized as fuel for a diesel engine, having the following steps: a) providing heavy oil ~~(OIL1)~~ for processing; b) passing the heavy oil ~~(OIL1)~~ provided and for processing from step a), especially using at least one pump, onward into a centrifuge, with heating of the heavy oil for processing before it reaches the centrifuge to a separation temperature of - preferably - more than 98°C, and c) separating an aqueous phase and a sludge phase from a clean oil phase ~~(OIL2)~~ in the centrifuge, also with performance of one or more of the following steps d) to f) : d) the catalyst fines content (Cat Fines IN) in the incoming heavy oil for processing - especially prior to heating - is determined with a sensor device, e) the catalyst fines content (Cat Fines OUT) in the outgoing cleaned or processed clean oil is determined with the or a second sensor device, f) the catalyst fines content(s) determined from step d) and/or e) is/are used as process variable(s) in a closed-loop control process and the process variable(s) determined are used with a closed-loop control device for closed-loop control especially of the separation temperature ~~T2~~ and/or the throughput of the pump.

Preference is given to using the following as process variables:

- current fuel consumption of the engines,
- current fuel level in a clean oil tank,
- catalyst fines content in the incoming or outgoing heavy oil and/or clean oil and/or current service tank overflow rate.

~~Further advantageous configurations are the subject of the dependent claims.~~

Claims

1. A method for on-ship processing of heavy oil which is to be utilized as fuel, especially for a diesel engine, having the following steps:
   a) providing heavy oil ~~(OIL1)~~ for processing;
   b) passing the heavy oil ~~(OIL1)~~ provided and for processing from step a) using at least one pump ~~(4)~~ onward into a centrifuge ~~(7)~~, with heating of the heavy oil for processing before it reaches the centrifuge ~~(7)~~, at least intermittently or permanently, to a separation temperature ~~T2~~ of more than 98°C, and
   c) separating an aqueous phase ~~(W)~~ and a sludge phase ~~(S)~~ from a clean oil phase ~~(OIL2)~~ in the centrifuge ~~(7)~~.

2. The method as claimed in claim 1, ~~characterized in that~~ wherein one condition for the intermittent heating of the heavy oil for processing to the separation temperature ~~T2~~ from step b) is that the content of catalyst fines ~~(cat fines content)~~ that can be separated in the centrifugal field exceeds a first upper limit in the incoming heavy oil for processing and/or a respective second upper limit in the outgoing clean oil.

3. The method as claimed in claim 1 or 2, ~~characterized in that~~ wherein the heating in step c) is effected in a single step.

4. The method as claimed in claim 1 or 2, ~~characterized in that~~wherein the heating in step c) is effected in at least two component steps c1) and c2).

5. The method as claimed in claim 4, ~~characterized in that~~ wherein the heavy oil ~~(OIL1)~~ for processing is passed in component step c1) through a first heating device, especially a first heat exchanger ~~(5A)~~, in which it is heated to a first temperature ~~T1~~, and in that the heavy oil for processing is then passed in the second component step c2) into a second heating device, preferably a second heat exchanger ~~(5B)~~, in which it is heated to a second temperature ~~T2~~ which is higher compared to the first temperature and is the separation temperature.

6. The method as claimed in any of the preceding claims, ~~characterized in that~~ wherein the heavy oil for processing is passed into the centrifuge immediately after the attainment of the separation temperature ~~T2~~.

7. The method as claimed in any of the preceding claims, ~~characterized in that~~ wherein thermal energy from the clean oil ~~(OIL2)~~ running out of the centrifuge is utilized to heat the heavy oil ~~(OIL1)~~ for processing.

8. The method as claimed in any of the preceding claims, ~~characterized in that~~ wherein the thermal energy from the clean oil ~~(OIL2)~~ running out of the centrifuge is released in the first heat exchanger ~~(5A)~~ to the heavy oil ~~(OIL1)~~ for processing, in order to heat it to the first temperature ~~T1~~.

9. The method as claimed in any of the preceding claims, ~~characterized in that~~ wherein the separation temperature ~~T2~~ is greater than 100°C, especially greater than 105°C and especially preferably greater than 110°C.

10. The method as claimed in any of the preceding claims, ~~characterized in that~~ wherein the feed output of the pump ~~(4)~~ is adjustable.

11. The method as claimed in any of the preceding claims or method for on-ship processing of heavy oil which is to be utilized as fuel for a diesel engine, having the following steps:

a) providing heavy oil ~~(OIL1)~~ for processing;

b) passing the heavy oil ~~(OIL1)~~ provided and for processing from step a), especially using at least one pump ~~(4)~~, onward into a centrifuge ~~(7)~~, with heating of the heavy oil for processing before it reaches the centrifuge ~~(7)~~ to a separation temperature of - preferably - more than 98°C, and

c) separating an aqueous phase ~~(W)~~ and a sludge phase ~~(S)~~ from a clean oil phase ~~(OIL2)~~ in the centrifuge ~~(7)~~,

~~characterized in that~~wherein

one or more of the following steps are also performed:

d) the catalyst fines content ~~(Cat Fines IN)~~ in the incoming heavy oil for processing - especially prior to heating - is determined with a sensor device ~~(11)~~,

e) the catalyst fines content ~~(Cat Fines OUT)~~ in the outgoing cleaned or processed clean oil is determined with the or a second sensor device ~~(12)~~,

f) the catalyst fines content(s) determined from step d) and/or e) is/are used as process variable(s) in a closed-loop control process and the process variable(s) determined are used for closed-loop control especially of the separation temperature ~~T2~~ and/or the throughput of the pump ~~(4)~~.

12. The method as claimed in claim 11, ~~characterized in that~~ wherein the following are used as process variables:

- current fuel consumption of the engines,
- current fuel level in a clean oil tank,
- catalyst fines content in the incoming or outgoing heavy oil and/or clean oil and/or
- current service tank overflow rate.