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BP Case No. INS 7800

AUSTRALIA
PATENTS ACTS 1990
PATENT REQUEST/NOTICE OF ENTITLEMENT

WE, OCEANFLOOR LIMITED

of Charleston Industrial Estate, Hythe, Southampton, SO4 6ZG, ENGLAND

being the Applicant and Nominated Person, request the grant of a patent for an invention entitled "END-CAPPED POLYALKYLENE GLYCOLS" which is described in the accompanying standard complete specification.

Convention priority is claimed from the following basic application:-

BASIC APPLICANT	APPLICATION NUMBER	APPLICATION DATE	COUNTRY	COUNTRY CODE
BP Chemicals Limited	9127370.6	24th December, 1991	U.K.	GB

Robert Brian CRACKNELL and John Robert MOXEY are the actual inventors of the invention.

Robert Brian CRACKNELL and John Robert MOXEY made their contributions to the invention for and on behalf of BP Chemicals Limited in the course of their duties as employees of BP Chemicals Limited.

Oceanfloor Limited is entitled to the grant of a patent for the invention by virtue of an Agreement dated 30th September, 1992.

The basic application was the first application made in a Convention country in respect of the invention the subject of this request.

Our Address for service is:-

GRIFFITH HACK & CO.
Level 8, Northside Gardens
168 Walker Street
North Sydney, NSW 2060
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Attorney Code: GH

Dated this 15th day of December, 1992

for OCEANFLOOR LIMITED

Keith Warwick DENBIGH - by Power of Attorney

AUSTRALIAN PATENT OFFICE RB

P/00/001
Section 29

AUSTRALIA
Patents Act 1990

PATENT REQUEST : STANDARD PATENT

The person identified below as the Applicant requests the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Applicant:	OCEANFLOOR LIMITED
Address:	Charleston Industrial Estate, Hythe, Southampton SO4 6ZG, ENGLAND
Nominated Person:	OCEANFLOOR LIMITED
Address:	Charleston Industrial Estate, Hythe, Southampton SO4 6ZG, ENGLAND
Invention Title:	END-CAPPED POLYALKYLENE GLYCOLS
Names of Actual Inventors:	Robert Brian Cracknell and John Robert Moxey
Address for Service:	GRIFFITH HACK & CO 168 WALKER STREET NORTH SYDNEY NSW 2060
Attorney Code:	GH

BASIC CONVENTION APPLICATION DETAILS

Application No	Country	Country Code	Date of Application
9127370.6	Great Britain	GB	24 December 1991

DATED this 4th day of January 1993

OCEANFLOOR LIMITED
By their Patent Attorney



GRIFFITH HACK & CO

BP Case No. INS 7800

AUSTRALIA
PATENTS ACTS 1990
PATENT REQUEST/NOTICE OF ENTITLEMENT

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Applicant: OCEANFLOOR LIMITED

Address: Charleston Industrial Estate, Hysthe, Southampton SO4 6ZG, ENGLAND

Nominated Person: OCEANFLOOR LIMITED

Address: Charleston Industrial Estate, Hysthe, Southampton SO4 6ZG, ENGLAND

Invention Title: END-CAPPED POLYALKYLENE GLYCOLS

Names of Actual Inventors: Robert Brian Cracknell and John Robert Moxey

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AUSTRALIAN PATENT OFFICE PRO 22 DEC 92

ADDRESS FOR SERVICE ALTERED

BASIC CONVENTION APPLICATION DETAILS

Application No	Country	Country Code	Date of Application
9127370.6	Great Britain	GB	24 December 1991

DATED this 22nd day of December 1992

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OCEANFLOOR LIMITED
By their Patent Attorney

GRIFFITH HACK & CO

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(54) Title
END-CAPPED POLYALKYLENE GLYCOLS

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(31) Number (32) Date (33) Country
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(56) Prior Art Documents
EP 355977
DE 3201478

(57)

The present invention relates to new polyether automotive or industrial lubricating oils.

Multigrade lubricating oils for use in automotive engines comprise several components, in particular viscosity index improvers, which function to enhance the viscometric properties of the lubricating oil. However, the use of viscosity index improvers is not without its disadvantages, for their degradation products during service can increase the deposits on the inlet valves and other parts of the engine and thereby impair its efficiency.

