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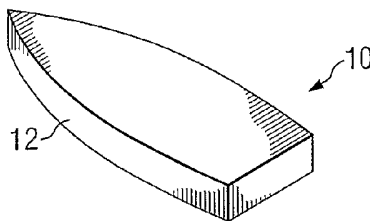
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(54) Title: ANTIFOULING TAPE AND METHOD OF APPLICATION THEREOF



(57) Abstract: Applying antifouling protection to a surface includes exposing the surface and adhering antifouling tape to the exposed surface. The antifouling tape includes an antifouling layer, a backing layer, and an adhesive layer, where the antifouling layer has an outer surface that prevents fouling matter from attaching to the antifouling layer. The adhesive layer includes an adhesive to adhere the backing layer to the surface, where the backing layer is disposed between the antifouling layer and the adhesive layer in order to expose the outer surface of the antifouling layer outwardly of the surface.

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ANTIFOULING TAPE AND METHOD OF APPLICATION THEREOF

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to the field of antifouling applications and more specifically to an antifouling tape and method of application and removal.

5 BACKGROUND OF THE INVENTION

Antifouling compounds are typically used to prevent the fouling of underwater surfaces, such as the hull of a boat. Fouling occurs when foreign matter, such as marine organisms, attach to the underwater surface. The foreign matter may include any fouling matter, including, but not limited to, marine organisms such as algae and barnacles, and
10 marine elements such as crystal growth and debris. For example, barnacles are one of various marine organisms that can form a hard shell and remain attached to an underwater surface, which if not treated with an antifouling compound, may become encrusted with barnacles. Similarly, algae, whether single cell or large variety, is another marine organism that may grow in an aquatic environment including an underwater surface,
15 which if not treated with antifouling compound, may attract algae growth.

Coating an underwater surface with an antifouling compound typically entails using a paint-based application. A technique for removing the paint-based application generally requires sanding or scraping the painted surface to remove the paint. Removal of the paint, however, results in the release of toxic dust particles that require the use of
20 dust masks, wearing special gear, and following Environmental Protection Agency guidelines for the disposal of released antifouling paint. Consequently, known techniques for applying and removal of an antifouling coating on an underwater surface are unsatisfactory in certain situations.

25 SUMMARY OF THE INVENTION

In accordance with the present invention, disadvantages and problems associated with previous techniques for applying and removing an antifouling compound may be reduced or eliminated.

According to one embodiment, applying antifouling protection to a surface
30 includes exposing a surface and adhering antifouling tape to the exposed surface. The antifouling tape includes an antifouling layer, a backing layer, and an adhesive layer,

where the antifouling layer has an outer surface that prevents fouling matter from attaching to the antifouling layer. The adhesive layer includes an adhesive to adhere the backing layer to the surface, where the backing layer is disposed between the antifouling layer and the adhesive layer in order to expose the outer surface of the antifouling layer outwardly of the surface.

Certain embodiments of the invention may provide one or more technical advantages. A technical advantage of one embodiment may be that by using taping technology, application of an antifouling compound to a surface may result in a more efficient application. Another technical advantage of one embodiment may be that by using a taping technology to apply an antifouling compound to a surface, removal of the antifouling compound may reduce or eliminate the need for sanding or scraping.

Certain embodiments of the invention may include none, some, or all of the above technical advantages. One or more other technical advantages may be readily apparent to one skilled in the art from the figures, descriptions, and claims included herein.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its features and advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a diagram illustrating one embodiment of a surface that may be exposed to fouling matter that may be used with the present invention;

FIGURES 2A-2B are diagrams illustrating embodiments of an antifouling tape application on a surface;

FIGURE 3 is a flowchart demonstrating one embodiment of a method for applying an antifouling tape to a surface in accordance with the present invention; and

