COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

6680/84 CONVENTION APPLICATION FOR A STANDARD PATENT

We SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V. of
Carel van Bylandtlaan 30, 2596 HR, The Hague, the Netherlands
hereby apply for the grant of a standard patent for an invention
entitled:

"OLEFIN SULPHONATE COMPOSITIONS"
which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION
Number of Basic Application:-
8331733

Name of Convention Country in which Basic
Application was filed:-
United Kingdom

Date of Basic application:-
23 November 1983

Our address for service is:-
C/- Spruson & Ferguson
Patent Attorneys
Level 33 St Martins Tower
31 Market Street
Sydney New South Wales Australia

DATED this SIXTEENTH day of NOVEMBER 1984
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

By:


TO: THE COMMISSIONER OF PATENTS
AUSTRALIA
SBR/ep 0192F
COMMONWEALTH OF AUSTRALIA
Patents Act 1952-55

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION
FOR A PATENT

In support of the Convention Application made by
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.
for a patent for an invention entitled:

"OLEFIN SULPHONATE COMPOSITIONS"

I, Onno Aalbers, of Carel van Bylandtlaan 30, The Hague,
the Netherlands, do solemnly and sincerely declare as follows:

1. I am authorized by SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.,
the applicant for the patent, to make this declaration on its
behalf.

2. The basic application(s) as defined by Section 141 of the Act
was/were made in the United Kingdom
on the 28th day of November, 1983
by SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

3. Sheila Mairi CRAVEN, of Chopinstraat 4, 1921 XK Akersloot,
the Netherlands, and George William FERNEY, of Badhuisweg
5, 1031 CH Amsterdam, the Netherlands, both British subjects,
is/are the actual inventor(s) of the invention and the facts upon
which the Applicant Company is entitled to make application are as
follows: as Assignees of the inventor(s).

4. The basic application(s) referred to in paragraph 2 of this
Declaration was/were the first application(s) made in a Convention
Country in respect of the invention the subject of the application.

Dated this 8th day of November, 1984.

Signature of Declarant

To.: The Commissioner of Patents,
Commonwealth of Australia

JB2H04
This invention relates to olefin sulphonate compositions and to their use in enhanced oil recovery processes, particularly foam drive processes of enhanced oil recovery.

Claim 1. An olefin sulphonate composition comprising an aqueous solution containing 15 to 35% w of a blend of
(a) C_{12-22} linear alpha-olefin sulphonate and
(b) alkyl aryl sulphonate of general formula

\[
\begin{align*}
\text{SO}_3M \\
\left(\text{CH}_3\right)_n
\end{align*}
\]

where n is 0, 1 or 2, R is a C_{8-18} alkyl group and M is an alkali metal or ammonium ion, the weight ratio (a):(b) being in the range 90:10 to 60:40.

10. Use of an olefin sulphonate composition according to any of claims 1 to 9 in an enhanced oil recovery process.
FORM 10

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)
FOR OFFICE USE:

Class Int. Class

Complete Specification Lodged:
Accepted:
Published:

Priority:
Related Art:

Name of Applicant: SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.
Address of Applicant: Carel van Bylandtlaan 30, 2596 HR, The Hague, the Netherlands
Actual Inventor(s): SHEILA MAIRI CRAVEN and GEORGE WILLIAM FERNLEY
Address for Service: Spruson & Ferguson, Patent Attorneys, Level 33 St Martins Tower, 31 Market Street, Sydney, New South Wales, 2000, Australia

Complete Specification for the invention entitled:

"OLEFIN SULPHONIC COMPOSITIONS"

The following statement is a full description of this invention, including the best method of performing it known to me:

SBR/ep 01925
OLEFIN SULPHONE COMPOSITIONS

This invention relates to olefin sulphonate compositions and to their use in enhanced oil recovery processes, particularly foam drive processes of enhanced oil recovery.

Foam drive processes for enhanced oil recovery are described in US Patents 4,086,964, 4,161,217 and 4,393,937. Such processes typically achieve displacement of oil within an oil-containing subterranean reservoir by flowing a steam-containing fluid containing a surfactant component through a relatively steam-permeable zone within the reservoir. In the process of US Patent 4,393,937, the surfactant component comprises an olefin sulphonate. The olefin sulphonate is conveniently used as a 30% aqueous solution in water. Alpha-olefin sulphonates, e.g. C₁₀-₂₄, preferably C₁₄-₂₀, and advantageously C₁₆-₁₈, are disclosed as being particularly suitable. However, although 30% aqueous solutions of sodium C₁₆-₁₈ alpha-olefin sulphonates have low viscosities (typically ca 8.5 mm²/s at 20°C), they are not stable on storage for 48 hours at 20°C. Indeed the minimum storage temperature (MST) is typically 30°C, which necessitates transport and storage at elevated temperatures, generally in insulated containers. US Patent 4,161,217 specifically discloses alkyl benzene sulphonates for such processes. However, in addition to having relatively high MST (typically greater than 30°C), 30% aqueous solutions of alkyl benzene sulphonates are typically highly viscous (e.g. greater than 6000 mm²/s at 20°C).

