PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)* **08 December 2017 (08.12.2017)**

Applicant's or agent's file reference
IS160578WPCT

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2017/049796	**01 September 2017 (01.09.2017)**	01 September 2016 (01.09.2016)

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Applicant
SCHLUMBERGER TECHNOLOGY CORPORATION et al.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR	Date of completion of this opinion	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	08 December 2017 (08.12.2017)	LEE, Hun Gil Telephone No. +82-42-481-8525

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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:
      ☐ in the form of an Annex C/ST.25 text file.
      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-35	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-35	NO
Industrial applicability (IA)	Claims	1-35	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2011-0174688 A1 (MILAM et al.) 21 July 2011
D2: US 2014-0078499 A1 (TUNHEIM et al.) 20 March 2014
D3: US 2014-0371105 A1 (THOMAS et al.) 18 December 2014

1. Novelty and Inventive Step

1.1 Independent Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a system comprising: a feed supply (2); a catalyst reservoir including a catalyst which has a particle size distribution with a median or mean particle size of from 50 nm up to 5 µm; a reactor (3) comprising a first inlet (5), a second inlet (9) and a bleed stream outlet (25), wherein the first inlet (5) is configured to receive hydrocarbon-containing liquid, wherein the second inlet (9) is configured to receive the catalyst; and a detector configured to analyze a combined liquid product (see paragraphs [0008], [0134], [0141], [0159], [0169], [0192] and figure 1).

This claim differs from D1 in that a system for detecting mercury in hydrocarbon-containing fluid, comprises: an output port configured to supply a slug-flow produced by a fluidic device where the slug flow includes a sample of the hydrocarbon-containing fluid and a liquid phase reagent solution (hereinafter referred to as feature 1-1); and an optical analyzer configured to analyze the slug flow produced by the fluidic device to determine concentration of mercury in the sample of the hydrocarbon-containing fluid (hereinafter referred to as feature 1-2). However, the feature 1-1 would be easily conceived from the disclosure of D1 considering that the

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

In Claim 10, the phrase "the amalgam nanoparticles" is not disclosed previously. Therefore, claim 10 is not clear, contrary to the requirement of PCT Article 6.

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reactor (3) may include the bleed stream outlet (25) for removal of a stream of hydrocarbon-depleted feed residuum and catalyst from a mixing zone (1) and the reactor (3) (see paragraph [0169] and figures 1-3). And the feature 1-2 would be easily conceived from the disclosure of D2 considering an optical computing device (314) configured to detect concentrations of a sample fluid or substance found within a pipeline, wherein the sample fluid or substance contains barium, calcium, manganese, sulfur, sulfates, iron, strontium, chlorine, and mercury (see paragraphs [0024], [0031], [0089]-[0092] and figure 4). As D1 and D2 are in the same technical field, it is considered that a skilled person would be motivated to combine the features of D2 with D1. Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 1 does not involve an inventive step under PCT Article 33(3).

1.2 Dependent Claims 2-18

1.2.1 Concerning Claim 2

The additional feature of claim 2, characterized in that the system further comprises: a first pump configured to pump the sample hydrocarbon-containing fluid pumped from the first reservoir to the first input port of the fluidic device; and a second pump configured to pump the liquid phase reagent solution from the second reservoir to the second input port of the fluidic device, would be easily conceived from the disclosure of D1 considering that the first inlet (5) is configured to receive the hydrocarbon-containing liquid, and the second inlet (9) is configured to receive the catalyst (see paragraph [0141] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 2 does not involve an inventive step under PCT Article 33(3).

1.2.2 Concerning Claim 3

The additional feature of claim 3, characterized in that the liquid phase reagent solution includes water and water-soluble polymer that stabilizes the suspension of the nanoparticles in the liquid phase reagent solution at high temperature conditions, would be easily conceived from the disclosure of D1 considering that the particle size of the catalyst material produced by mixing the first and second salts in the aqueous mixture increases, and the surface area of the particles decreases with increasing concentrations of the salts, wherein the aqueous mixture is defined as containing more than 50 vol. % water (see paragraphs [0039], [0127] and figure 1).

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Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 3 does not involve an inventive step under PCT Article 33(3).

1.2.3 Concerning Claim 4

The additional feature of claim 4, characterized in that the water-soluble polymer comprises at least one of poly(acrylic acid), poly(acrylamide-co-acrylic acid), poly(vinyl pyridine), poly(ethylene oxide), poly(vinyl alcohol), poly(4-styrene sulfonic acid), a poly(methacrylic acid), and poly(vinyl pyrrolidone), is merely one of several straightforward possibilities from which a skilled person would select, in accordance with circumstances, without the exercise of inventive skill, considering the feature of D1 disclosing that the material of the catalyst may be a polythiometallate polymer (see paragraph [0097]). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 4 does not involve an inventive step under PCT Article 33(3).