FIGURE 4 is a flowchart demonstrating one embodiment of a method for removal of an antifouling tape in accordance with the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention and its advantages are best understood by referring to FIGURES 1 through 4 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is a diagram illustrating one embodiment of a surface that may be exposed to fouling matter. In the illustrated embodiment, a surface 12 such as a hull of a vessel 10 may be equipped with an application of an antifouling tape as will be more particularly described with reference to FIGURES 2A and 2B. It will be understood, that the antifouling tape may be applied to any surface 12 that may be exposed to fouling matter. For example, surface 12 may include all or a portion of a surface of any aquatic structure, whether submersible or not, such as a vessel, a marine rig, a pier, a dock, a pontoon, substantially all or a portion of a single or double hull structure, or any other surface suitable for underwater application, whether salt water or otherwise, that may expose surface 12 to fouling matter. According to the illustrated embodiment, surface 12 comprises all or a portion of the hull surface of a boat. Additionally, surface 12 may be made of any material suitable for aquatic applications, whether for salt water use or otherwise, such as fiberglass, wood, or any other suitable material.

FIGURES 2A and 2B are diagrams illustrating embodiments of an antifouling tape application on surface 12. FIGURE 2A illustrates one embodiment of antifouling tape 20 positioned on surface 12. According to the illustrated embodiment, antifouling tape 20 includes an adhesive layer 14, a backing layer 16, and an antifouling layer 18 layered as shown in FIGURE 2A. It will be understood that antifouling tape 20 may comprise any suitable thickness without departing from the scope of the invention. Additionally, antifouling tape 20 may be formed to cover any suitable surface area. For example, antifouling tape 20 may be made in strips, sheets, rolled or otherwise, without departing from the scope of the invention.

Adhesive layer 14 adheres backing layer 16 to surface 12. According to one embodiment, adhesive layer 14 comprises an adhesive. Any adhesive suitable for adhering backing layer 16 to a surface 12 may be used without departing from the scope of the invention. For example, the adhesive may be of any setting type, such as aerobic, anaerobic, radiation, thermal-setting, thermal-releasing, water-setting, or requiring a curing or release agent. As another example, the adhesive may comprise any solution or compound with adhesive properties such as rubber-based adhesives, resin adhesives, wax-based adhesives, inorganic adhesives, or any other suitable adhesive compound. According to the illustrated embodiment, any adhesive suitable for use with any tape technology may be used without departing from the scope of the invention. According to another embodiment, adhesive layer 14 may also adhere antifouling layer 18 to surface 12.

Referring to Table 1 below, the following adhesive compounds or solutions may be used, either alone or in combination, without departing from the scope of the invention. Other adhesive solutions and compounds not referred to specifically in Table 1 may be used in a removable antifouling tape application. These are presented as examples and should not be construed to limit the scope of the present invention to any of the listed or any other particular adhesive.

TABLE 1

Adhesive Class	Adhesive Type
Rubber-based adhesive	Styrene Butadiene Rubber(SBR) Nitrile rubber Neoprene rubber Butyral and butyl rubber Polysulfide rubber Silicone rubber Natural latex rubber Synthetic latex rubber
Resin-based adhesive	Polyvinyl (including Polyvinyl acetate, Polyvinyl butyral, Polyvinyl chloride(PVC)) Acrylic Anaerobic Ethylene Vinyl Acetate (EVA) Polyethylene-based Polyolefin-based Nylon-based Phenol-based (including formaldehyde-based) Urea based (including formaldehyde-based) Epoxy resin Polyurethane-based Rosin-based (including rosin esters) Polyterpene-based Petroleum-based Low molecular-based adhesives
Inorganic adhesives	Silicate Adhesive (including Sodium Silicate)
Wax Adhesives	Paraffin Natural Wax Bees Wax

10

Backing layer 16 supports antifouling layer 18 and adhesive layer 14. According to the illustrated embodiment, backing layer 16 is disposed between adhesive layer 14 and antifouling layer 18. Backing layer 16 comprises any suitable backing material for supporting adhesive layer 14 and antifouling layer 18. For example, backing layer 16 may

include a backing such as a cellulose-based film, a rubber-based film, a plastic film, a metal film, a nylon-reinforced film, a glass fiber, a glass-reinforced film, a plastic-reinforced film, a textile-based film, some, none, or a combination of the preceding. In one embodiment, a backing comprising a plastic film may include polyolefins, polyvinyls, polyurethane, polystyrenes, polybutyrls, any resin or petroleum plastic. Any other suitable backing may be used as backing layer 16 without departing from the scope of the invention.

