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Señores

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISION DE NUEVAS CREACIONES

E. _____ S. _____ D. _____

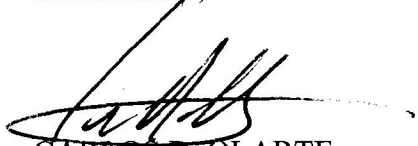
Re: **No. 00.048.024.**

Solicitud de Patente de Invención titulada:
"AMINAS NOVEDOSAS UTILES PARA
INHIBIR LA FORMACION DE HIDRATOS DE
GAS"

Solicitante: **GOLDSCHMIDT CHEMICAL
COMPANY.**

CARLOS R. OLARTE, mayor de edad y vecino de Bogotá D.C., identificado tal como aparece al pie de mi firma en mi carácter de apoderado de la sociedad solicitante, respetuosamente me permito presentar la Copia Certificada, de la cual se reclama prioridad, de la Solicitud de Patente No. 60/140,893 presentada el 24 de junio de 1999 ante la Oficina de Patentes y Marcas Estadounidense, así como la traducción de su Capítulo Reivindicatorio.

Atentamente,



CARLOS R. OLARTE
C.C. No. 79.782.747 de Bogotá
T.P. 74.295

Anexos: Copia Certificada del Documento de Prioridad.
Traducción del Capítulo Reivindicatorio del Documento de Prioridad.

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Esta es una traducción parcial al idioma español de un documento escrito originalmente en el idioma inglés.

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A TODOS AQUELLOS A QUIEN ESTE DOCUMENTO SE LES PRESENTE:

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Oficina de Patentes y Marcas de los Estados Unidos

Junio 28, 2000

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111.

NO. DE SOLICITUD: 60/140,893

FECHA DE PRESENTACION: 24 de Junio de 1999

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SELLO DE LA
OFICINA DE MARCAS Y PATENTES
DE LOS ESTADOS UNIDOS DE

Por la Autoridad del
COMISIONADO DE PATENTES Y MARCAS

[firma ilegible]

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H.L. JACKSON
Oficial de Certificación

3 46

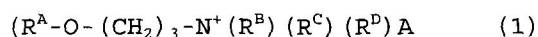
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REINVINDICACIONES

LO QUE REINVINDICA ES:

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1. Un compuesto de la formula (1)



- 10 en donde R^A es seleccionado del grupo que consiste de alquilo, alquenilo, arilo, arilalquilo, arilalquenilo, alquilarilo y grupos alquenilarilo y glicoles que tienen de 4 a 24 átomos de carbono y opcionalmente contiene al menos un heteroátomo como oxígeno, nitrógeno o sulfuro.

- 15 R^B y R^C son independientemente seleccionados de grupo que consiste de grupos alquilo de cadena lineal y ramificada que contienen 3 a 6 átomos los cuales pueden opcionalmente ser substituidos con fenilo;

- R^D es seleccionado del grupo que consiste de hidrógeno y grupos alquilo de cadena lineal y ramificada que contienen 1 a 6 átomos los
20 cuales pueden opcionalmente ser substituidos con fenilo;

A es un anión

2. Un método para reducir la aglomeración de hidratos de hidrocarburos que contienen de 1 a 5 átomos de carbono, que comprende la adición de
25 una cantidad efectiva de al menos un compuesto según la reivindicación 1.

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3. Un método para inhibir la orificación de un conducto, el conducto contiene una mezcla corriente que comprende una cantidad de hidrocarburos que tienen de 1 a 5 átomos de carbono y una cantidad de agua en donde las cantidades de hidrocarburos y agua son suficiente a la formación de hidratos la temperatura del conducto y la presión en la ausencia de un hidrato forman un inhibidor, el método comprende adicionar las mezclas de un hidrato inhibidor formado en donde comprende un compuesto de acuerdo con la reivindicación 1 en una cantidad efectiva del inhibidor formando hidratos en la mezcla del conductor a temperatura y presiones; y la mezcla corriente contiene la formación de un hidrato inhibidor a través del conducto.

4. El método de la reivindicación 3, en donde R^A es una cadena lineal ramificada del grupo alquilo teniendo de 6 a 20 átomos de carbono.

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5. El método de la reivindicación 3, en donde R^A es una cadena lineal ramificada del grupo alquilo teniendo de 8 a 18 átomos de carbono.

6. El método de la reivindicación 3, en donde R^A es una cadena lineal ramificada del grupo alquilo teniendo de 12 a 15 átomos de carbono.