1.2.4 Concerning Claim 5

The additional feature of claim 5, characterized in that the nanoparticles are formed from a noble metal, a silica core coated with a noble metal shell, a noble metal coated with a silica shell, or recursive layers of silica and a noble metal, would be easily conceived from the disclosure of D1 considering that conventional hydrocracking catalysts utilize an active hydrogenation metal, for example a Group VIII metal such as nickel, on a support having Lewis acid properties, for example, silica, silica-alumina, or alumina supports (see paragraph [0035]). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 5 does not involve an inventive step under PCT Article 33(3).

1.2.5 Concerning Claim 6

The additional feature of claim 6, characterized in that the nanoparticles have a concentration of up to 1 x 10^{15} nanoparticles/cm3 in the liquid phase reagent solution, would be easily conceived from the disclosure of D1 considering the catalyst material having a particle size distribution with a median or mean particle size of from 50 nm up to 5 µm (see paragraph [0134] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 6 does not involve an inventive step under PCT Article 33(3).

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1.2.6 Concerning Claim 7

The additional feature of claim 7, characterized in that the system is configured such that the slug flow produced by the fluidic device includes a liquid phase that carries amalgam nanoparticles that are suspended as a colloid in the liquid phase of the slug flow, would be easily conceived from the disclosure of D3 considering that elemental mercury refers to mercury in its metallic form, and is intended to encompass mixtures of mercury with other metals or compounds such as amalgams of mercury, as well as the various isotopes of mercury (see paragraph [0023] and figure 1). As D1, D2 and D3 are in the same technical field, it is considered that a skilled person would be motivated to combine the feature of D3 with D1-D2. Accordingly, this claim would have been obvious over the combination of D1-D3. Therefore, claim 7 does not involve an inventive step under PCT Article 33(3).

1.2.7 Concerning Claims 8-9

The additional features of claims 8-9, characterized in that the system is configured such that the slug flow produced by the fluidic device is controlled by the flow rate of the hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution supplied to the fluidic device (claim 8), and that the system is configured to control the flow rate of the hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution supplied to the fluidic device according to fluid analysis that determines the appropriate class of fluid sample type and pump control settings that dictate the flow rate of the hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution for producing the desired slug flow (claim 9), would be easily conceived from the disclosure of D1 considering that the total gas flow rate of each hydrocracking treatment is maintained at 950 standard liters per hour, where the hydrogen flow rate of the treatements ranges from 640-720 standard liters per hour and the hydrogen sulfide flow rate of the treatments ranges from 210-310 standard liters per hour (see paragraph [0187] and figure 1). Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 8-9 do not involve an inventive step under PCT Article 33(3).

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1.2.8 Concerning Claims 10-11

The additional features of claims 10-11, characterized in that the fluidic device includes a mixer section upstream from a reactor section, wherein the mixer section is configured to produce slug flow from the hydrocarbon-containing fluid sample and the liquid phase reagent solution introduced into the first and second input ports, and wherein the reactor section is configured to extract mercury of hydrocarbon-containing fluid sample where it adsorbs on the nanoparticles to form the amalgam nanoparticles contained in the slug flow (claim 10), and that the fluidic device further includes a third input port configured to receive a flow of a diluent and a diluter section upstream of the mixer section that dilutes the liquid phase reagent solution with the diluent introduced into the third input port; and the mixer section is configured to produce slug slow from the hydrocarbon-containing fluid sample introduced into the first input port and the diluted liquid phase reagent solution produced by the diluter section (claim 11), would be easily conceived from the disclosure of D1 considering that the reactor (3) comprises a mixing zone (1); the hydrocarbon-containing feedstock may be provided to the mixing zone (1) of the reactor (3) at a rate of at least 350 kg/hr per m3 of the mixture volume within mixing zone (1) of the reactor (3); and the mixture volume is defined herein as the combined volume of the catalyst (see paragraphs [0141]-[0142] and figure 1); and the disclosure of D3 considering that elemental mercury refers to mercury in its metallic form, and is intended to encompass mixtures of mercury with other metals or compounds such as amalgams of mercury, as well as the various isotopes of mercury (see paragraph [0023] and figure 1). As D1, D2 and D3 are in the same technical field, it is considered that a skilled person would be motivated to combine the feature of D3 with D1-D2. Accordingly, these claims would have been obvious over the combination of D1-D3. Therefore, claims 10-11 do not involve an inventive step under PCT Article 33(3).

