Process for Reduction of Asphaltenes from Marine Fuels

Description

The present invention discloses a process for reduction of asphaltenes from marine fuels using quaternary ammonium compounds in certain marine fuels, the use of such quaternary ammonium compounds, and certain marine fuels comprising such quaternary ammonium compounds.

Asphaltenes are a widespread constituent of crude oils and refinery stream thereof. In fuels with a certain composition such asphaltenes tend to precipitate from the fuels causing fouling of equipment in contact with the fuel, unless they are dissolved or dispersed.

The nature, chemical, and physical properties of asphaltenes are described in US 5214224, furthermore US 5214224 discloses certain copolymers for the dispersion of asphaltenes. Regardless of their chemical composition and constitution asphaltenes in the context of the present invention are determined in accordance with ASTM D3279 and are defined as that part of a marine fuel which is determined according to this method.

WO 2014/193692 A1 discloses a method of asphaltene control in a hydrocarbon fluid using certain quaternary ammonium compounds. *Inter alia* as hydrocarbon fluids marine fuel oils are mentioned, the composition of such oils is not explicitly disclosed, it is mentioned that such oils include aliphatic or liquid aromatic oils.

It was an object of the present disclosure to provide a method for further reducing fouling caused by asphaltenes in marine fuels.

The object was achieved by the use of at least one quaternary ammonium compound for dissolving or dispersing asphaltenes in marine fuels comprising

- 5 to 70 wt% saturates (determined according to SARA analysis using TLC-FID, IP 469), preferably 5 to 60, more preferably 10 to 50 wt%
- 10 to 85 wt% aromatics (determined according to SARA analysis using TLC-FID, IP 469), preferably 20 to 80, more preferably 30 to 70 wt%, and
- 1 to 30 wt% asphaltenes (determined according to SARA analysis using TLC-FID, IP 469), preferably 3 to 25, more preferably 5 to 20 wt%,

with the proviso that the sum of saturates, aromatics, and asphaltenes is less than 100 wt%, wherein

the weight ratio of aromatics to asphaltenes is not more than 7.0, preferably not more than 6.0,

more preferably not more than 5.5, very more preferably not more than 5.0, even more preferably not more than 4.5, and especially not more than 4.0.

In an aspect, there is provided the use of at least one quaternary ammonium compound for dissolving or dispersing asphaltenes in marine fuels comprising
- 5 to 70 wt% saturates (determined according to SARA analysis using TLC-FID, IP 469), preferably 5 to 60, more preferably 10 to 50 wt%
- 10 to 85 wt% aromatics (determined according to SARA analysis using TLC-FID, IP 469), preferably 20 to 80, more preferably 30 to 70 wt%, and
- 1 to 30 wt% asphaltenes (determined according to SARA analysis using TLC-FID, IP 469), preferably 3 to 25, more preferably 5 to 20 wt%,
with the proviso that the sum of saturates, aromatics, and asphaltenes is less than 100 wt%, wherein
the weight ratio of aromatics to asphaltenes is not more than 7.0, preferably not more than 6.0, more preferably not more than 5.5, very more preferably not more than 5.0, even more preferably not more than 4.5, and especially not more than 4.0.

In another aspect, there is provided a marine fuel composition, comprising
- 5 to 70 wt% saturates (determined according to SARA analysis using TLC-FID, IP 469), preferably 5 to 60, more preferably 10 to 50 wt%,
- 10 to 85 wt% aromatics (determined according to SARA analysis using TLC-FID, IP 469), preferably 20 to 80, more preferably 30 to 70 wt%,
- 1 to 30 wt% asphaltenes (determined according to SARA analysis using TLC-FID, IP 469), preferably 3 to 25, more preferably 5 to 20 wt%, and
- 50 to 2000 ppm by weight of at least one quaternary ammonium compound, preferably 60 to 1500, and more preferably 70 to 1000 ppm by weight,
wherein
the weight ratio of aromatics to asphaltenes is not more than 7.0, preferably not more than 6.0, more preferably not more than 5.5, very more preferably not more than 5.0, even more preferably not more than 4.5, and especially not more than 4.0.

In another aspect, there is provided a process for reducing or preventing fouling caused by asphaltenes in marine fuels comprising
- 5 to 70 wt% saturates (determined according to SARA analysis using TLC-FID, IP 469), preferably 5 to 60, more preferably 10 to 50 wt%,
- 10 to 85 wt% aromatics (determined according to SARA analysis using TLC-FID, IP 469), preferably 20 to 80, more preferably 30 to 70 wt%,

- 1 to 30 wt% asphaltenes (determined according to SARA analysis using TLC-FID, IP 469), preferably 3 to 25, more preferably 5 to 20 wt%, and

wherein

the weight ratio of aromatics to asphaltenes is not more than 7.0, preferably not more than 6.0, more preferably not more than 5.5, very more preferably not more than 5.0, even more preferably not more than 4.5, and especially not more than 4.0

by adding 50 to 2000 ppm by weight of at least one quaternary ammonium compound to the said marine fuel, preferably 60 to 1500, and more preferably 70 to 1000 ppm by weight.

In a preferred example of this process according to the disclosure it is possible to reduce the potential total sediment (TSP) value, determined according to ISO 10307-2:2009(E), procedure A, of the unadditised marine fuel by at least 25 %, preferably by at least 30 %, more preferably

by at least 35 %, and even by at least 40 % by adding the indicated amounts of at least one quaternary ammonium compound to the said marine fuel.

The basis underlying this disclosure is the observation that quaternary ammonium compounds are more effective in dissolving or dispersing asphaltenes in marine fuels with a lower content of aromatics than in those with a higher content.

Therefore, the use of quaternary ammonium compounds is preferred in marine fuels with a content of aromatics and polyaromatics according to IP 469 of not more than 50 wt%, more preferably not more than 45 wt%.

For the sake of simplicity within this text aromatics and polyaromatics according to IP 469 are collectively referred to as "aromatics" and polyaromatics are deemed to be included, even if not explicitly mentioned.

With regard to marine fuels saturates, aromatics, and asphaltenes refer to those compounds which are determined according to the respective SARA analysis.

It should be mentioned that the content of asphaltenes is independent of the content of saturates, aromatics, and resins in the marine fuel, so that the amounts of asphaltenes (determined according to SARA analysis using TLC-FID, IP 469) in the marine fuel is from 1 to 30 wt% asphaltenes, preferably from 3 to 25, and more preferably from 5 to 20 wt% irrespective of the content of saturates, aromatics, and/or resins.

The disclosure is described in further detail as follows:

Marine Fuel

The fuel is a marine fuel, such as MGO (Marine gas oil), MDO (Marine diesel oil), IFO (Intermediate fuel oil), MFO (Marine fuel oil), or HFO (Heavy fuel oil). Further examples for marine fuel are IFO 380 (an Intermediate fuel oil with a maximum viscosity of 380 centistokes at 50 °C (<3.5% sulphur)), IFO 180 (an Intermediate fuel oil with a maximum viscosity of 180 centistokes (<3.5% sulphur)), LS 380 (a Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 380 centistokes), LS 180 (a Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 180 centistokes), LSMGO (a Low-sulphur (<0.1%) Marine Gas Oil, which is often be used in European Ports and Anchorages according to EU Sulphur directive 2005/33/EC), or ULSMGO (a Ultra-Low-Sulphur Marine Gas Oil, also referred to as Ultra-Low-Sulfur Diesel (sul-