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7. El método de la reivindicación 3 en donde R^B , R^C , y R^D son cada uno seleccionados independientemente del grupo que consiste de n-butilo, isofenilo y n-fenilo.

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8. El método de la reivindicación 3 en donde A es seleccionado del grupo de consiste de hidroxido, carboxilato, halido, sulfato, y sulfato orgánico.

5 9. El método de la reivindicación 3 en donde A es seleccionado del grupo de consiste de hidroxido, acetato, cloro, bromo, sulfato, metilsulfato y etilsulfato.

10 10. El método de la reivindicación 3 en donde la cantidad del inhibidor formado de hidrato está entre 0.05 y 5 % por peso base de agua en la mezcla.

15 11. El método de la reivindicación 3 en donde la cantidad del inhibidor formado de hidrato está entre 0.1 y 0.5 % por peso de agua en la mezcla.

20 Q es etileno, propileno, ó butileno el cual puede ser lineal ó ramificado;

X es 0 a 4;

25 y y z son cada uno independientemente 0 a x+1;

w es 1 a x+1;

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v es un número el cual satura el átomo de nitrógeno;

k y p son independientemente 0 ó 1, con la condición que k+p es mayor o igual a 1;

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s es 1, 2 o 3;

T es de 0 a 20;

10 cada R^E , R^B , y R^C es independientemente seleccionado del grupo que consta de grupos alquilo de cadena lineal y ramificada que contienen de 2 a 6 átomos de carbono los cuales pueden opcionalmente ser substituidos con fenilo, y R^E puede además ser (R^A , -O- B_T -Q);

15 cada R^D es independientemente seleccionado del grupo que consta de hidrogeno y grupos alquilo de cadena lineal y ramificada que contienen 1 a 6 átomos los cuales pueden opcionalmente ser substituidos con fenilo;

20 B es un residual de oxido de etileno, óxido de propileno ó oxido de butileno; y

A es un anión.

3. El compuestos de la Reivindicación 1 en donde Q es propileno.

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4. El compuesto de la Reivindicación 1 en donde R^A es un grupo alquilo lineal o ramificado que tiene de 3 a 20 átomos de carbono.

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SZ

5. El compuesto de la Reivindicación 3 en donde R^A es un grupo alquilo lineal o ramificado que tiene de 7 a 10 átomos de carbono.

5 6. El compuesto de la Reivindicación 1 en donde R^B , R^C , y R^D son cada uno independientemente seleccionados del grupo que consta de metilo, etilo, propilo, butilo, e isobutilo.

7. El compuesto de la Reivindicación 1 en donde R^D es hidrogeno.

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8. El compuesto de la Reivindicación 1 en donde A es seleccionado del grupo que consta de hidróxido, carboxilato, haluro, sulfato, y sulfato orgánico.

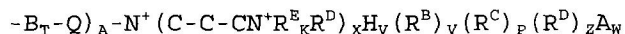
15 9. El compuesto de la Reivindicación 1 en donde A es bromo, metilsulfato ó etilsulfato.

10. El compuesto de la Reivindicación 1 en donde al menos uno de dichos grupos R^E son R^A-O-B_T-Q .

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11. Un método para reducir la aglomeración de hidratos de hidrocarburos que contienen de 1 a 5 átomos de carbono, ó para disminuir la formación de dichos hidratos que comprende la adición de una cantidad efectiva de al menos un compuesto según cualquiera de las reivindicaciones 1-9.

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en donde R^A es seleccionado entre grupos de alquilo, alquenilo, arilo, arilalquilo, arilalquenilo, alquilarilo, alquenilarilo y glicoles teniendo de 1 a 24 átomos de carbono y opcionalmente contiene al menos un

5 heteroátomo; Q es etileno, propileno o butileno los cuales pueden ser lineales o ramificados; x es 0 a 4; y y z son cada uno independientemente 0 a x+1; w es 1 a x+1; v es un número el cual satura el átomo de nitrógeno;

10 k y p son independientemente 0 ó 1, con la condición que k+p es mayor o igual a 1; s es 1, 2 ó 3, preferiblemente 1 ó 2; T es de 0 a 20; cada R^E , R^B , R^C es independientemente seleccionado del grupo que consta de grupos alquilo de cadena lineal o ramificada conteniendo 2 a 6 átomos de carbono los cuales pueden opcionalmente ser substituidos con fenilo, y R^E puede

15 ser además (R^A-O-B_T-Q); cada R^D es independientemente seleccionado del grupo que consta de hidrogeno y grupos alquilo de cadena lineal o ramificada conteniendo 1 a 6 átomos de carbono los cuales pueden opcionalmente ser substituidos con fenilo; B es un residual de oxido de etileno, oxido de propileno u oxido de butileno; y A es un anión.

