

DESCRIPTION

APPARATUS FOR MANAGING VESSEL FOULING RISK, PROGRAM, AND RECORDING MEDIUM

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Technical Field

[0001] The present invention relates to a technique for managing vessel fouling risk.

10 Background Art

[0002] When foreign matter such as an organism attaches to a water contacting surface of a vessel, resistance during a voyage of the vessel increases, thus incurring an increase in the maintenance burden due to a reduction in vessel speed, an increase in fuel consumption, and an increase
15 in the main engine load. Also, when organisms attach to the water contacting surface of a vessel, the organisms are dispersed beyond their original habitat accompanying movement of the vessel, and thus there is a risk of adversely affecting the ecosystem.

[0003] The water contacting surface of the vessel is coated with an
20 anti-fouling paint in order to prevent or suppress attachment of organisms and the like to the water contacting surface of the vessel. An anti-fouling agent contained in an anti-fouling paint for vessels that is widely used dissolves in water and thereby generates copper ions, which organisms dislike, thereby suppressing attachment of the organisms. Also, in the
25 anti-fouling paint of the type in which the anti-fouling paint itself dissolves, the surface of the vessel body is renewed due to the anti-fouling paint dissolving, and attached foreign matter is prevented from remaining on the vessel body.

[0004] Patent Literature 1 is an example of literature that discloses a
30 technique relating to an anti-fouling paint for a vessel. Patent Literature 1

proposes a non-tin-based anti-fouling paint composition that has a suitable paint film consumption rate from initial immersion in water, and according to which an excellent anti-fouling performance can be exhibited continuously for a long time against organisms that attach to a vessel, underwater structure, or the like.

Citation List

Patent Literature

[0005] Patent Literature 1: JP 2012-251158A

Summary of Invention

Technical Problem

[0006] If all of the anti-fouling agent in the anti-fouling paint covering the vessel dissolves, foreign matter such as organisms will rapidly attach to the vessel body, resulting in an increase in fuel consumption, a reduction in vessel speed, and an adverse effect on the ecosystem. Accordingly, a company that operates the vessel or the like needs to add a coat of the anti-fouling paint to the vessel body before all of the anti-fouling agent dissolves.

[0007] Also, even if the vessel body is coated with the anti-fouling paint in which the anti-fouling agent remains, attachment of foreign matter such as organisms to the vessel body sometimes occurs in the case where the vessel is stopped or moored for a long period of time, or in the case of voyaging through a body of water inhabited by organisms with a strong attachment force. If the amount of foreign matter attached to the vessel body increases by a certain extent or more, it is necessary to perform a cleaning task for removing the attached foreign matter from the vessel body in order to recover the reduced vessel speed, reduce the increased fuel consumption, and optimize the main engine load.

[0008] Conventionally, the company that operates the vessel or the like

determined the timing of adding a coat of the anti-fouling paint, the type of anti-fouling paint to be added, and the paint film thickness using individual and sensory grounds, such as intuition and experience, based on information such as vessel speed and water temperature during a voyage of the vessel.

5 For this reason, a coat of the anti-fouling paint was added at an inappropriate timing, or the vessel body was coated using an inappropriate type or amount of the anti-fouling paint.

[0009] Also, conventionally, the company that operates the vessel or the like used individual or sensory grounds, such as intuition and experience, to
10 estimate the degree of advancement of the attachment of the organisms to the vessel body due to stopping or mooring the vessel or a voyage through a body of water inhabited by organisms with a strong attachment force. For this reason, in some cases, the foreign matter attaches to the vessel body more rapidly than expected, and an unplanned cleaning task becomes
15 necessary.

[0010] Accordingly, the company that operates the vessel or the like needs to obtain information relating to the fouling state of the vessel body, such as the remaining amount of anti-fouling agent contained in the anti-fouling paint and the degree of advancement of the attachment of foreign matter to the
20 vessel body.

[0011] In view of the foregoing circumstance, the present invention aims to provide a means for enabling a company that operates the vessel or the like to obtain objective information relating to the fouling state of the vessel.

