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.

In an aspect, 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 ASTM D3279), 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 saturates to asphaltenes is at least 4.0, preferably at least 4.2, more preferably at least 4.5, even more preferably at least 4.75, and especially at least 5.0.

Another aspect of the present disclosure is 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 ASTM D3279), 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 saturates to asphaltenes is at least 4.0, preferably at least 4.2, more preferably at least 4.5, even more preferably at least 4.75, and especially at least 5.0.

Another aspect of the present disclosure is 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 ASTM D3279), preferably 3 to 25, more preferably 5 to 20 wt%, and
wherein
the weight ratio of saturates to asphaltenes is at least 4.0, preferably at least 4.2, more preferably at least 4.5, even more preferably at least 4.75, and especially at least 5.0

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 diclosure is the observation that quaternary ammonium compounds are more effective in dissolving or dispersing asphaltenes in marine fuels with a high content of saturates than in those with a lower content.

Therefore, the use of quaternary ammonium compounds is preferred in marine fuels with a content of saturates according to IP 469 of at least 15, preferably at least 20 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 norm, i.e. SARA analysis in the case of saturates and aromatics or ASTM D3279 for asphaltenes.

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 ASTM D3279) 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 (sulphur 0.0015% max). Further suitable marine fuels are according to DIN ISO 8217 of the category ISO-F- DMX, DMA, DFA, DMZ, DFZ, or DFB, or ISO-F RMA, RMB, RMD, RME, RMG, or RMK. Further suitable marine fuel is distillate marine diesel or residual marine diesel.