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THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

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United States Patent and Trademark Office

June 28, 2000

**THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM
THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK
OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT
APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A
FILING DATE UNDER 35 USC 111.**

APPLICATION NUMBER: 60/140,893 ✓

FILING DATE: June 24, 1999



**By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS**

H. L. Jackson

H. L. JACKSON

Certifying Officer

Please type a plus sign (+) inside this box → ☐

Docket Number:

10771

PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Large Entity)

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)/APPLICANT(S)

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Charles R. Gary M.	Milburn Sitz	255 N. Franklin St., Delaware, OH 43015 515 Surrey Lane, Marysville, OH 43040

☐ Additional inventors are being named on page 2 attached hereto

TITLE OF THE INVENTION (280 characters max)

NOVEL AMINES USEFUL IN INHIBITING GAS HYDRATE FORMATION

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Place Customer Number
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ENCLOSED APPLICATION PARTS (check all that apply)

☒ Specification Number of Pages 14

☐ Drawing(s) Number of Sheets

☐ Other (specify)

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)

☒ A check or money order is enclosed to cover the filing fees

FILING FEE
AMOUNT

☒ The Commissioner is hereby authorized to charge filing fees or
credit any overpayment to Deposit Account Number:

19-1013

\$150.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,

SIGNATURE

DATE

June 24, 1999

TYPED or PRINTED NAME Frank S. DiGiglio

REGISTRATION NO.
(if appropriate)

31,346

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NOVEL AMINES USEFUL IN INHIBITING GAS HYDRATE FORMATION

FIELD OF THE INVENTION

This invention relates to a method of modifying the behavior of gas hydrates to inhibit the plugging of conduits, and also to a method of improving multiphase reactions by using a novel amine which exhibits the beneficial property of improved water solubility or dispersibility.

BACKGROUND OF THE INVENTION

Gas hydrates are clathrates (inclusion compounds) of gases in a lattice consisting of water molecules. Low-boiling hydrocarbons, such as methane, ethane, propane, butane and iso-butane, are present in natural gas and also in crude oil. Because water may also be present in varying amounts in natural gas and crude oil, the mixture, under conditions of elevated pressure and reduced temperature, tends to form gas hydrate crystals. The maximum temperature at which gas hydrates can be formed strongly depends on the pressure of the system. For example, ethane at a pressure of approximately 1 Mpa can form hydrates only at temperatures below 4°C whereas at a pressure of 3 Mpa stable hydrates can be present at temperatures as high as 14°C. With respect to this strong dependence of the hydrate melting point on pressure, hydrates differ markedly from ice. As described by M. von Stackelberg and H.R. Muller (Z. Electrochem. 1954 5825), methane and ethane hydrates form cubic lattices having a lattice constant of 1.2 nm (hydrate structure I). The lattice constant of the cubic propane and butane gas hydrates is

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1.73 nm (hydrate structure II). However, the presence of even small amounts of propane in a mixture of low-boiling hydrocarbons will result in the formation of gas hydrates having structure II (J.H. van der Waals and J.C. Platteeuw, Adv. Chem. Phys. 2 1959 1).

It has been known for a long time that gas hydrate crystals, when allowed to form and grow inside a conduit such as a pipeline, tend to block or even damage the conduit. To prevent such blocking, the following thermodynamic measures are possible in principle: removing free water, maintaining elevated temperatures and/or reduced pressures, or adding melting point depressants (antifreeze). In practice, the last-mentioned measure is most frequently applied. However, the antifreezes, such as the lower alcohols and glycols, have to be added in substantial amounts (several tens of percent by weight of the water present) to be effective. An additional disadvantage of such amounts is that recovery of the antifreezes is usually required during subsequent processing of the mixtures.

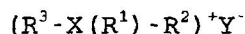
An attractive alternative to the anti-hydrate measures described above, particularly the antifreezes, is to use a crystal growth inhibitor. The principle of interfering with crystal growth is known.

Plants, and animals such as insects and cold-water fish, are known to protect themselves from freezing, both by antifreezes such as glycols and by special peptides and glycopeptides (termed Antifreeze Proteins, AFP's and Antifreeze Glycoproteins, AFGP's) which interfere with ice crystal growth (A.L. de Vries,

Comp. Biochem. Physiol, 73 1982 627). Such cold-water
fish peptides and glycopeptides have been said to be
effective in interfering with the growth of gas-hydrate
crystals. However, their production and use for this
purpose are considered to be uneconomical.