W. German Offenlegungsschrift 2,523,589 discloses a dishwashing composition which comprises (a) C₈-₂₀ alpha-olefin sulphonates and (b) C₈-₂₄ secondary alkanol sulphonates and/or (C₉-₁₈ alkyl) aryl sulphonates, wherein the weight ratio a:b is in the range 50:50 to 10:90.
Canadian Patent 1,031,686 discloses a water-flood composition for enhanced oil recovery, which comprises an aqueous composition containing a maximum of 5%w of each of (a) an oil-soluble petroleum sulphonate, (b) a C_{8-30}, preferably C_{12-18}, alpha-olefin sulphonate and (c) an oxyalkylated alcohol.

It has now surprisingly been found possible to provide an olefin sulphonate composition having a high concentration of surfactant, which has a minimum storage temperature not greater than 20°C while having a viscosity at 20°C of less than 1000 mm²/s.

Such compositions are of sufficiently low viscosity to be readily transported and handled (e.g. transferred from one container to another), and do not have to be stored at disadvantageous elevated temperatures.

According to the present invention therefore there is provided an olefin sulphonate composition comprising an aqueous solution containing 15 to 35%w of a blend of:

a) C_{12-22} linear alpha-olefin sulphonate and
b) alkyl aryl sulphonate of general formula

\[ \text{(I)} \]

\[ \text{R} \quad \text{(CH}_3\text{)}_n \quad \text{SO}_3\text{M} \]

where \( n \) is 0, 1 or 2, \( R \) is a C_{8-18} alkyl group and \( M \) is an alkali metal or ammonium ion, the weight ratio (a):(b) being in the range 90:10 to 60:40.

Linear alpha-olefin sulphonates are known compounds and various examples thereof are described in US Patent 4,393,937, together with outline processes for their preparation. Preferably the olefin sulphonate is a C_{14-20} linear alpha-olefin sulphonate, more preferably a C_{16-18} linear alpha-olefin sulphonate.

Suitable olein sulphonates are conveniently prepared by sulphonation, hydrolysis and neutralisation of C_{12-22} linear alpha-olefins prepared by the "SHELL" Higher Olefins Process ("SHELL" is a registered trade mark).
Compounds of formula I are alkyl benzene sulphonates (n is 0), alkyl toluene sulphonates (n is 1) and alkyl xylene sulphonates. Such compounds are also known. Preferably n is 0. It is further preferred for R to be a C10-14 alkyl group. Conveniently the compounds of formula I are those prepared by alkylation of benzene, toluene or xylene with linear alpha-olefins prepared by the "SHELL" Higher Olefins Process ("SHELL" is a registered trade mark), followed by sulphonation and neutralisation.

The olefin sulphonate (a) and the alkyl aryl sulphonate (b) are alkali metal or ammonium salts. Alkali metal salts may be e.g. potassium or, preferably, sodium salts. Ammonium salts include those derived from ammonia and from primary, secondary or tertiary amines, for example amines bearing one, two or three C1-5 alkyl or hydroxyalkyl moieties, e.g. triethanolamine. Alternative ammonium salts are quaternary salts such as tetramethyl ammonium salts. Sodium salts are very suitable.

Preferably the aqueous solution contains at least 20 %w, advantageously at least 25 %w, of the blend of (a) and (b). More preferably the aqueous solution contains substantially 30 %w of the blend of (a) and (b).

The invention further provides the use of an olefin sulphonate composition according to the invention in an enhanced oil recovery process, particularly a foam drive process of enhanced oil recovery, such as the techniques disclosed in US Patents 4,089,964, 4,161,217 and 4,393,937.

The invention will be further understood from the following illustrative Examples, in which parts and percentages are by weight (w/w) unless otherwise indicated.