Claim

1. A lubricating oil composition comprising a base fluid component in the form of a poly-alpha-olefin, a synthetic ester, a hydrocracked mineral oil or a mineral oil, and at least one polyether having the formula

$$RX[(C_xH_{2x}O)_n(C_yH_{2y}O)_pZ]_m \qquad (I)$$

wherein:

R is either an alkyl or an alkyl phenyl group having from 7 to 30 carbon atoms,

X is selected from oxygen, sulfur or nitrogen;

x, is an integer from 2 to 4;

y is an integer from 6 to 30;

.../2

Z is a hydrocarbyl group containing from 1 to 30 carbon atoms;

m is 1 when X is oxygen or sulfur, or m is 2 when X is nitrogen;

n and p are such that the polyether contains between 1 and 40% by weight of $(C_yH_{2y}O)$ units and between 40 and 80% by weight of $(C_xH_{2x}O)$ units; and

the molecular weight of the polyether is between 500 and 3,500.

P/00/011
Regulation 3.2

AUSTRALIA
Patents Act 1990

668530

ORIGINAL

COMPLETE SPECIFICATION

STANDARD PATENT

Invention Title: END-CAPPED POLYALKYLENE GLYCOLS

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

GH&CO REF: P22566-A:PJW:RK

END-CAPPED POLYALKYLENE GLYCOLS

The present invention relates to new polyether automotive or industrial lubricating oils.

Multigrade lubricating oils for use in automotive engines comprise several components, in particular viscosity index improvers, which function to enhance the viscometric properties of the lubricating oil. However, the use of viscosity index improvers is not without its disadvantages, for their degradation products during service can increase the deposits on the inlet valves and other parts of the engine and thereby impair its efficiency.

The use of polyethers as components of lubricating oils is known. Thus, Japanese Kokai 50/133205 discloses a lubricating oil composition in which polyoxyalkylene glycol ethers of general formula (1) and/or (2):-

$$R_1\text{-}O\text{-}(AO)_n\text{-}R_2 \qquad (1)$$

$$R_1\text{-}O\text{-}[(AO)_m\text{-}CH_2]_2\text{—}(AO)_m\text{-}R_1 \qquad (2)$$

(where R_1 and R_2 are hydrogen or 1-24C straight chain or branched hydrocarbon groups, m is 1-100, n is an integer in the range 1-50, AO is an oxyalkylene group, A is a C_pH_{2p} alkylene group, p being an integer in the range 2-26, and the ratio number of carbon atoms/number of oxygen atoms in the molecule is made 3.5-9.5 through copolymerisation with one or more 8-26C alpha-olefin oxides as (AO)) are mixed with mineral oil of lubricating oil viscosity. Polyethers according to the invention of the prior art document are said to have better solubility in mineral oil than conventional polyethylene glycol, polypropylene glycol and polyethylene/polypropylene glycol

and to have superior viscosity index improvement and pour point depression characteristics as compared with conventional viscosity index improvers, such as polymethacrylate and polybutene, for example. The following observations can be made regarding the disclosure of this patent publication:-

(i) No distinction is made between the properties of a polyether wherein R_1 and R_2 are hydrogen and a polyether in which R_1 and R_2 are hydrocarbyl groups. In this connection the Examples illustrate the preparation of both uncoupled and coupled hydrogen-terminated polyethers.

(ii) The ability to improve the viscosity index and lower the pour point is said to be greater as the values of m and n are greater, i.e. as the molecular weight is greater, and as the viscosity increases. It is perhaps relevant that the polyethers used in the determinations upon which this observation is based contain 50% or greater of the 8-26C alpha-olefin oxide.

(iii) No specific mention is made of the possiblity of R_1 being an aryl hydrocarbyl group.

EP 246612 describes a lubricating oil composition based upon a mixture of mineral oil and a polyether. Whilst the description indicates that the polyether is freely soluble in the mineral oil, only compositions in which 5 to 60% by weight of the polyether is present are taught as being advantageous. The polyether is one having the general formula $R[(C_nH_{2n}0)_x(C_mH_{2m}0)_yH]_z$ where R is a moiety derived from an organic starter, n is 2 to 4, m is 6 to 40, x and y are integers, z is 1 to 8 and the content of $(C_mH_{2m}0)$ groups in the polyether is 15 to 60% by weight.

The polyethers of this invention are hydrogen-terminated materials.