In PCT Patent Application EP93/01519, the use
of polymers and copolymers of N-vinyl-2-pyrrolidone for
inhibiting the formation, growth and/or agglomeration of
gas hydrate crystals is disclosed.

U.S. Patent No. 5,460,728 discloses that
certain alkylated ammonium, phosphonium and sulphonium
compounds are effective in interfering with the growth of
gas hydrate crystals and are useful in inhibiting the
plugging by gas hydrates of conduits containing low-
boiling hydrocarbons and water. The compounds have the
structure:



wherein R^1 , R^2 and R^3 are independently selected from the
group consisting of normal and branched alkyl groups
containing at least 4 carbon atoms; X is S, N- R^4 or P-
 R^4 ; R^4 is hydrogen or an organic substituent which may
contain one or more hetero atom such as oxygen and can be
in particular alkyl, alkenyl, aryl, arylalkyl,
arylalkenyl, alkylaryl, alkenylaryl, or glycol having 1
to 20 carbon atoms; and Y^- is an anion. The preferred
ammonium compounds are said to be those compounds in

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which R⁴ is alkyl or alkenyl containing 8 to 20 carbon atoms.

5 U.S. Patent No. 5,460,728 further discloses
that compounds wherein R⁴ contains more than 12 carbon
atoms can provide additional properties, in addition to
the inherent hydrate crystal growth-inhibiting
properties, such as surface-active properties which help
to emulsify the aqueous and hydrocarbon phases (as
10 water-in-oil or oil-in-water emulsions), thereby keeping
the concentration of water available for hydrate forming
at the conduit wall small. Surface-active properties
also help to do the following:

15 - Concentrate the preferred compound near the
water-hydrocarbon interfaces, where hydrate formation is
most pronounced, thereby raising the local concentration
of ions to freezing-point depressing level.

20 - Modify the structure of water near the
hydrocarbon-water interface in such a way that the
formation of hydrate crystals is hindered.

- Impede further access of water molecules to the
hydrate crystal after attachment of the subject compound
to the hydrate crystals.

25 - Prevent agglomeration of hydrate crystals by
making their surface hydrophobic.

- Adhere the subject compound to the conduit wall,
thereby preventing the adhesion of hydrates thereto.

30 The amount of the preferred compounds to be
used in the process according to U.S. Patent No.
5,460,728 is generally between 0.05 and 5 wt.%,

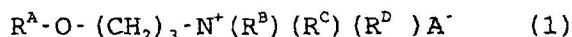
preferably between 0.1 and 0.5 wt. %, based on the amount of water in the hydrocarbon-containing mixture.

It will be understood that the compounds used have to be soluble in water in the concentration required and at a temperature of about 5°C.

While these compounds may be satisfactory to some extent, there is still a need for compounds which are more hydrophilic, thus providing better water solubility and better dispersibility in antifreeze solutions and which are liquid at lower temperatures thereby providing a higher degree of performance while requiring reduced amounts of the active compound. It is therefore an object of the present invention to provide improved compounds to inhibit formation of hydrates in streams containing at least some light hydrocarbons and water. It is a further object to provide such a method wherein a high concentration of additive is not required.

BRIEF SUMMARY OF THE INVENTION

One aspect of the present invention is compounds of the formula (1)



wherein

R^A is chosen from the group consisting of alkyl, alkenyl, aryl, arylalkyl, arylalkenyl, alkylaryl, and alkenylaryl groups and glycols having from 4 to 24, preferably from 8-18, carbon atoms and optionally contains a hetero atom such as oxygen, nitrogen or sulfur;

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R^B and R^C are independently chosen from the group consisting of straight and branched chain alkyl groups containing 3 to 6 carbon atoms which may optionally be substituted with phenyl;

5 R^D is chosen from the group consisting of hydrogen and straight and branched chain alkyl groups containing 1 to 6 carbon atoms which may optionally be substituted with phenyl;

A is an anion.

10 Another aspect of the present invention is a method for inhibiting the plugging of a conduit, the conduit containing a flowing mixture comprising an amount of hydrocarbons having from one to five carbons and an amount of water wherein the amounts of hydrocarbons and
15 water could form hydrates at conduit temperatures and pressures, the method comprising the steps of:

adding to the mixture an amount of a hydrate formation inhibitor component of the formula (1) in an amount effective to inhibit formation of hydrates
20 in the mixture at conduit temperatures and pressures; and flowing the mixture containing the hydrate formation inhibitor through the conduit.