Antifouling layer 18 forms the outer layer of antifouling tape 20. Antifouling layer 18 comprises an antifouling compound embedded, attached, or contained in adhesive layer 14, backing layer 16, either, or both, so that antifouling layer 18 may be disposed outwardly of surface 12. According to one embodiment, embedding or attaching antifouling layer 18 to backing layer 16 may be accomplished by using any coating, whether reinforced or non-reinforced, as an adhesive base at antifouling layer 18. According to another embodiment, antifouling layer 18 may comprise an adhesive quality that may be used to embed or attach antifouling layer 18 to backing layer 16. Any other suitable technique for embedding, attaching, or containing antifouling layer 18 in adhesive layer 14, backing layer 16, either, or both, may be used without departing from the scope of the invention.

Antifouling compound of antifouling layer 18 may include any antifouling agent suitable for preventing fouling matter from attaching to antifouling tape 20 such as a cupric compound, a hydrogen peroxide releasing biocide, an enzymatic agent, a complex biocide like diuron, chlorothalonil, SeaNine, and Irgarol, a tin based biocide including TBT, and a chlorite-based biocide. Any other suitable antifouling compound or technique may be used in antifouling layer 18 without departing from the scope of the invention. For example, antifouling layer 18 may include any compound that forms a smooth surface to which fouling matter may not attach. As another example, antifouling layer 18 may include an ablative layer, a chemical layer, or any other toxic application that may prevent fouling matter from adhering to antifouling layer 18.

Antifouling tape 20 may be positioned on surface 12 so that adhesive layer 14 is in direct contact with surface 12. According to one embodiment, antifouling tape 20 may comprise, for example, a "peel-and-stick" adhesive layer 14 that may be positioned on surface 12 without peeling the backing to ensure that antifouling tape 20 is positioned at an appropriate location before activating the adhesive. Antifouling tape 20 may be

positioned on surface 12 using any other suitable technique without departing from the scope of the invention. For example, fasteners such as tape, clips, rope, magnets, screws, whether permanent or otherwise, affixing solutions, or any other suitable device, solution, or technique may be used to position antifouling tape 20 on surface 12 before activating the adhesive layer 14.

FIGURE 2B illustrates antifouling tape 20 positioned on surface 12 and activation energy 22 directed towards antifouling tape 20. According to one embodiment, activation energy 22 may be used to activate the adhesive of adhesive layer 14 when antifouling tape 20 is positioned on surface 12. Activation energy 22 may activate some, none, or all of the adhesive of adhesive layer 14 so that antifouling tape 20 may be removably adhered to surface 12. Activation energy 22 may include thermal energy, water application, a curing application, radiation, pressure application, or any other suitable application that may activate adhesive layer 14. For example, activation energy 22 may comprise heat application using a thermal-releasing device such as a heat gun if adhesive layer 14 comprises a thermal-setting adhesive such as polyolefin. In the embodiment of a heat activation, any suitable thermal-releasing device may be used without departing from the scope of the invention. As another example, a pressure application may be used as activation energy 22 if the adhesive of adhesive layer 14 comprises a pressure-applied adhesive such as a butyl rubber adhesive.