EP 0355977 discloses an industrial or automobile lubricating oil, for use, e.g. as automotive or industrial gear lubricants, two-stroke engine lubricants, which comprise (a) 0 to 40% by weight of mineral oil(s) and (b) 100 to 60% by weight of a polyether having the general formula $RX[(C_xH_{2x}0)_n(C_yH_{2y}0)_pH]_m$ wherein R is C_9 to C_{30} alkyl or alkylphenyl, X is 0, S or N, x is 2 to 4, y is 6 to 30, m

is 1 or 2 and n and p are such that the polyether contains between 1 and 35% by weight of $(C_yH_{2y}O)$ units and between 35 and 80% by weight of $(C_xH_{2x}O)$ units. Again no reference is made to hydrocarbyl group-terminated polyethers.

None of the aforesaid prior art discloses the use of such polyethers, or compositions comprising such polyethers, as inlet-valve deposit inhibitors. However, the use of polyethers for this purpose is described in our copending unpublished UK application No.9115911.1 which discloses the use of a lubricating oil as an inlet valve deposit inhibitor characterised in that the lubricating oil composition comprises a polyether of the formula:-

$$RX[(C_xH_{2x}O)_n(C_yH_{2y}O)_pH]_m$$

wherein R is either an alkyl or alkyl phenyl group having from 7 to 30 carbon atoms,

X is selected from O, S or N, or RX together represent H,

x is an integer from 2 to 4,

y is an integer from 6 to 30,

m is 1 when X is O or S or when RX together represent H, or m is 2 when X is N, and

n and p are such that the polyether contains between 0 and 40% by weight of $(C_yH_{2y}O)$ units and between 35 and 80% by weight of $(C_xH_{2x}O)$ units. There is no reference in this disclosure, however, to the use of hydrocarbyl group-terminated polyethers for the purpose of inlet-valve deposit inhibition.

The problem with the prior art to be solved is to improve lubricating oil compositions containing polyethers, particularly with regard to at least one of the properties:- compatibility, viscosity index improvement and inlet-valve deposit inhibition. The present invention solves the problem posed by the prior art by using as an essential component of lubricating oil compositions hydrocarbyl group-terminated polyethers of strictly defined composition and molecular weight.

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Accordingly, the present invention provides a lubricating oil composition comprising a base fluid component in the form of a poly-alpha-olefin, a synthetic ester, a hydrocracked mineral oil or a mineral oil, and at least one polyether having the formula

$$RX[(C_xH_{2x}O)_n(C_yH_{2y}O)_pZ]_m \qquad (I)$$

wherein:

R is either an alkyl or an alkyl phenyl group having from 7 to 30 carbon atoms,

X is selected from oxygen, sulfur or nitrogen;

x is an integer from 2 to 4;

y is an integer from 6 to 30;

Z is a hydrocarbyl group containing from 1 to 30 carbon atoms;

m is 1 when X is oxygen or sulfur, or m is 2 when X is nitrogen;

n and p are such that the polyether contains between 1 and 40% by weight of $(C_yH_{2y}O)$ units and between 40 and 80% by weight of $(C_xH_{2x}O)$ units; and

the molecular weight of the polyether is between 500 and 3,500.

The polyether having the formula (I) may suitably comprise from 0.1 to 99%, preferably from 1 to 70%, more preferably from 5 to 50%, most preferably from 5 to 25% by weight of the composition.

As regards the moiety R in the formula (I), this is suitably either an alkyl or an alkyl phenyl group having from 7 to 30 carbon atoms. When R is an alkyl group it is preferably a C_{10} to C_{24} alkyl group, such as may be obtained from the corresponding fatty acid alcohol, thiol or amine. Of the alkyl groups, most preferred are alkyl groups having from 12 to 18 carbon atoms. In the case where R is alkyl phenyl, R preferably has from 9 to 30 carbon atoms with phenyl groups substituted with one or more C_6 to C_{12} alkyl groups being most preferred. Particularly preferred are phenyl groups substituted with two C_2 to C_{12} alkyl groups.

X in the formula (I) can be O, S or N. Preferably X is O and RX is derived from a phenol, for example dinonyl phenol. On the other hand RX can be derived from a thiol or an amine.