DETAILED DESCRIPTION OF THE INVENTION

25 More in particular, R^A is preferably linear or branched alkyl having 6 to 20, more preferably, 8 to 18, most preferably, 12 to 15 carbon atoms. R^B , R^C and R^D are preferably independently chosen from the group of n-butyl, isobutyl, isopentyl, n-pentyl and hydrogen. The
30 anions of the compounds according to the invention can be broadly chosen. Examples include anions such as

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hydroxide, carboxylate (such as acetate, propionate, butyrate, or benzoate), halide, sulfate, and organic sulfate. Preferred anions are bromide, acetate, chloride, sulfate, methylsulfate and ethylsulfate, most preferably bromide.

The most preferred compounds of U.S. Patent No. 5,460,728 contain either an oleyl or a C₁₂ to C₁₈ linear fatty moiety which renders the compounds quite hydrophobic and in many cases solid at the temperatures of use. In the present invention it has surprisingly been discovered that by replacing the fatty moiety with an oxypropylalkyl moiety of a similar range of molecular weight the liquidity and the water dispersibility are improved. Surprisingly the resulting compound is not only more dispersible but is in fact soluble in water at room temperature. Even more surprisingly, not only does this improve the ease of application but both the effectiveness as a gas hydrate inhibitor and the usage rate for gas hydrate inhibition improved significantly.

The compounds of formula (1) according to the invention can be prepared by procedures which are known in the art, from starting materials which are simple and abundantly available. For instance, the corresponding ether amine can be prepared or acquired and quaternized with a halide such as R^D Br in a solvent such as isopropanol in the presence of a base such as sodium bicarbonate.

The compounds of formula (1) according to the present invention can be added to the mixture of hydrocarbons and water as a liquid or, preferably, in a

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concentrated solution. The amount of compounds of formula (1) present should comprise 0.05 to 5.0 wt.% based on the weight of water present. Preferably, the amount thereof should be 0.1 to 0.5 wt.% based on the weight of water present. When used in this fashion, these compounds will reduce the speed and/or extent to which gas hydrates are formed as compared to concentrated mixtures.

The following Examples are provided to illustrate the invention and are not intended to be limiting in any way.

EXAMPLE 1

Example 1 demonstrates the preparation of several compounds of formula (1).

A typical method used to prepare alkylethertributylammonium bromide is as follows: Charge 1.0 mole of the starting primary amine, 3.0 moles of 1-bromobutane, 2.0 moles of sodium bicarbonate (sodium hydroxide or potassium hydroxide can be substituted for sodium bicarbonate) and sufficient isopropyl alcohol (virtually any low molecular weight alcohol can be substituted for the isopropyl alcohol, i.e. methanol, ethanol, butanol, ethylene glycol, propylene glycol) to a reactor. Seal the reactor and heat to 120-140 °C. Heat at reaction temperature for 5-8 hours to yield a final product with approximately 50-75% quaternary material. Reaction is considered complete when the Total Amine Value (TAV is in mg KOH / gram sample) is less than 1.0. When the reaction is complete, the reactor is cooled and the CO₂ gas generated during the reaction is vented. The

reaction mixture is then filtered through filter aid to remove the NaBr formed during the reaction.

The following amines were used to prepare the tributyl quaternary bromide materials using this general method:

1. C₈₋₁₀ oxypropyl amine
2. C_{12i} oxypropyl amine
3. C₁₂₋₁₄ oxypropyl amine
4. C₁₂₋₁₅ oxypropyl amine
5. C₁₄ oxypropyl amine
6. C₁₆ oxypropyl amine
7. C₁₆ alkyl primary amine
8. C₁₈ oxypropyl amine
9. C₂₀ Guerbet oxypropyl amine
10. oleyl primary amine
11. soft tallow primary amine

EXAMPLE 2

This example demonstrates the improved liquidity and dispersibility of materials of formula (1) as compared to the preferred compounds of U.S. Patent No. 5,460,728. The compounds tested had the formula Z-N-T B_x, wherein the substituent Z and T are set forth in the following Table I.

