be designed to ensure that temperature induced expansion does not lead to errors in the infrared measurements.

According to another aspect of the present invention there is provided an infrared apparatus configured to perform the method as previously described. Such an infrared apparatus comprises:

an infrared device configured to take infrared measurements of the hydrocarbon fluid;

a heater configured to heat and/or cool the hydrocarbon fluid;

a controller configured to control the infrared device to take a first infrared measurement at a first temperature across at least one infrared absorption wavelength of water and to take a second infrared measurement at a second temperature across the at least one infrared absorption wavelength of water, the second temperature being different to the first temperature; and

a processing unit configured to determining a change between said first and second infrared measurements and use the change between said first and second infrared measurements to determine the water content in the hydrocarbon fluid.

It is also envisaged that standard infrared equipment could be utilized to take the infrared measurements at different temperatures and a computer program can be provided to perform the data analysis required to implement the method as described herein. As such, according to yet another aspect of the present invention there is provided a computer readable storage medium comprising computer-executable instructions which, when executed, configure one or more processors to perform the method as described herein. As an alternative to a computer readable storage medium, the computer program can be provided for download via the internet.

Brief Description of the Drawings

Embodiments of the present invention are described by way of example only with reference to the accompanying drawings in which:

Figure 1 shows a schematic of an infrared apparatus for measuring water content in a hydrocarbon fluid as described herein;

Figure 2 shows another schematic of an infrared apparatus for measuring water content in a hydrocarbon fluid as described herein;

Claims

1. A method of measuring water content in a hydrocarbon fluid, the method comprising:

taking a first infrared measurement of the hydrocarbon fluid at a first temperature across at least one infrared absorption wavelength of water;

taking a second infrared measurement of the hydrocarbon fluid at a second temperature across the at least one infrared absorption wavelength of water, the second temperature being different to the first temperature;

determining a change between said first and second infrared measurements; and

using the change between said first and second infrared measurements to determine the water content in the hydrocarbon fluid.

2. A method according to claim 1,

wherein the first and second infrared measurements each comprise taking an infrared spectrum of the hydrocarbon fluid over a wavelength range which includes the at least one infrared absorption wavelength of water.

3. A method according to claim 1 or 2,

wherein the first and second infrared measurements include measuring transmittance through a sample of the hydrocarbon fluid.

4. A method according to claim 1 or 2,

wherein the first and second infrared measurements both include an attenuated total reflectance (ATR) infrared measurement.

5. A method according to any preceding claim,

wherein infrared measurements are taken over more than two temperatures or a gradually changing temperature.

6. A method according to any preceding claim,

wherein the change is calculated by subtraction of two infrared measurements or using a gradient of changing infrared intensity with temperature.

7. A method according to any preceding claim,

wherein the hydrocarbon fluid is one of a lubricant, a fuel, or an oil.

8. A method according to any preceding claim,

wherein the hydrocarbon fluid comprises soot.

9. A method according to any preceding claim,

wherein calibration data is utilized to determine the water content in the hydrocarbon fluid from the first and second infrared spectroscopy measurements, the calibration data generated from samples of hydrocarbon fluid having known concentrations of water.

10. A method according to claim 9,

wherein for each family of hydrocarbon fluids, the same calibration data is used.

11. A method according to any preceding claim,

wherein a correction is applied to account for expansion or contraction of the hydrocarbon fluid between the first and second temperatures.

12. A method according to claim 11,

wherein the correction comprises taking an infrared measurement at the first and second temperatures at a wavelength associated with the hydrocarbon fluid and subtracting a change in the infrared measurement to correct for changes in absorption due to expansion or contraction of the hydrocarbon fluid.

13. An infrared apparatus for measuring water content in a hydrocarbon fluid, the infrared apparatus comprising:

an infrared device configured to take infrared measurements of the hydrocarbon fluid;

a heater configured to heat and/or cool the hydrocarbon fluid;

a controller configured to control the infrared device to take a first infrared measurement at a first temperature across at least one infrared absorption wavelength of water and to take a second infrared measurement at a second temperature across the at least one infrared absorption wavelength of water, the second temperature being different to the first temperature; and

a processing unit configured to determining a change between said first and second infrared measurements and use the change between said first and second infrared measurements to determine the water content in the hydrocarbon fluid.

14. An infrared apparatus according to claim 13, configured to perform the method of any one of claims 1 to 12.

15. A computer readable storage medium comprising computer-executable instructions which, when executed, configure one or more processors to perform the method of any one of claims 1 to 12 using

data from the first and second infrared measurements to determine the water content in the hydrocarbon fluid.

16. A computer program comprising computer-executable instructions which, when executed, configure one or more processors to perform the method of any one of claims 1 to 12 using data from the first and second infrared measurements to determine the water content in the hydrocarbon fluid.