In addition to the moiety R and the group X the polyether is comprised of an oxyalkylene backbone of formula $[(C_xH_{2x}O)_n(C_yH_{2y}O)_pZ]$. Such backbones can be created by alkoxylating a starter molecule of formula $RX(H)_m$ with two or more alkylene oxides consecutively so that the backbone formed comprises blocks of units of a given type, ie. a block copolymer. It is optional whether the alkylene oxide of formula $C_xH_{2x}O$ or the

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alkylene oxide of formula $C_yH_{2y}O$ is reacted initially with the starter molecule. Alternatively, and very much preferred for the purpose of the present invention, the alkoxylation can be carried out using a mixture of alkylene oxides, i.e. reacting two or more alkylene oxides simultaneously, in which case the backbone formed will comprise a random distribution of the units. For each of the two types of alkylene oxide, $C_xH_{2x}O$ and $C_yH_{2y}O$, one or more different alkylene oxides can be used. The only constraint is that in the final polyether, the total number of units having the formula $C_xH_{2x}O$ should comprise between 40 and 80, preferably between 40 and 70, more preferably between 45 and 65% by weight and the total number of units having the formula $C_yH_{2y}O$ should comprise between 1 and 40, preferably 8 to 40, more preferably 10 to 30% by weight.

It is preferred that the units of formula ($C_xH_{2x}O$) are mainly, i.e. greater than 50 mole%, comprised of oxypropylene (C_3H_6O) units. Most preferred are those polyethers where the $C_xH_{2x}O$ groups are exclusively oxypropylene. As regards the ($C_yH_{2y}O$) units these are preferably such that y is in the range from 10 to 20, preferably 12 or 16. A preferred ($C_yH_{2y}O$) unit is derived from hexadecene-1-oxide, i.e. y = 16.

Z in the formula (I) is a hydrocarbyl group containing from 1 to 30 carbon atoms. Suitably the hydrocarbyl group is either an alkyl or an aryl group, preferably containing from 1 to 12 carbon atoms. More preferred are alkyl groups containing from 1 to 3 carbon atoms, with methyl or ethyl groups being most preferred.

- The polyethers preferably have a molecular weight in the range 500 to 3,500, preferably 700 to 3000, more preferably in the range from 800 to 2500 most preferably 1200 to 2400. For the avoidance of doubt, the term 'molecular weight' as used in this specification means the weight average molecular weight as measured by Gel Permeation Chromatography using polystyrene standards.

A preferred polyether is a random oxyalkylene backbone chain polyether of the formula (I) wherein:-

R = a C_{12}-C_{18} alkyl group or a phenyl group substituted with at least one C_6 to C_{12} alkyl group;

X = O;

x = 3;

y = 12 to 18, preferably 12 or 16

Z = a C_1 to C_3 alkyl group, preferably methyl or ethyl;

m = 1

n and p are such that the polyether contains between 10 and 30% by weight of ($C_yH_{2y}O$) units and between 40 and 70% by weight of ($C_xH_{2x}O$) units; and the molecular weight of the polyether is in the range from 700 to 3000, preferably from 800 to 2500, most preferably from 1,200 to 2,400.

The use of polyethers having the formula (I) in lubricating oil compositions rather than hydrogen-terminated (ie. non-capped polyethers) has the advantages that the compatibility of the polyether with either base fluid components, for example mineral oil or synthetic ester fluids, additives and viscosity index improvers

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is superior and also the viscosity index improver properties are increased. Furthermore, lubricating oil compositions according to the invention have good inlet valve cleanliness properties.

Polyethers having the formula (I) can be prepared by reacting in a first step a starter molecule $RX(H)_m$ with a mixture of $(C_xH_{2x}O)$ and $(C_yH_{2y}O)$ in appropriate proportions at elevated temperature, suitably in the presence of a basic catalyst, for example an alkali metal hydroxide, for a time sufficient to substantially completely polymerise the mixture and then optionally removing the catalyst; in a second step forming an alkali metal salt of the polymer formed in the first step, suitably by reaction in an inert solvent, for example toluene, with an alkali metal alkoxide, for example sodium methoxide, dissolved in a suitable inert solvent, which in the case of an alkali metal alkoxide as the reactant is preferably the alcohol eliminated in the reaction, for example methanol in the case of sodium methoxide as the reactant, and removing low-boiling solvent(s) from the mixture; and in a third step reacting at elevated temperature the product of the second step with a C_1 to C_{30} hydrocarbyl monohalide for example chloromethane, or other reagent comprising a C_1 to C_{30} hydrocarbyl radical and a good leaving group, e.g. tosylate, and removing the alkali metal salt so-formed. Alternatively, the polyether of formula I can be prepared from a block copolymer which is prepared in the first step. The second and third steps would be carried out as described above.