Modifications, additions, or omissions may be made to antifouling tape 20 without departing from the scope of the invention. For example, backing layer 16 may be modified so that instead of forming a separate distinct layer, it may be embedded, contained, or formed into adhesive layer 14 or antifouling layer 18. Although FIGURES 2A and 2B show a uniform width of adhesive layer 14, backing layer 16, and antifouling layer 18, variations of width or thickness may be used at any or some portions, none, or all of the antifouling tape 20 at some, none or all of the layers of antifouling tape 20. Any suitable thickness or variation in thickness of any of the layers of antifouling tape 20 may be used without departing from the scope of the invention.

FIGURE 3 is a flowchart demonstrating one embodiment of a method for applying an antifouling tape 20 to surface 12 that may be used in accordance with the present invention. The method begins at step 30 where a surface 12 is exposed. For example, in an embodiment of a vessel 12 composed of fiberglass material, paint applications, including those antifouling, may be stripped off surface 12 to expose the fiberglass clear

coat. Any other surface condition suitable for applying antifouling tape 20 may be exposed at surface 12 without departing from the scope of the invention.

At step 32, antifouling tape 20 is positioned to exposed surface 12. According to the illustrated embodiment, exposed surface 12 may receive antifouling tape 20 positioned at an appropriate location at surface 12 before the adhesive of adhesive layer 14 is activated.

The method then proceeds to step 34, where antifouling tape 20 is activated and shaped. As was described with reference to FIGURE 2B, activation energy 22 may activate the adhesive of adhesive layer 14. Substantially simultaneously with the activation, antifouling tape 20 may be shaped to conform to the contours of surface 12. For example, in the embodiment of a heat activation of a thermal-setting adhesive, antifouling tape 20 may shrink as it adheres to surface 12 so that antifouling tape 20 conforms to the contours of surface 12.

At step 36, antifouling tape 20 adheres to surface 12. As was described with reference to FIGURE 2B, the adhesive properties of adhesive layer 14 may be activated using activation energy 22. For example, using a pressure-applied adhesive at adhesive layer 14, applying pressure onto the shaped antifouling tape 20 may adhere adhesive layer 14 to surface 12. After adhering the shaped antifouling tape 20 to surface 12, the method terminates.

Steps may be added, omitted, modified, or performed in any suitable order without departing from the scope of the invention. For example, positioning antifouling tape 20 at exposed surface 12 at step 32 may be performed substantially simultaneously with activating and shaping antifouling tape 20 at step 34. As another example, activating and shaping antifouling tape 20 at step 34 may be performed substantially simultaneously with adhering shaped antifouling tape 20 to surface 12 at step 36.

FIGURE 4 is a flowchart illustrating one embodiment of a method for removal of an antifouling tape 20 that may be used in accordance with the present invention. The method begins at step 40, where an underwater surface is removed from the water. It will be understood, that the underwater surface may be all or partially treated with antifouling tape 20, which is now desired to be removed.

At step 42, surface 12 is heated to loosen the adhesive layer 14. According to the illustrated embodiment, heat may be applied to surface 12 using any thermal-releasing device such as a heat gun to loosen the adhesive layer 14. Although typically heat

application may be used with a thermal-setting adhesive, any other type of adhesive included in adhesive layer 14 may be heated at this step.

5 The method proceeds to step 44, where the loosened antifouling tape 20 may be pulled off surface 12. Additionally, the loosened antifouling tape 20 may be scraped to pull all or a portion of antifouling tape 20.

At step 46, remnants of adhesive may be removed from surface 12. Removing adhesive remnants may include applying solvents, chemicals, heat, or any other suitable adhesive removal technique or solution. The method proceeds to step 48 where surface 12 is exposed, after which the method terminates.

10 Steps may be added, omitted, modified, or performed in any suitable order without departing from the scope of the invention. For example, pulling loosened antifouling tape 20 off surface 12 at step 44 may be performed substantially simultaneously with removing adhesive remnant from surface 12 at step 46. As another example, removing adhesive remnants from surface 12 at step 46 may be performed substantially simultaneously with exposing surface 12 at step 48. As yet another example, heating surface 12 to loosen adhesive layer 14 at step 42 may be modified to include applying solutions, chemicals, solvents, radiation, or any other suitable adhesive removal solution or technique that may loosen adhesive layer 14.

