Biodegradable surfactant

Field of the invention

The present invention is related to a surfactant comprising at least one C_8 to C_{30} branched alkanol alkoxylate, a process for the preparation of said surfactant, an article comprising said surfactant as well as the use thereof.

Background of the invention

The application of alkanol alkoxylates as surfactants, emulsifiers and antifoaming agents is well known in the art. For instance, non-ionic surfactants featured by a low surface tension and excellent emulsifier properties which are applicable for hard surfaces can be obtained by alkoxylation of branched aliphatic alcohols.

However, with regard to stricter environmental regulations and the desire for environmental sustainability, biodegradability is also a desired property of surfactants. It is well known that alkoxylated linear alcohols such as fatty alcohols are readily biodegradable. US 4,925,587, US 4,317,940 and US 4,317,940 describe linear alcohols alkoxylated with blocks of polyethylene oxide (PO) and ethylene oxide (EO) which are readily biodegradable surfactants. Said surfactants are based on linear alcohols since the application of branched alcohols has a detrimental effect on biodegradability. It has been confirmed that alkoxylated branched alcohols do not show a significant degradation while significant degradation was observed using surfactants based on linear alcohols.

Alkanol alkoxylates based on linear alcohols, however, are not featured by a superior surface activity like wetting of different surfaces and emulsion stability comparable with alkoxylates obtained from branched alcohols which, on the other hand, are not readily biodegradable.

Since biodegradability also becomes more important in the fields of application of branched alkanol alkoxylate surfactants having an excellent surface activity, there is a need in the art for readily biodegradable surfactants obtained from branched aliphatic alcohols.

Accordingly, it is an object of the present disclosure to provide biodegradable branched alkanol alkoxylate surfactants. Further, it is an object of the present disclosure to provide a process for the preparation of said biodegradable branched alkanol alkoxylate surfactants.

Summary

The foregoing and other objects are solved by the subject-matter of the present disclosure.

According to a first aspect, a surfactant of formula (I)

R^1-O-(CH_2-CH_2-O)$_n$-(CH_2-CH(R^2)-O)$_m$-(CH_2-CH_2-O)$_p$-H (I)

wherein
R^1 is selected from the group consisting of 2-dodecyl, 2-ethylhexyl, 2-propylheptyl, iso-tridecyl, 2-tetradecyl, 2-hexadecyl, 7-ethyl-3-decyl, 3-methyl-6-ethyl-2-nonyl, 2-hexadecyl, 2-octadecyl, 3-nonadecyl, 3-methyl-2-octadecyl, 3-methyl-2-hexadecyl, 3-heptadecyl, iso-decyl, iso-undecyl, iso-dodecyl, 2-butyloctyl, 2-pentylnonyl and 2-hexyldecyl,
R^2 stands for methyl or ethyl,
n is the range of 4 to 6,
m is the range of 5 to 20, and
p is in the range of 0 to 25,

and wherein p is 0 when R^1 is 2-propylheptyl, R^2 is methyl and m is in the range of 1 to 10.

is provided.

It was surprisingly found by the inventors that alkanol alkoxylate surfactants of formula R-EO-PO or R-EO-PO-EO having a polyethylene oxide block (EO) between the alkanol residue block R^1 and the polypropylene oxide block (PO) are featured by a high degree of biodegradability.

According to another example of the present disclosure, the ratio n/m is in the range of 0.05 to 3.0 and the ratio p/m is in the range of 0.0 to 5.0.

It is especially preferred that n is in the range of 5 to 6, m is in the range of 6 to 18, and p is in the range of 0 to 2.

According to a further example of the present disclosure, m is in the range of 10 to 20 when p is equal or above 1.

According to one example of the present disclosure, the surfactant is of formula (Ia)

R^3-O-(CH_2-CH_2-O)$_q$-(CH_2-CH(R^4)-O)$_r$-H (Ia)

wherein
R^3 is selected from the group consisting of 2-dodecyl, 2-ethylhexyl, 2-propylheptyl, iso-tridecyl, 2-tetradecyl, 2-hexadecyl, 7-ethyl-3-decyl, 3-methyl-6-ethyl-2-nonyl, 2-hexadecyl, 2-octadecyl, 3-nonadecyl, 3-methyl-2-octadecyl, 3-methyl-2-hexadecyl, 3-heptadecyl, iso-decyl, iso-undecyl, iso-dodecyl, 2-butyloctyl, 2-pentylnonyl and 2-hexyldecyl,
R^4 stands for methyl or ethyl,
q is the range of 4 to 6, and
r is the range of 5 to 20.

According to another example of the present disclosure, the ratio q/r is in the range of 0.05 to 3.0.

According to a further example of the present disclosure, q is in the range of 5 to 6 and r is in the range of 6 to 18.

According to one example of the present disclosure, R^2 and/or R^4 is methyl.

It is especially preferred that R^1 and/or R^3 is selected from the group consisting of 2-propylheptyl and iso-tridecyl.

According to one example of the present disclosure, the surfactant is biodegradable.

According to another example of the present disclosure, biodegradability is achieved at decomposition percentages of at least 60 % determined in accordance with OECD 301B or OECD 301F.

In another aspect, the present disclosure is also directed to a process for the preparation of a surfactant as defined above, comprising the steps of

a) reacting an alcohol of formula R^1OH with ethylene oxide under alkoxylation conditions,
b) reacting the product obtained in step a) with propylene oxide or butylene oxide under alkoxylation conditions, thereby obtaining the surfactant of formula (I) or (Ia), and
c) optionally reacting the product obtained in step b) with ethylene oxide under alkoxylation conditions, thereby obtaining the surfactant of formula (I).

In another aspect, the present disclosure is further directed to the use of a surfactant as described above in cleaning formulations, cosmetic and pharmaceutical formulations, finishes, coating materials, paints, pigment preparations and adhesives, leather decreasing agents, formulations for the textile industry, fiber processing formulations for the paper and pulp industry, metal processing formulations, oil production applications, oil field applications, tertiary oil production, food industry applications, water treatment, fermentation, mineral processing and dust control, building assistants, emulsion polymerization and preparation of dispersions, coolants and lubricants.

In another aspect, the present disclosure is also directed to a detergent, cleaning agent, wetting agent, coating material, adhesive, leather fatliquoring agent, humectant or textile treatment composition, additive for mineral building materials or cosmetic, additive for mineral oil formulations, pharmaceutical or crop protection formulation, containing the surfactant as described above.

In the following, the present invention is described in more detail.