Thus, according to a further aspect of the invention, there is provided a method of preparing a polyether as defined above comprising:

(a) in a first step reacting a starter molecular $RX(H)_m$ with $C_xH_{2x}O$ and $C_yH_{2y}O$ either simultaneously or consecutively to give a polymer of formula II

$$RX[(C_xH_{2x}O)_m\ (C_yH_{2y}O)_pH]_m \qquad \text{II},$$

(b) in a second step forming an alkali metal salt of the polymer of formula II formed in (a), and

(c) in a third step reacting the product formed in the second step with a reagent comprising a hydrocarbyl radical and a good

leaving group,

wherein R, X, x, y, m, n, p have the meanings as set out above.

In addition to the polyether or polyethers of formula (I) the lubricating oil composition may also contain a viscosity index improver (VII). Suitable VIIs include olefin copolymers (OCPs), for example ethylene/propylene copolymers, polymethacrylates (PMAS), dispersant OCPs, i.e. OCPs modified to contain nitrogen compounds, OCP-PMA graft copolymers, styrene/butadiene copolymers and styrene/isoprene copolymers. All the aforesaid types of VIIs are commercially available.

The lubricating oil composition may also contain other additives commonly employed in such compositions. Such additives include, for example, dispersants, detergents, antioxidants, metal passivators, corrosion inhibitors, pour point depressants, high pressure agents and/or anti-wear agents. It is common for a combination of two or more of the aforesaid additives to be contained in an additive package specifically formulated for lubricating oil composition depending upon its particular application.

Where the lubricating oil composition is for use in a gasoline fuel engine it is preferred that any detergent is present in the composition in the range 2-4%, any dispersant in the range 4-7%, any antioxidant in the range 0 to 0.5% and the EP/AW additive in the range 0.5 to 2% by weight.

Alternatively, if the composition is for use in a diesel fuel engine, it is preferred that any detergent is present in the composition in the range 2-6%, any dispersant in the range 1-7%, any antioxidant in the range 0 to 0.5% and any EP/AW additive in the range 0.5 to 2% by weight.

The composition contains in addition to the polyether having the formula (I), at least one further base fluid component in the form of, for example, either a poly-alpha-olefin (PAO), a synthetic ester, a hydrocracked mineral oil or a mineral oil. Suitably the PAO may be, for example, an oligomer of decene-1. Suitable esters include polyol esters and dibasic acid esters. A

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suitable hydrocracked mineral oil is Lavera Hydrocracker residue (LHC) obtainable from BP Oil. Alternatively Shell's XHVI may be employed.

The components of the lubricating oil composition are suitably mixed in proportions such that they are compatible. Such proportions will be well-known to those skilled in the art without experimentation, though it is a simple matter to determine stable compositions by experiment, if desired. An advantage of using an end-capped polyether of the formula (I) as compared with an H-terminated polyether is that the compatibility is improved, so that greater amounts may be employed if desired.

Preferred lubricating oil compositions comprise:-

(A)(i) a base fluid comprising from 40 to 70%, preferably 45 to 65%, of a hydrocracked mineral oil; from 20 to 45%, preferably 20 to 40% of an ester, preferably a polyol ester and from 5 to 25%, preferably from 10 to 20% of a polyether having the formula (I), the amounts of the components being selected within the aforesaid ranges such as to total 100%;

(ii) from 3 to 8% of a VII, preferably a PMA or styrene/butadiene VII; and

(iii) from 10 to 14%, preferably about 12%, of an additive package.

(B)(i) a base fluid comprising from 50 to 80%, preferably from 60 to 70%, of a poly alpha-olefin (PAO); from 0 to 15% of an ester, preferably a polyol ester and from 10 to 50%, preferably from 10 to 30%, of a polyether having the formula (I); the amounts of the base components being selected within the aforesaid ranges such as to total 100%;

(ii) from 4 to 12%, preferably from 5 to 10%, of a VII, which is preferably either a PMA or a styrene/butadiene copolymer; and

(iii) from 10 to 14%, preferably about 12%, of an additive package

(C)(i) a base fluid comprising from 50 to 90%, preferably from 60 to 80%, of a hydrocracked mineral oil; and from 10 to 50% of a polyether having the formula (I); the amounts of the base components being selected within the aforesaid ranges such as to total 100%;

(ii) from 4 to 12%, preferably from 6 to 10%, of a VII, which is preferably either a PMA or a styrene/butadiene VII; and

(iii) from 10 to 14%, preferably about 12%, of an additive package.