20 Certain embodiments of the invention may provide one or more technical advantages. A technical advantage of one embodiment may be that by using taping technology, application of an antifouling compound to a surface may result in a more efficient application. Another technical advantage of one embodiment may be that by using a taping technology to apply an antifouling compound to a surface, removal of the antifouling compound may reduce or eliminate the need for sanding or scraping the surface.

25 Although an embodiment of the invention and its advantages are described in detail, a person skilled in the art could make various alterations, additions, and omissions without departing from the spirit and scope of the present invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method of applying antifouling protection to a surface, comprising:
exposing a surface; and
adhering an antifouling tape to the exposed surface, the antifouling tape
5 comprising an antifouling layer, a backing layer, and an adhesive layer, the antifouling
layer comprising an outer surface operable to prevent fouling matter from attaching to the
antifouling layer, the adhesive layer comprising an adhesive operable to adhere the
backing layer to the surface, the backing layer disposed between the antifouling layer and
the adhesive layer in order to expose the outer surface of the antifouling layer outwardly of
10 the surface.
2. The method of Claim 1, wherein adhering the antifouling tape to the
exposed surface further comprises:
activating the adhesive layer of the antifouling tape; and
15 shaping the antifouling tape to conform to the contours of the surface substantially
simultaneously with activating the adhesive layer.
3. The method of Claim 2, wherein:
the adhesive layer further comprises a thermal-setting adhesive; and
20 activating the adhesive layer of the antifouling tape further comprises applying
heat to the antifouling tape to activate the thermal-setting adhesive.
4. The method of Claim 2, wherein:
the adhesive layer further comprises a pressure-applied adhesive; and
25 activating the adhesive layer of the antifouling tape further comprises applying
pressure to the antifouling tape to adhere the adhesive layer to the exposed surface.
5. The method of Claim 1, wherein the antifouling layer further comprises an
antifouling compound selected from a group consisting of a cupric compound, a hydrogen
30 peroxide releasing biocide, an enzymatic agent, a complex biocide, a tin based biocide,
and a chlorite-based biocide.

6. The method of Claim 1, wherein the backing layer is operable to support the antifouling layer and the adhesive layer, the antifouling layer being embedded in the backing layer.

5 7. The method of Claim 1, wherein the backing layer comprises a backing selected from a group consisting of a cellulose-based film, a rubber-based film, a plastic-based film, a metal film, a nylon-reinforced film, a glass fiber, a glass-reinforced film, a plastic-reinforced film, and a textile-based film.

10 8. The method of claim 3, wherein the thermal-setting adhesive comprises an adhesive compound selected from a group consisting of Ethylene Vinyl Acetate and polyolefin compound.

9. An antifouling tape, comprising:

15 an antifouling layer comprising an outer surface operable to prevent fouling matter from adhering to the antifouling layer;

an adhesive layer; and

20 a backing layer disposed between the antifouling layer and the adhesive layer, the adhesive layer comprising an adhesive operable to adhere the backing layer to a surface in order to expose the outer surface of the antifouling layer outwardly of the surface.

10. The antifouling tape of Claim 9, wherein the antifouling compound comprises a compound selected from a group consisting of a cupric compound, a hydrogen peroxide releasing biocide, an enzymatic agent, a complex biocide, a tin based biocide, and a chlorite-based biocide.

11. The antifouling tape of Claim 9, wherein the backing layer comprises a backing selected from a group consisting of a cellulose-based film, a rubber-based film, a plastic film, a metal film, a nylon-reinforced film, a glass fiber, a glass-reinforced film, a plastic-reinforced film, and a textile-based film.

