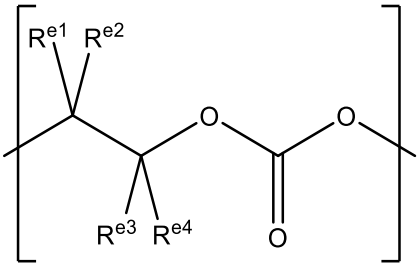
CLAIMS

1. A surface-active agent comprising a polycarbonate block polyether of the formula I

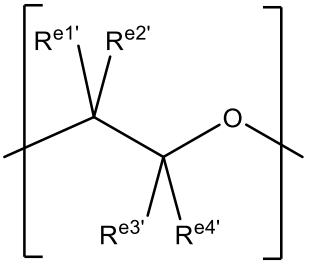
Z^1-$(PC)_P$-$(PE)_Q$-Z^2 ….(I)

wherein PC represents a carbonate block with P repeat units of formula



wherein R^{e1}, R^{e2}, R^{e3}, and R^{e4} are independently selected from H, methyl, ethyl, propyl, butyl, or an ether, ester or carbonate group, with the proviso that when one of R^{e1}, R^{e2}, R^{e3}, and R^{e4} is methyl, ethyl, propyl, butyl, or an ether, ester or carbonate group, the remaining R^{e1}, R^{e2}, R^{e3}, and R^{e4} are H;

PE represents a polyether block with Q repeat units of formula



wherein $R^{e1'}$, $R^{e2'}$, $R^{e3'}$, and $R^{e4'}$ are independently selected from H, methyl, ethyl, propyl, butyl, or an ether, ester or carbonate groups, with the proviso that when one of $R^{e1'}$, $R^{e2'}$, $R^{e3'}$, and $R^{e4'}$ is methyl, ethyl, propyl, butyl, or an ether, ester or carbonate group, the remaining $R^{e1'}$, $R^{e2'}$, $R^{e3'}$, and $R^{e4'}$ are H;

Z^1 is R, R-O, R-C(O)-O- or R-O-C(O)-O;

R is an optionally substituted straight or branched chain C_1-C_{11} alkyl group;

Z^2 is H, R, R-(O)C or R-O-(O)C; and

wherein the value of P does not exceed the value of Q.

2. A surface-active agent according to claim 1, wherein R is a C_2-C_{11} alkyl group.

3. A surface-active agent according to any preceding claim, wherein R is a linear alkyl group.

4. A surface-active agent according to any of claim 1 to 3, wherein R is a C_2-C_6 alkyl group, or wherein R is a C_2-C_5 alkyl group or a C_2-C_4 alkyl group.

5. A surface-active agent according to any of claims 2 to 4, wherein R^{e1}, R^{e2}, R^{e3}, R^{e4} $R^{e1'}$, $R^{e2'}$, $R^{e3'}$, and $R^{e4'}$ are independently selected from H, methyl, or ethyl, or wherein R^{e1}, R^{e2}, R^{e3}, R^{e4} $R^{e1'}$, $R^{e2'}$, $R^{e3'}$, and $R^{e4'}$ are each H.

6. A surface-active agent according to any preceding claim wherein Z^1 is R-C(O)-O or R-O-C(O)-O, or wherein Z^1 is a short chain carbonate or ester group R-O.

7. A surface-active agent according to claim 6, wherein R is C_2-C_5 or C_2-C_4.

8. A surface-active agent according to any preceding claim wherein Z^2 is H or methyl, or wherein Z^2 is H.

9. A surface-active agent according to any preceding claim wherein the total surface-active agent has greater than 10wt% CO_2 incorporation, or wherein the total surface-active agent has greater than 15, 20 or 21wt% CO_2 incorporation.

10. A surface-active agent according to any preceding claim wherein the total surface-active agent has 10 to 40wt% CO_2 incorporation, or wherein the total surface-active agent has 15 to 40wt% CO_2 incorporation.

11. A surface-active agent according to any preceding claim, wherein the total surface-active agent has 20 to 40wt% CO_2 incorporation.

12. A surface-active agent according to any preceding claim wherein the Q:P ratio is at or between 1:1 and 5:1, at or between 1:1 and 2:1.

13. A surface-active agent according to any preceding claim wherein P is at or between 3 and 100, or wherein P is at or between 3 and 50, 3 and 20 or 3 and 15.

14. A surface-active agent according to any preceding claim wherein Q is at or between 3 and 200, or wherein Q is at or between 3 and 100, 3 and 50, 5 and 20 or 5 and 15.

15. A surface-active agent according to any preceding claim wherein the polyether block has less than 40% carbonate linkages, or wherein the polyether block has less than 30%, less than 20%, less than 10%, less than 5%, less than 2% or less than 1% carbonate linkages.

16. A surface-active agent according to any preceding claim wherein the polyether block has 0% carbonate linkages.

17. A surface-active agent according to any preceding claim which is water-soluble.

18. A surface-active agent according to claim 17 having water solubility of at least 0.25g/ml at STP.

19. A surface-active agent according to any preceding claim wherein the P:Q ratio is such that the carbonate blocks contribute at least 50%w/w of the surface-active agent, or wherein the P:Q ratio is such that the carbonate blocks contribute at least 60%w/w of the surface-active agent.

20. A surface-active agent according to any preceding claim wherein the P:Q ratio is such that the carbonate blocks contribute from 50%w/w to 70%w/w of the surface-active agent.

21. A method of producing a surface-active agent according to any of claims 1 to 20, wherein the method comprises the steps of

(i) reacting carbon dioxide and an epoxide in the presence of a carbonate catalyst, and a monofunctional starter compound to form a polycarbonate compound and

(ii) reacting of the polycarbonate compound of step (i) with an epoxide and an ether catalyst to produce the surface-active agent according to any of claims 1 to 20.

22. A method of producing a surface-active agent according to any of claims 1 to 20 in a multiple reactor system; the system comprising a first and second reactor wherein a first reaction takes place in the first reactor and a second reaction takes place in the second reactor; wherein the first reaction is the reaction of a carbonate catalyst with CO_2 and epoxide, in the presence of a monofunctional starter compound, and optionally a solvent, to produce a polycarbonate compound and the second reaction is the semi-batch or continuous reaction of an ether catalyst with the polycarbonate compound of the first reaction and epoxide to produce the surface-active agent according to any of claims 1 to 20.

23. The method of claim 21 or claim 22 wherein the carbonate catalyst is a bimetallic phenolate complex.

24. The method of any one of claims 21 to 23 wherein the ether catalyst is a DMC catalyst.

25. A method of producing a surface-active agent according to any of claims 1 to 20, wherein a mono-hydroxy functional polyether is reacted

(i) with a carbonate catalyst, epoxide and CO_2 and

(ii) with an end-capping group, such as an anhydride, to produce the surface-active agent of any of claims 1 to 20.

26. Use of the surface-active agent according to any one of claims 1 to 20: as agrichemical adjuvants; for the preparation of foams, coatings, paints, adhesives and sealants for the building construction industry; in the automotive industry; in the manufacture of textiles; for the enhanced recovery of crude oil.