Suitably, composition A is targeted to meet the viscosity grades SAE OW/5W - 30/40/50, preferably 5W-30. Suitably composition B is targeted to meet the viscosity grades SAEOW/5W/10W-30/40/50, preferably 5W-40. Suitably composition C is targeted to meet the viscosity grades SAE5W/10W-30/40/50, preferably 5W-40.

The lubricating oil compositions according to the invention may be used as industrial or automotive lubricants.

In another aspect the present invention provides the use of a lubricating oil composition as hereinbefore defined as an automotive engine inlet-valve deposit inhibitor.

The invention will now be further illustrated by reference to the following Examples. The extent of methyl-capping is determined by measuring the hydroxyl content before and after the methyl-capping reaction.

(A) Preparation

Comparative Example 1

Preparation of H-terminated polyalkylene glycol

Dinonylphenol (250g) was heated in the presence of potassium hydroxide (2.5g) as catalyst whilst vacuum stripping the water of reaction, then reacted simultaneously at 115°C and 50psi with propylene oxide (500g) and hexadec-1-ene oxide (250g) to a theoretical molecular weight of 1380. The catalyst was removed by treatment with Magnesol (magnesium silicate), vacuum stripping and filtration to yield 1000g of an oil-soluble polyalkylene glycol having the composition shown below:-

Composition (%wt)

Dinonyl phenol	25.0
Propylene oxide	50.0
Hexadec-1-ene oxide	25.0

Example 2 (according to the invention)

Preparation of methyl-terminated polyalkylene glycol

Polyalkylene glycol prepared according to Comparative Example 1

(1500g) was dissolved in toluene (1500g) and reacted with sodium methoxide (87g) in methanol solution and the methanol of reaction/solution removed by azeotropic distillation. The resulting material was then reacted with chloromethane (97g) at 90°C and, after cooling, residual excess alkalinity was neutralised with hydrochloric acid. The liberated sodium chloride was agglomerated by addition of water and magnesium sulphate.

After filtration and vacuum stripping there remained an oil-soluble methyl-terminated polyalkylene glycol.

Comparative Example 3

Preparation of H-terminated polyalkylene glycol

A C_{12}-C_{14} linear secondary alcohol (220g) was heated in the presence of potassium hydroxide (2.5g) as catalyst whilst vacuum stripping the water of reaction, then reacted simultaneously at 115°C and 50psi with propylene oxide (651g) and hexadec-1-ene oxide (129g) to a theoretical molecular weight of 870. The catalyst was removed by treatment with Magnesol (magnesium silicate), vacuum stripping and filtration to yield 1000g of an oil-soluble polyalkylene glycol having the composition:-

Composition (%wt)

Secondary C_{12}-C_{14} alcohol	22.0
Propylene oxide	65.1
Hexadec-1-ene oxide	12.9

Example 4 (according to the invention)

Preparation of methyl-terminated polyalkylene glycol

The product of Example 3 (700g) was dissolved in toluene (700g) and reacted with sodium methoxide (43g) in methanol solution and the methanol of reaction/solution removed by azeotropic distillation. The resulting material was then reacted with chloromethane (40g) at 90°C and, after cooling, residual excess alkalinity was neutralised with hydrochloric acid. The liberated sodium chloride was agglomerated by addition of water and magnesium sulphate. After filtration and vacuum stripping there remained an oil-soluble methyl-terminated polyalkylene glycol.

Examples 5 and 6 were carried out according to the method set

out in Examples 1 and 2 except that the mole ratio of propylene oxide to hexa-dec-1-ene oxide was 31.0:1.3, and the reactants reacted to a theoretical molecular weight of 2,400.

(B) Properties

Example 7

The viscometric properties of the polyalkylene glycols of Examples 1 to 6 were determined. The results are given in Table 1.

Example 8

The compatibility in a multigrade lubricating oil, expressed as the percentage of polyalkylene glycol in base fluid that gives a compatible formulation, was determined for the polyalkylene glycols of Examples 1 to 6 using a formulation consisting of base fluid (hydrocracked mineral oil + polyalkylene glycol), additive pack (10%) and VII (10%). The results are given in Table 2.