**EXAMPLES 1 to 4**

A C16-18 linear alpha-olefin sulphonate composition containing 30% active matter and sold by member companies of the Royal Dutch/Shell group of companies under the registered trade mark "ENORET AOS/340", is prepared by sulphonation using vapourised sulphur trioxide, followed by hydrolysis and neutralisation to
give the sodium salt, of a mixture of C\textsubscript{16}-18 linear alpha-olefins prepared by the "SHELL" Higher Olefins Process ("SHELL" is a registered trade mark), and characterized by consisting of about 55\% C\textsubscript{16}, about 42\% C\textsubscript{18} and not greater than 3\% of each of C\textsubscript{14} and C\textsubscript{20} olefins, of which about 94\% is linear terminal, about 3\% branched terminal and about 2\% linear internal.

A (C\textsubscript{10}-14 linear alkyl) benzene sulphonate solution containing 30\% active matter was prepared by adding 100 g "DOBANIC ACID JN" (registered trade mark) (containing 97.5\% active matter) to 72 g of 15.7\% aqueous sodium hydroxide solution and diluting the resulting paste with water to give an aqueous solution of 30\% active matter. "DOBANIC ACID JN" is prepared by sulphonation of "DOBANE JN" (registered trade mark) detergent alkylate wherein typically 12\% of the alkyl substituents are C\textsubscript{10}, 28\% are C\textsubscript{11}, 27\% are C\textsubscript{12}, 25\% are C\textsubscript{13} and 8\% are C\textsubscript{14}.

The resulting olefin sulphonate composition and alkyl benzene sulphonate solution were heated at 30\(^\circ\)C to 60\(^\circ\)C until homogeneous, and blends were prepared. In each case, of course, the active matter content was 30\%.

The viscosities of the various compositions were measured using a Ubbelohde viscometer at 20\(^\circ\)C according to ASTM D445.

Minimum storage temperature determination was as follows. The compositions were stored for at least 48 hours in a cooler. The temperature of the cooler was lowered by 1\(^\circ\)C every 48 hours, and the temperature immediately prior to that at which precipitation was observed was noted as the minimum storage temperature (MST).

Constitution of the various compositions and results of viscosity and MST determinations are given in Table I following.
TABLE I

<table>
<thead>
<tr>
<th>Example</th>
<th>Weight ratio olefin sulphonate: alkyl benzene sulphonate</th>
<th>Viscosity (mm²/s)</th>
<th>MST (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative</td>
<td>100:0</td>
<td>8.5</td>
<td>30</td>
</tr>
<tr>
<td>1</td>
<td>90:10</td>
<td>11.5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>80:20</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>70:30</td>
<td>77</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>60:40</td>
<td>256</td>
<td>8</td>
</tr>
<tr>
<td>Comparative</td>
<td>0:100</td>
<td>6840</td>
<td>34</td>
</tr>
</tbody>
</table>

It can readily be seen that the presence of the alkyl benzene sulphonate confers surprising benefit in terms of reduced MST, whilst viscosity remains conveniently low.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An olefin sulphonate composition comprising an aqueous solution containing 15 to 35 wt% of a blend of
   (a) C_{18-20} linear alpha-olefin sulphonate and
   (b) alkyl aryl sulphonate of general formula
   \[
   \text{R}-\text{CH}-\text{S}^+\text{OM}^-
   \]
   where \( n \) is 0, 1 or 2, \( R \) is a C_{18-19} alkyl group and \( M \) is an alkali metal or ammonium ion, the weight ratio (a):(b) being in the range 90:10 to 60:40.

2. A composition according to claim 1 wherein the olefin sulphonate is a C_{18-20} linear alpha-olefin sulphonate.

3. A composition according to claim 1 or 2 wherein the olefin sulphonate is a C_{18-19} linear alpha-olefin sulphonate.

4. A composition according to claim 1, 2 or 3 wherein in formula (I) \( n \) is 0.

5. A composition according to any of claims 1 to 4 wherein \( R \) is a C_{18-19} alkyl group.

6. A composition according to any of claims 1 to 5 wherein the olefin sulphonate and the alkyl aryl sulphonate are sodium salts.

7. A composition according to any of claims 1 to 6 wherein the aqueous solution contains at least 25 wt% of the blend of (a) and (b).

8. A composition according to any of claims 1 to 7 wherein the aqueous solution contains substantially 30 wt% of the blend of (a) and (b).

9. A composition according to claim 1 substantially as herebefore described with reference to any of Examples 1 to 4.

10. Use of an olefin sulphonate composition according to any of claims 1 to 9 in an enhanced oil recovery process.
DATED this NINETEENTH day of NOVEMBER 1984

SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Patent Attorneys for the Applicant
SPRUSON & FERGUSON
END