

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Appl. No.: 11/615,539

Confirmation No.: 1057

Applicant: Stuart N. Milligan et al.

Filed: 12/22/2006

TC/A.U.: 1764

Examiner: Boyle, Robert C.

Docket No.: 34249US

Customer No.: 28841

Title: Drag Reduction of Asphaltenic Crude Oils

Commissioner for Patents

P.O. Box 1450

Alexandria VA 22313-1450

**RESPONSE TO OFFICE ACTION**

Sir:

In response to the Office Action of November 18, 2010, please amend the above-identified application as follows:

**Amendments to the Claims** are reflected in the listing of claims which begin on page 2 of this paper.

**Remarks/Arguments** begin on page 5 of this paper.

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1-112. (Cancelled)

113. (Currently Amended) A method comprising:

introducing a drag reducing polymer, between two pump stations capable of reducing friction loss associated with the turbulent flow through a pipeline by suppressing the growth of turbulent eddies, into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer;

wherein the drag reducing polymer has a solubility parameter within 4 MPa<sup>1/2</sup> of the solubility parameter of the liquid hydrocarbon and

the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw.

114. (Previously Presented) The method of claim 113, wherein the solubility parameter of the drag reducing polymer is at least about 17 MPa<sup>1/2</sup>.

115. (Previously Presented) The method of claim 113, wherein the drag reducing polymer comprises at least about 25,000 repeating units.

116. (Previously Presented) The method of claim 113, wherein a plurality of the repeating units comprise a heteroatom.

117. (Previously Presented) The method of claim 116, wherein the heteroatom is selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a phosphorus atom.

118. (Previously Presented) The method of claim 113, wherein the drag reducing polymer has a weight average molecular weight of at least 1 X 10<sup>6</sup> g/mol.

119. (Previously Presented) The method of claim 113, wherein the drag reducing polymer has a solubility parameter within  $2.5 \text{ MPa}^{1/2}$  of the liquid hydrocarbon.

120. (Previously Presented) The method of claim 113, wherein the solubility parameter of the liquid hydrocarbon is determined by the following equation:

$$\delta_2 = [(\Delta H_v - RT)/V]^{1/2}$$

where  $\Delta H_v$  is the energy of vaporization,  $R$  is the universal gas constant,  $T$  is the temperature in Kelvin,  $V$  is the molar volume and  $\delta_2$  is the solubility parameter.

121. (Previously Presented) The method of claim 113, wherein the solubility parameter of the drag reducing polymer is determined by the following equation:

$$\delta = (\delta_d^2 + \delta_p^2 + \delta_h^2)^{1/2}$$

where  $\delta$  is the solubility parameter,  $\delta_d = \sum F_{di}/V$ ,  $\delta_h = (\sum F_{hi}/V)^{1/2}$ ,  $\delta_p = (\sum F_{pi}^2)^{1/2}/V$ .

122. (Cancelled)

123. (Cancelled)

124. (Currently Amended) A method comprising:

introducing a drag reducing polymer having a solubility parameter of at least about  $17 \text{ MPa}^{1/2}$ , between two pump stations capable of reducing friction loss associated with the turbulent flow through a pipeline by suppressing the growth of turbulent eddies, into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about  $26^\circ$  to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer;

wherein the drag reducing polymer has a solubility parameter within  $4 \text{ MPa}^{1/2}$  of the solubility parameter of the liquid hydrocarbon and the drag reducing polymer comprises at least about 25,000 repeating units, and wherein a plurality of the repeating units comprise a heteroatom, wherein the heteroatom is selected from the group consisting of an oxygen atom, a nitrogen atom, a

sulfur atom and/or a phosphorus atom and wherein the drag reducing polymer has a weight average molecular weight of at least  $1 \times 10^6$  g/mol and

the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw.

125. (Currently Amended) A method comprising:

introducing a drag reducing polymer, between two pump stations capable of reducing friction loss associated with the turbulent flow through a pipeline by suppressing the growth of turbulent eddies, into a liquid hydrocarbon;

wherein the drag reducing polymer has a solubility parameter within  $4 \text{ MPa}^{1/2}$  of the solubility parameter of the liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about  $26^\circ$  to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer;

wherein the solubility parameter of the liquid hydrocarbon is determined by the following equation:

$$\delta_2 = [(\Delta H_v - RT)/V]^{1/2}$$

where  $\Delta H_v$  is the energy of vaporization, R is the universal gas constant, T is the temperature in Kelvin, V is the molar volume and  $\delta_2$  is the solubility parameter; and

wherein the solubility parameter of the drag reducing polymer is determined by the following equation:

$$\delta = (\delta_d^2 + \delta_p^2 + \delta_h^2)^{1/2}$$

where  $\delta$  is the solubility parameter,  $\delta_d = \sum F_{di}/V$ ,  $\delta_h = (\sum F_{hi}/V)^{1/2}$ ,  $\delta_p = (\sum F_{pi}^2)^{1/2}/V$  and

the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw.