1.2.9 Concerning Claim 12

The additional feature of claim 12 is identical to the feature of D2 in that the device (314) includes a sampling window (412), an electromagnetic radiation source (404), a first detector (420), and a second detector (424) (see paragraphs [0091]-[0092], [0097]-[0098] and figure 4). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 12 does not involve an inventive step under PCT Article 33(3).

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1.2.10 Concerning Claims 13-14

The additional features of claims 13-14, characterized in that the light source and the detector are configured to perform absorption spectroscopy (claim 13), and that the detector is configured to measure the transmission spectrum of light for the slug flow passing through the flow-thru optical cell (claim 14), would be easily conceived from the disclosure of D2 considering that the voltage returned by the detector (420) is essentially the dot product of the optical interaction of the optically interacted radiation (414) with the respective ICE (416) as a function of the concentration of the characteristic of interest of the substance (402) (see paragraphs [0034], [0097]-[0098] and figure 4). Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 13-14 do not involve an inventive step under PCT Article 33(3).

1.2.11 Concerning Claim 15

The additional feature of claim 15, characterized in that the optical analyzer further includes a data processing system configured to process the transmission spectrum to determine a shift in SPR peak wavelength and uses the shift in SPR peak wavelength to determine mercury concentration in the hydrocarbon-containing fluid sample, would be easily conceived from the disclosure of D2 considering that a signal processor (318) may be a computer including a non-transitory machine-readable medium and configured to process the output signals and thereby provide a resulting output signal (322) indicative of the detected characteristic(s) of interest (see paragraph [0064] and figure 4). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 15 does not involve an inventive step under PCT Article 33(3).

1.2.12 Concerning Claim 16

The additional feature of claim 16, characterized in that the hydrocarbon-containing fluid sample is selected from: a gas phase fluid sample that includes gaseous hydrocarbons, a liquid phase fluid sample that includes oil, and a gas and liquid phase fluid sample including a mixture of gaseous hydrocarbons and oil, would be easily conceived from the disclosure of D1 considering that the reactor (3) is preferably configured and operated so that substantially only vapors and gases may exit the reactor product outlet (11) (see paragraphs [0159], [0169] and

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figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 16 does not involve an inventive step under PCT Article 33(3).

1.2.13 Concerning Claims 17-18

The additional features of claims 17-18, characterized in that the system is part of a downhole tool configured to determine mercury concentration in a sample of formation fluid collected by the downhole tool (claim 17), and that the system is part of a surface-located facility to determine mercury concentration in fluids produced from a production well (claim 18), would be easily conceived from the disclosure of D2 considering that the optical computing device (314) is configured to detect concentrations of the sample fluid or substance found within the pipeline, and the foregoing advantages and others make the described optical computing devices particularly well suited for hydrocarbon processing and downhole use (see paragraphs [0030]-[0031], [0089]-[0092] and figure 4). Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 17-18 do not involve an inventive step under PCT Article 33(3).

1.3 Independent Claim 19

D1, which is considered to be the closest prior art to the subject matter of claim 19, discloses a system comprising a feed supply (2), wherein the feed supply (2) is configured to collect formation fluid (see paragraph [0141] and figure 1).

This claim differs from D1 in a system fluidly coupled to a flowline, wherein the system is configured to determine mercury concentration in a sample of formation fluid that flows into the flowline. However, this feature would be easily conceived from the disclosure of D2 considering an optical computing device (314) configured to detect concentrations of a sample fluid or substance found within a pipeline, wherein the sample fluid or substance contains barium, calcium, manganese, sulfur, sulfates, iron, strontium, chlorine, and mercury (see paragraphs [0024], [0031], [0089]-[0092] and figure 4). Meanwhile, claim 19 has the same system as in claim 1. The same reasoning as in claim 1 applies to claim 19. Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 19 does not involve an inventive step under PCT Article 33(3).

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1.4 Independent Claim 20

D1, which is considered to be the closest prior art to the subject matter of claim 20, discloses a system comprising a feed supply (2); a catalyst reservoir including a catalyst which has a particle size distribution with a median or mean particle size of from 50 nm up to 5 μm; a reactor (3) comprising a first inlet (5), a second inlet (9) and a bleed stream outlet (25), wherein the first inlet (5) is configured to receive hydrocarbon-containing liquid, wherein the second inlet (9) is configured to receive a catalyst; and a detector configured to analyze a combined liquid product (see paragraphs [0008], [0134], [0141], [0159], [0169], [0192] and figure 1).