12. The antifouling tape of Claim 9, wherein the adhesive comprises a thermal-setting adhesive.

13. The antifouling tape of Claim 9, wherein the adhesive comprises a pressure-applied adhesive.

5 14. The antifouling tape of Claim 9, wherein the adhesive comprises a rubber based adhesive selected from the group consisting of styrene-butadiene rubber (SBR), nitrile rubber, neoprene rubber, butyral rubber, butyl rubber, polysulfide rubber, polysulfide rubber, silicone rubber, natural latex rubber, and synthetic latex rubber.

10 15. The antifouling tape of Claim 9, wherein the adhesive comprises a resin-based adhesive selected from the group consisting of polyvinyl, polyvinyl acetate, polyvinyl butyral, polyvinyl chloride (PVC), acrylic, anaerobic, ethylene vinyl acetate (EVA), polyethylene, polyolefin, nylon, phenol, urea, epoxy, polyurethane, rosin, polyterpene, and petroleum.

15 16. The antifouling tape of Claim 9, wherein the adhesive comprises a wax based adhesive selected from the group consisting of paraffin, natural wax, and bees wax.

17. An antifouling tape, comprising:
means for antifouling comprising an outer surface operable to prevent fouling
20 matter from adhering to a surface;
means for adhering; and
means for backing disposed between the means for antifouling and the means for adhering, the means for adhering comprising an adhesive operable to adhere the means for backing to the surface in order to expose the outer surface of the means for antifouling
25 outwardly of the surface.

18. A method for applying antifouling tape to a surface, comprising:

exposing a surface to accept an antifouling tape, the antifouling tape comprising an antifouling layer, a backing layer, and an adhesive layer, the antifouling layer comprising an outer surface operable to prevent fouling matter from attaching to the antifouling layer, the adhesive layer comprising an adhesive operable to adhere the backing layer to the surface, the backing layer disposed between the antifouling layer and the adhesive layer, the adhesive further comprising a thermal-setting adhesive selected from a group consisting of Ethylene Vinyl Acetate and polyolefin compound; and

adhering the antifouling tape to the exposed surface by:

activating the adhesive layer of the antifouling tape by applying heat to the antifouling tape to activate the thermal-setting adhesive; and

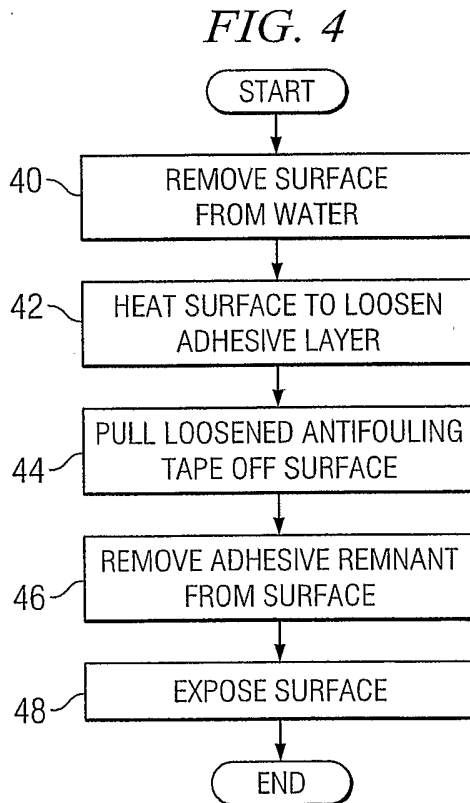
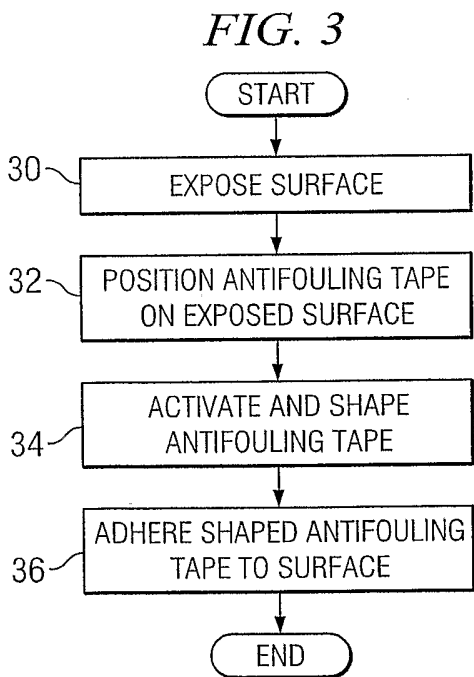
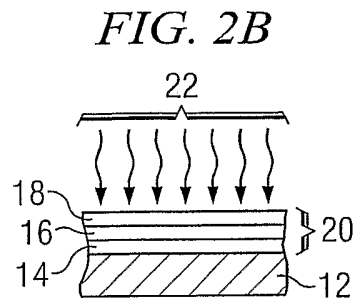
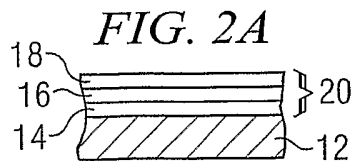
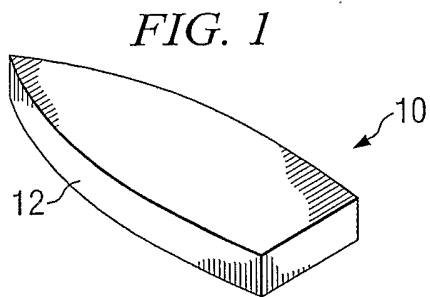
shaping the antifouling tape to conform to the contours of the surface substantially simultaneously with activating the adhesive layer, wherein the adhered antifouling tape exposes the outer surface of the antifouling layer outwardly of the surface.