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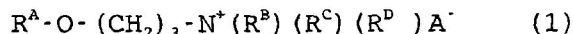
TABLE I		
QUATERNARY COMPOUND SOLUBILITY IN WATER		
Z-SUBSTITUENT	T-SUBSTITUENT*	BEHAVIOR OF COMPOUND
OLEYL	TB	DISPERSES SLOWLY; INSOLUBLE
SOFT TALLOW	TB	DISPERSES QUICKLY; INSOLUBLE
HEXADECYL	TB	INSOLUBLE
isODODECYL OXYPROPYL	TB	SOLUBLE
HEXADECYL OXYPROPYL	TB	SOLUBLE
ISOFOL 20 OXYPROPYL	TB	DISPERSES SLOWLY; SEPARATES
C12-14 OXYPROPYL	TB	SOLUBLE
C12-C15 OXYPROPYL	TB	SOLUBLE
C12-C15 OXYPROPLY- DIBUTYL METHYL CHLORIDE	DBM	SOLUBLE
C12-C14 OXYPROPYL	DBM	SOLUBLE

* TB = $(C_4H_9)_3$
 DBM = $(C_6H_5)_2(CH_3)$

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WHAT IS CLAIMED IS:

1. A compound of the formula (1)



wherein

5 R^A is chosen from the group consisting of alkyl, alkenyl, aryl, arylalkyl, arylalkenyl, alkylaryl, and alkenylaryl groups and glycols having from 4 to 24 carbon atoms and optionally contains a hetero atom such as oxygen, nitrogen or sulfur;

10 R^B and R^C are independently chosen from the group consisting of straight and branched alkyl groups containing 3 to 6 carbon atoms, optionally substituted with phenyl;

15 R^D is chosen from the group consisting of hydrogen and straight and branched alkyl groups containing 1 to 6 carbon atoms, optionally substituted with phenyl;

A is an anion.

20 2. A method for decreasing the growth rate of hydrates of hydrocarbons containing 1 to 5 carbon atoms, comprising adding thereto an effective amount of a compound according to claim 1.

25 3. A method for inhibiting the plugging of a conduit, the conduit containing a flowing mixture comprising an amount of hydrocarbons having from 1 to 5 carbon atoms and an amount of water wherein the amounts of hydrocarbons and water are sufficient to form hydrates
30 at conduit temperatures and pressures in the absence of a hydrate formation inhibitor, the method comprising adding

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to the mixture a hydrate formation inhibitor which comprises a compound according to claim 1 in an amount effective to inhibit formation of hydrates in the mixture at conduit temperatures and pressures; and flowing the mixture containing the hydrate formation inhibitor through the conduit.

4. The method of claim 3 wherein R^A is a linear or branched alkyl group having from 6 to 20 carbon atoms.

5. The method of claim 3 wherein R^A is a linear or branched alkyl group having from 8 to 18 carbon atoms.

6. The method of claim 3 wherein R^A is a linear or branched alkyl group having from 12 to 15 carbon atoms.

7. The method of claim 3 wherein R^B , R^C , and R^D are each independently chosen from the group consisting of n-butyl, isopentyl and n-pentyl.

8. The method of claim 3 wherein A is selected from the group consisting of hydroxide, carboxylate, halide, sulfate, and organic sulfate.

9. The method of claim 3 wherein A is selected from the group consisting of hydroxide, acetate, chloride, bromide, sulfate, methylsulfate, and ethylsulfate.

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10. The method of claim 3 wherein the amount of the hydrate formation inhibitor is between 0.05 and 5 percent by weight based on the water in the mixture.

5 11. The method of claim 3 wherein the amount of the hydrate formation inhibitor is between 0.1 and 0.5 percent by weight of the water in the mixture.

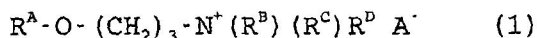
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ABSTRACT OF THE DISCLOSURE

5 A novel amine is provided with improved water dispersibility which is functional as a crystal growth modifier and is useful to modify the formation of hydrates in streams containing low-boiling hydrocarbons and water. The amine has the formula



10 wherein R^A is chosen from the group consisting of alkyl, alkenyl, aryl, arylalkyl, arylalkenyl, alkylaryl, and alkenylaryl groups and glycols having from 4 to 24 carbon atoms and optionally contains a hetero atom such as oxygen, nitrogen or sulfur;

15 R^B and R^C are independently chosen from the group consisting of straight and branched alkyl groups containing 3 to 6 carbon atoms, optionally substituted with phenyl;

20 R^D is chosen from the group consisting of hydrogen and straight and branched alkyl groups containing 1 to 6 carbon atoms, optionally substituted with phenyl;

A is an anion.

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