This claim differs from D1 in a method comprising: by using a fluidic device, producing slug flow that includes a sample of a hydrocarbon-containing fluid and a liquid phase reagent solution (hereinafter referred to as feature 20-1); and optically analyzing the slug flow produced by the fluidic device to determine concentration of mercury in the sample of the hydrocarbon-containing fluid (hereinafter referred to as feature 20-2). However, the feature 20-1 would be easily conceived from the disclosure of D1 considering that the reactor (3) may include the bleed stream outlet (25) for removal of a stream of hydrocarbon-depleted feed residuum and a catalyst from a mixing zone (1) and the reactor (3) (see paragraph [0169] and figures 1-3). And the feature 20-2 would be easily conceived from the disclosure of D2 considering an optical computing device (314) configured to detect concentrations of a sample fluid or substance found within a pipeline, wherein the sample fluid or substance contains barium, calcium, manganese, sulfur, sulfates, iron, strontium, chlorine, and mercury (see paragraphs [0024], [0031], [0089]-[0092] and figure 4). As D1 and D2 are in the same technical field, it is considered that a skilled person would be motivated to combine the features of D2 with D1. Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 20 does not involve an inventive step under PCT Article 33(3).

1.5 Dependent Claims 21-35

1.5.1 Concerning Claim 21

The additional feature of claim 21, characterized in that the liquid phase reagent solution includes water and water-soluble polymer that stabilizes the suspension of the nanoparticles in

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the liquid phase reagent solution at high temperature conditions, would be easily conceived from the disclosure of D1 considering that the particle size of the catalyst material produced by mixing the first and second salts in the aqueous mixture increases, and the surface area of the particles decreases with increasing concentrations of the salts, wherein the aqueous mixture is defined as containing more than 50 vol. % water (see paragraphs [0039], [0127] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 21 does not involve an inventive step under PCT Article 33(3).

1.5.2 Concerning Claim 22

The additional feature of claim 22, characterized in that the water-soluble polymer comprises at least one of poly(acrylic acid), poly(acrylamide-co-acrylic acid), poly(vinyl pyridine), poly(ethylene oxide), poly(vinyl alcohol), poly(4-styrene sulfonic acid), a poly(methacrylic acid), and poly(vinyl pyrrolidone), is merely one of several straightforward possibilities from which a skilled person would select, in accordance with circumstances, without the exercise of inventive skill, considering the feature of D1 disclosing that the material of the catalyst may be a polythiometallate polymer (see paragraph [0097]). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 22 does not involve an inventive step under PCT Article 33(3).

1.5.3 Concerning Claim 23

The additional feature of claim 23, characterized in that the nanoparticles are formed from a noble metal, a silica core coated with a noble metal shell, a noble metal coated with a silica shell, or recursive layers of silica and a noble metal, would be easily conceived from the disclosure of D1 considering that conventional hydrocracking catalysts utilize an active hydrogenation metal, for example a Group VIII metal such as nickel, on a support having Lewis acid properties, for example, silica, silica-alumina, or alumina supports (see paragraph [0035]). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 23 does not involve an inventive step under PCT Article 33(3).

1.5.4 Concerning Claim 24

The additional feature of claim 24, characterized in that the nanoparticles have a

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concentration of up to 1 x 10^{15} nanoparticles/cm3 in the liquid phase reagent solution, would be easily conceived from the disclosure of D1 considering the catalyst material having a particle size distribution with a median or mean particle size of from 50 nm up to 5 μm (see paragraph [0134] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 24 does not involve an inventive step under PCT Article 33(3).

1.5.5 Concerning Claim 25

The additional feature of claim 25, characterized in that the slug flow produced by the fluidic device includes a liquid phase that carries amalgam nanoparticles that are suspended as a colloid in the liquid phase of the slug flow, would be easily conceived from the disclosure of D3 considering that elemental mercury refers to mercury in its metallic form, and is intended to encompass mixtures of mercury with other metals or compounds such as amalgams of mercury, as well as the various isotopes of mercury (see paragraph [0023] and figure 1). As D1, D2 and D3 are in the same technical field, it is considered that a skilled person would be motivated to combine the feature of D3 with D1-D2. Accordingly, this claim would have been obvious over the combination of D1-D3. Therefore, claim 25 does not involve an inventive step under PCT Article 33(3).

