Some traditional biocide containing antifouling coatings have demonstrated a greater resistance towards marine fouling compared to the silicone based fouling release coatings under, e.g., static conditions. The surface characteristics of such a coating will however lead to an increased drag resistance compared to silicone coatings even when the surface is fouling free.

The rationale behind the present invention has been to prolong the slime free period of a silicone based coating by combining the biocidal components from the antifouling coatings with a silicone based fouling release coating. This provides a coating with low drag resistance that will remain fouling free for a longer time than conventional silicone based fouling release coatings.

SUMMARY ~~OF THE INVENTION~~

In view of the above-mentioned needs, the present inventors have now developed new fouling control coating compositions which comprise biocides and one or more hydrophilic-modified polysiloxanes which facilitate and control the leaching of the biocides. In this way, the advantages of silicone fouling release are combined with those of traditional anti-fouling coatings, thus gaining a foul-free, low-friction surface with the use of a relatively small amount of biocide.

The present inventors have realised that the use of certain hydrophilic-modified polysiloxanes, in particular poly(oxyalkylene)-modified polysiloxanes, (see further below) renders it possible to obtain a media for water- and biocidal transport through a cross-linked polysiloxane film, in particular a film of a polysiloxane-based coating composition. The leach rate of the biocide can be controlled amongst others by the amount and the hydrophilicity/hydrophilic moieties of the added polysiloxane(s).

In a first aspect, there is provided a fouling control coating composition comprising a polysiloxane-based binder system,
0.01-20 % by dry weight of one or more hydrophilic-modified polysiloxanes, and one or more biocides, wherein the weight ratio between the one or more hydrophilic-modified polysiloxanes and the one or more biocides is in the range 1:0.2 to 1:6, wherein the hydrophilic-modified polysiloxane has a number average molecular weight (M_n) in the range of 100-100,000 g/mol, and wherein the one or more hydrophilic-modified polysiloxanes do not contain groups that can react with the binder or any cross-linker.

In a second aspect, there is provided a top coat composition as defined above which comprises:
(i) 40-70 % by wet weight of the total top coat composition of a silanol-terminated polydiorganosiloxane and a cross-linker;
(ii) 0.1-10 % by wet weight of the total top coat composition of one or more biocides, preferably selected from organic biocides; and
(iii) 0.1-10 % by wet weight of the total top coat composition of one or more hydrophilic-modified polysiloxanes selected from poly(oxyalkylene)-modified polysiloxanes
with the proviso that the weight ratio between the one or more poly(oxyalkylene)-modified polysiloxanes and the one or more biocides is in the range 1:0.2 to 1:6.

In a third aspect, there is provided a marine structure comprising on at least a part of the outer surface thereof an outermost coating prepared from a coating composition as defined above.

In a fourth aspect, there is provided the use of the combination of one or more non-reactive hydrophilic-modified polysiloxanes
and one or more biocides, wherein the weight ratio between the one or more hydrophilic-modified polysiloxanes and the one or more biocides is in the range 1:0.2 to 1:6, wherein the hydrophilic-modified polysiloxane has a number average molecular weight (M_n) in the range of 100-100,000 g/mol, and wherein the one or more hydrophilic-modified polysiloxanes do not contain groups that can react with the binder or any cross-linker, for improving the antifouling properties of a polysiloxane based coating composition.

So, in a first ~~aspect~~embodiment the present ~~invention~~disclosure relates to a fouling control coating composition comprising a polysiloxane-based binder system, 0.01-20 % by dry weight of one or more hydrophilic-modified polysiloxanes, and one or more biocides.

A second ~~aspect~~embodiment of the ~~invention~~disclosure relates to a marine structure comprising on at least a part of the outer surface thereof an outermost coating prepared from a coating composition as defined herein.

In currently preferred embodiments of the above aspects, the weight ratio between the one or more hydrophilic-modified polysiloxanes and the one or more biocides is in the range 1:0.2 to 1:6.

A third ~~aspect~~embodiment of the ~~invention~~disclosure relates to the use of the combination of one or more non-reactive hydrophilic-modified polysiloxanes and one or more biocides, wherein the weight ratio between the one or more hydrophilic modified polysiloxanes and the one or more biocides is in the range 1:0.2 to 1:6, for improving the antifouling properties of a polysiloxane based coating composition.

DETAILED DISCLOSURE OF THE INVENTION

The coating composition

As mentioned above, the present invention provides a fouling control coating composition comprising a polysiloxane-based binder system 0.01-20 %, e.g. 0.05-10 %, by dry weight of one or more hydrophilic-modified polysiloxanes, and one or more biocides.

Hydrophilic-modified polysiloxane

Hydrophilic-modified polysiloxanes are widely used as surfactants and emulsifiers due to the content of both hydrophilic and lipophilic groups in the same molecule.

Means to obtain the hydrophilic character include modification of the polysiloxane backbone by the addition of non-ionic oligomeric or polymeric groups which can be charge-polarized and/or capable of hydrogen bonding, enhancing their interaction with polar solvents, in particular with water, or with other polar oligomeric or polymeric groups. Examples of these groups include, amides (e.g. poly(vinyl pyrrolidone), poly[N-(2-hydroxypropyl)methacrylamide], poly(N,N- dimethacrylamide)), acids (e.g. poly(acrylic acid)), alcohols (e.g. poly(glycerol), polyHEMA, polysaccharides), ketones (polyketones), aldehydes (e.g. poly(aldehyde guluronate), amines (e.g. polyvinylamine), esters (e.g. polycaprolactones, poly(vinyl acetate), polyacrylates), ethers (e.g. polyoxyalkylenes like polyethylene glycol, polypropylene glycol), imides (e.g. poly(2-methyl-2-oxazoline)), etc., including copolymers of the foregoing Preferably the hydrophilicity is obtained by modification with polyoxyalkylene groups.