19. The method of Claim 18, wherein the antifouling layer further comprises an antifouling compound selected from a group consisting of a cupric compound, a hydrogen peroxide releasing biocide, an enzymatic agent, a complex biocide, a tin based biocide, and a chlorite-based biocide.

20. The method of Claim 18, wherein:

the backing layer is operable to support the antifouling layer and the adhesive layer, the antifouling layer being embedded in the backing layer; and

the backing layer comprises a backing selected from a group consisting of a cellulose-based film, a rubber-based film, a plastic-based film, a metal film, a nylon-reinforced film, a glass fiber, a glass-reinforced film, a plastic-reinforced film, and a textile-based film.



INTERNATIONAL SEARCH REPORT

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PCT/US2004/017166

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C09J7/02 C09D5/16 B32B33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C09J C09D B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 148 803 A (UNITED WIRE GROUP PLC) 5 June 1985 (1985-06-05) page 1, line 29 - line 37 page 1, line 53 - line 62 page 1, line 87 - line 103 page 2, line 101 - line 113; figure 5 claims 1,23,25,26,28,29	1,3,5-7, 9-12,14, 17
X	"Antifouling multilayered sheet for aquatic structures - comprises polymer sheet or tape coated with powdery metal contg. copper and polyethylene" WPI WORLD PATENT INF, 28 January 1988 (1988-01-28), XP002908013 abstract -& JP 63 021144 A (SHOWA DENKO KK) 28 January 1988 (1988-01-28)	9-11,17

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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27 October 2004

Date of mailing of the international search report

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Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/017166

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE WPI Section Ch, Week 198630 Derwent Publications Ltd., London, GB; Class A94, AN 1986-193343 XP002302708 -& JP 61 126002 A (SHOWA DENKO KK) 13 June 1986 (1986-06-13) abstract</p> <p style="text-align: center;">-----</p>	9-11,17
A	<p>DATABASE WPI Section Ch, Week 197606 Derwent Publications Ltd., London, GB; Class A11, AN 1976-09801X XP002302709 -& JP 50 021034 A (MITSUBISHI RAYON CO LTD) 6 March 1975 (1975-03-06) abstract</p> <p style="text-align: center;">-----</p>	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

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