1.5.6 Concerning Claims 26-27

The additional features of claims 26-27, characterized in that the slug flow produced by the fluidic device is controlled by the flow rate of the hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution supplied to the fluidic device (claim 26), and that the flow rate of hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution supplied to the fluidic device are controlled according to fluid analysis that determines the appropriate class of fluid sample type and pump control settings that dictate the flow rate of the hydrocarbon-containing fluid sample and the flow rate of the liquid phase reagent solution for producing the desired slug flow (claim 27), would be easily conceived from the disclosure of D1 considering that the total gas flow rate of each hydrocracking treatment is maintained at 950 standard liters per hour, where the hydrogen flow rate of the treatements ranges from 640-720 standard liters per hour and the hydrogen sulfide flow rate of the treatments ranges from 210-310 standard liters per hour (see paragraph [0187] and figure 1). Accordingly, these claims would have been obvious over the combination of D1-D3.

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Therefore, claims 26-27 do not involve an inventive step under PCT Article 33(3).

1.5.7 Concerning Claim 28

The additional feature of claim 28, characterized in the method further comprising delivering a diluent into a third port of the fluidic device for dilution of the liquid phase reagent solution such that the fluidic device produces slug flow from the hydrocarbon-containing fluid sample and the diluted liquid phase reagnet solution, would be easily conceived from the disclosure of D1 considering that the reactor (3) comprises a mixing zone (1); the hydrocarbon-containing feedstock may be provided to the mixing zone (1) of the reactor (3) at a rate of at least 350 kg/hr per m3 of the mixture volume within the mixing zone (1) of the reactor (3); and the mixture volume is defined herein as the combined volume of the catalyst (see paragraphs [0141]-[0142] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 28 does not involve an inventive step under PCT Article 33(3).

1.5.8 Concerning Claim 29

The additional feature of claim 29 is identical to the feature of D2 in that the device (314) includes a sampling window (412), an electromagnetic radiation source (404), a first detector (420), and a second detector (424) (see paragraphs [0091]-[0092], [0097]-[0098] and figure 4). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 29 does not involve an inventive step under PCT Article 33(3).

1.5.9 Concerning Claims 30-31

The additional features of claims 30-31, characterized in that the light source and the detector are configured to perform absorption spectroscopy (claim 30), and that the detector measures the transmission spectrum of light for the slug flow passing through the flow-thru optical cell (claim 31), would be easily conceived from the disclosure of D2 considering that the voltage returned by the detector (420) is essentially the dot product of the optical interaction of the optically interacted radiation (414) with the respective ICE (416) as a function of the concentration of the characteristic of interest of the substance (402) (see paragraphs [0034], [0097]-[0098] and figure 4). Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 30-31 do not involve an inventive step

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under PCT Article 33(3).

1.5.10 Concerning Claim 32

The additional feature of claim 32, characterized in that the optical analysis further involves processing the transmission spectrum to determine a shift in SPR peak wavelength and uses the shift in SPR peak wavelength to determine mercury concentration in the hydrocarbon-containing fluid sample, would be easily conceived from the disclosure of D2 considering that a signal processor (318) may be a computer including a non-transitory machine-readable medium and configured to process the output signals and thereby provide a resulting output signal (322) indicative of the detected characteristic(s) of interest (see paragraph [0064] and figure 4). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 32 does not involve an inventive step under PCT Article 33(3).

1.5.11 Concerning Claim 33

The additional feature of claim 33, characterized in that the hydrocarbon-containing fluid sample is selected from: a gas phase fluid sample that includes gaseous hydrocarbons; a liquid phase fluid sample that includes oil; and a gas and liquid phase fluid sample including a mixture of gaseous hydrocarbons and oil, would be easily conceived from the disclosure of D1 considering that the reactor (3) is preferably configured and operated so that substantially only vapors and gases may exit the reactor product outlet (11) (see paragraphs [0159], [0169] and figure 1). Accordingly, this claim would have been obvious over D1 in view of D2. Therefore, claim 33 does not involve an inventive step under PCT Article 33(3).

1.5.12 Concerning Claims 34-35

The additional features of claims 34-35, characterized in that the method is carried out by a downhole tool to determine mercury concentration in a sample of formation fluid collected by the downhole tool (claim 34), and that the method is carried out by a surface-located facility to determine mercury concentration in fluids produced from a production well (claim 35), would be easily conceived from the disclosure of D2 considering that the optical computing device (314) is configured to detect concentrations of the sample fluid or substance found within the pipeline, and the foregoing advantages and others make the described optical

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computing devices particularly well suited for hydrocarbon processing and downhole use (see paragraphs [0030]-[0031], [0089]-[0092] and figure 4). Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 34-35 do not involve an inventive step under PCT Article 33(3).

2. Industrial Applicability

Claims 1-35 are industrially applicable under PCT Article 33(4).