### **REMARKS/ARGUMENTS**

Claims 113-121 and 124-125 are currently pending. Claims 1-112 and 122-123 are currently cancelled. Claims 113, 124 and 125 are currently amended.

Initially, applicant would like to thank examiner for meeting with applicant on March 17, 2011.

#### Claims Rejections – 35 USC § 102

Claims 113-125 are rejected under 35 USC § 102(b) as being anticipated by Inaoka (EP 0882739).

Claims 113-121, 124-125 are rejected under 35 USC § 102(b) as being anticipated by Castner (US 4,736,005).

Claims 113-114, 116-121, and 124-125 are rejected under 35 USC § 102(b) as being anticipated by Ball (US 5,021,526).

Initially, Applicant has amended the independent claims to include that the drag reducing polymer is introduced “between two pump stations capable of reducing friction loss associated with the turbulent flow through a pipeline by suppressing the growth of turbulent eddies” and that “the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw”. Basis for these amendments can be found in the original application as filed page 26, lines 18-19, page 1, lines 20-26 and previous claim 122. No new matter has been added with these amendments.

As discussed in the in-person interview, Castner does not anticipate our novel invention because it is a method for enhanced oil recovery (title of invention and rest of application) and Ball does not anticipate our novel invention because it is an emulsion (title of invention and rest of application). As shown in the peer reviewed article “Transportation of heavy and extra-heavy crude oil by pipeline” it is described that these methods are not drag reducers and in fact both

methods would modify the viscosity of the fluid which brings it outside the scope of applicant's claimed invention.

As described in the peer reviewed article "Transportation of heavy and extra-heavy crude oil by pipeline" the only method currently known or described that can be a drag reducer in heavy crude oil is our current patent application. Properties of drag reducers such as reducing friction loss associated with the turbulent flow through a pipeline by suppressing the growth of turbulent eddies have been added to applicants independent claims.

Inaoka does not teach, suggest or describe to one skilled in the art a method of incorporating a drag reducing polymer into heavy crude oil. The properties of the specific species of heavy crude oil are so distinct and different from typical crude oil that they present special challenges compared to the production, transportation, and refining of compared to the broad genus of crude oil. Prior to applicant's invention, one skilled in the art would not have transported applicant's liquid hydrocarbon via pipelines due to challenges such as the high viscosity and asphaltene content of heavy crude oil.

Heavy crude oil is so distinct that entire textbooks and studies have been dedicated to studying the different properties of heavy crude oil, please see "Composition and Analysis of Heavy Petroleum Fractions" and "Petroleum Refinery Engineering". In Petroleum Refinery Engineering an entire chapter is spent on trying to distinguish the different types of oil and how they are each distinct from each other. Furthermore Appendix B is spent trying to describe the multitude of crude oils that the found around the world. Composition and Analysis of Heavy Petroleum Fractions spends considerable time trying to find sensible ways to characterize heavy crude oil.

Applicant's application limits the multitude of heavy crude oil available in the world and expressly distinguishes itself from conventional crude oil by the claim limitation of introducing the drag reducing polymer into a "liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26°". Applicant's selection of this specific subspecies underneath the general species of heavy crude oil which is a distinct species from conventional crude oil renders applicants claims unanticipated by Inaoka.

Inaoka never intended their application to be used in the species of heavy crude oil as it is a distinct species from crude oil and does not include the same properties or characteristics as heavy crude oil. Due to the distinct chemical and physical differences between crude oil and heavy crude oil one skilled in the art would not infer that a drag reducer that is capable for use in crude oil would be capable for use in heavy crude oil. Accordingly, Inaoka does not teach, suggest or motivate one skilled in the art to utilize a drag reducing polymer in heavy crude oils.

As secondary consideration please note that the peer reviewed journal article "Transportation of heavy and extra-heavy crude oil by pipeline" describe that the only true drag reducer ever thought about or conceived to be feasible with the heavy crude oil is applicants own patent application. Reconsideration of the rejection is respectfully requested.

Claims Rejections – 35 USC § 103

Claims 113-125 are rejected under 35 USC § 103(a) as being anticipated by Inaoka (EP 0882739).

Due to the arguments and claim amendments submitted above, reconsideration of the rejection is respectfully requested.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case. Applicant requests a two-month extension of time. The Commissioner is authorized to charge any fees due herein or credit any overpayment to Deposit Account 16-1575, ref. 34249US.

Respectfully Submitted,

Date: April 8, 2011

By: /Richard Yuen/

Richard Yuen

Registration No. 65,287

Email: Richard.Y.Yuen@conocophillips.com

CONOCOPHILLIPS COMPANY – I.P. LEGAL

ATTN: Docketing

600 N. Dairy Ashford, ML-1065

Houston, Texas 77079

(281) 293-3454

(281) 293-2127 (Fax)