The results indicate that either VI or compatibility or both are improved when a methyl-terminated polyalkylene glycol is used in place of the hydrogen-terminated material.

Table 1

Example	Visc at 100°C (cSt)	Visc at 40°C (cSt)	Visc at <0°C (cP)	Visc Index	Molar % Me-capped
1	17.9	157	4800(-5)	126	
2	15.3	107.7	3600(-10)	149	96%
3	9.02	48.8	2700(-20)	167	
4	8.51	37.75	2240(-25)	212	91%
5	25.8	191	4800(-5)	172	
6	24.8	159	3300(-5)	190	91%

Table 2

Example	Compatibility (%)
1	30
2	50
3	10
4	35
5	15
6	15

CLAIMS

1. A lubricating oil composition comprising a base fluid component in the form of a poly-alpha-olefin, a synthetic ester, a hydrocracked mineral oil or a mineral oil, and at least one polyether having the formula

$$RX[(C_xH_{2x}O)_n(C_yH_{2y}O)_pZ]_m \qquad (I)$$

wherein:

R is either an alkyl or an alkyl phenyl group having from 7 to 30 carbon atoms,

X is selected from oxygen, sulfur or nitrogen;

x is an integer from 2 to 4;

y is an integer from 6 to 30;

Z is a hydrocarbyl group containing from 1 to 30 carbon atoms;

m is 1 when X is oxygen or sulfur, or m is 2 when X is nitrogen;

n and p are such that the polyether contains between 1 and 40% by weight of $(C_yH_{2y}O)$ units and between 40 and 80% by weight of $(C_xH_{2x}O)$ units; and

the molecular weight of the polyether is between 500 and 3,500.

2. A lubricating oil composition as claimed in claim 1 wherein, in the polyether of formula (I), R is a phenyl group substituted with two C_2 to C_{12} alkyl groups.

3. A lubricating oil composition as claimed in claim 1 or claim 2 wherein, in the polyether of formula (I), X is oxygen.

4. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), RX is derived from dinonyl phenol.

5. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), the total number of units having the formula $C_yH_{2y}O$ comprise between 10 and 30% by weight.

6. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), greater than 50 mole % of the $C_xH_{2x}O$ units are oxypropylene units.

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7. A lubricating oil composition as claimed in claim 6 wherein, in the polyether of formula (I), the $C_xH_{2x}O$ units are oxypropylene units.

8. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), y is an integer from 12 to 16.

9. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), Z is methyl or ethyl.

10. A lubricating oil composition as claimed in any one of the preceding claims wherein, in the polyether of formula (I), the backbone chain comprises a random distribution of the $(C_xH_{2x}O)$ and $(C_yH_{2y}O)$ units.

11. A lubricating oil composition comprisinga polyether and a base fluid component in the form of a poly-alpha-olefin, a synthetic ester, a hydrocracked mineral oil or a mineral oil wherein the polyether is substantially as herein described with reference to Example 2, Example 4 or Example 6.

12. The use of a lubricating oil composition as claimed in any one of the preceding claims as an automotive engine inlet-valve deposit inhibitor.

DATED this 21st day of February 1996
OCEANFLOOR LIMITED
By its Patent Attorney
GRIFFITH HACK & CO.

AUSTRALIAN PATENT OFFICE RB

ABSTRACT

END-CAPPED POLYALKYLENE GLYCOLS

A polyether having the formula

$$RX[(C_xH_{2x}O)_n(C_yH_{2y}O)_pZ]_m \qquad (I)$$

wherein:

R is either an alkyl or alkyl phenyl group having from 7 to 30 carbon atoms,

X is selected from O, S or N;

x is an integer from 2 to 4;

y is an integer from 6 to 30;

Z is a hydrocarbyl group containing from 1 to 30 carbon atoms;

m is 1 when X is O or S or m is 2 when X is N;

n and p are such that the polyether contains between 1 and 40% by weight of $(C_yH_{2y}O)$ units and between 40 and 80% by weight of $(C_xH_{2x}O)$ units; and

the molecular weight of the polyether is between 500 and 3,500.

Lubricating oil compositions comprising such polyethers are disclosed.

A method of preparing the polyethers is disclosed and comprises preparing a H-capped polyether, preparing an alkali-metal salt thereof and reacting said salt with an alkylating agent.