25 Solution to Problem

[0012] In order to solve the foregoing problem, the present invention proposes, as a first aspect, an apparatus including: a parameter acquisition means for acquiring a parameter relating to an environment in which a vessel is placed; an index value acquisition means for acquiring a first index
30 value indicating a likelihood of occurrence of fouling of a water contacting

surface of the vessel per unit time in the environment; and an index value specification means for specifying a second index value indicating the likelihood of the occurrence of fouling of the water contacting surface of the vessel in a first period in the environment, based on the first index value.

5 [0013] In the apparatus according to the first aspect, as a second aspect, it is possible to use a configuration in which the parameter acquisition means acquires water temperature and vessel speed as the parameters, and the first index value and the second index value indicate decrease amounts of an anti-fouling paint on the water contacting surface of the vessel or an
10 anti-fouling component contained in the anti-fouling paint.

[0014] In the apparatus according to the second aspect, as a third aspect, it is possible to use a configuration in which the parameter acquisition means acquires the parameters for each of a plurality of periods constituting the first period, the index value acquisition means acquires the first index value
15 for each of the plurality of periods, and for each of the plurality of periods, based on the first index value acquired by the index value acquisition means for the period, the index value specification means specifies a third index value indicating the likelihood of the occurrence of fouling of the water contacting surface of the vessel in an environment indicated by the
20 parameters acquired by the parameter acquisition means for the period, and specifies the second index value based on a plurality of the third index values that were specified.

[0015] In the apparatus according to the third aspect, as a fourth aspect, it is possible to use a configuration including: a remaining amount acquisition
25 means for acquiring a remaining amount of the anti-fouling paint on the water contacting surface of the vessel or the anti-fouling component contained in the anti-fouling paint at a start timing of the first period; and a remaining amount specification means for specifying a remaining amount of the anti-fouling paint on the water contacting surface of the vessel or the
30 anti-fouling component contained in the anti-fouling paint at an end timing

of the first period, based on the remaining amount of the anti-fouling component and the second index value.

[0016] In the apparatus according to the third aspect, as a fifth aspect, it is possible to use a configuration in which the index value acquisition means
5 acquires the first index value for each of a plurality of types of anti-fouling paint, and the index value specification means specifies the second index value for each of the plurality of types of anti-fouling paint.

[0017] In the apparatus according to the second aspect, as a sixth aspect, it is possible to use a configuration including: a decrease amount acquisition
10 means for acquiring a measurement value of the decrease amount of the anti-fouling paint on the water contacting surface of the vessel or the anti-fouling component contained in the anti-fouling paint in the first period; and an index value correction means for, for each of a plurality of the first periods, correcting the first index value based on the parameters acquired by
15 the parameter acquisition means and the measurement value acquired by the decrease amount acquisition means.

[0018] In the apparatus according to the first aspect, as a seventh aspect, it is possible to use a configuration in which the parameter acquisition means acquires a vessel speed and a position of the vessel as the parameters, and
20 the first index value and the second index value indicate degrees of influence that attached matter on the water contacting surface of the vessel has on an increase in resistance that occurs during a voyage of the vessel.

[0019] In the apparatus according to the seventh aspect, as an eighth aspect, it is possible to use a configuration in which the parameter acquisition
25 means acquires the decrease amount of the anti-fouling paint on the water contacting surface of the vessel or the anti-fouling component contained in the anti-fouling paint, as the parameter.

[0020] In the apparatus according to the first aspect, as a ninth aspect, it is possible to use a configuration in which the parameter acquisition means
30 acquires the vessel speed of the vessel or a physical amount correlated with

the vessel speed of the vessel, and the fuel consumption of the vessel or a physical amount correlated with the fuel consumption of the vessel, as the parameters, and the first index value and the second index value indicate degrees of influence that attached matter on the water contacting surface of the vessel has on an increase in resistance that occurs during the voyage of the vessel.

[0021] In the apparatus according to any of the seventh to ninth aspects, as a tenth aspect, it is possible to use a configuration in which the parameter acquisition means acquires the parameter for each of a plurality of periods constituting the first period, the index value acquisition means acquires the first index value for each of the plurality of periods, and for each of the plurality of periods, based on the first index value acquired by the index acquisition means for the period, the index value specification means specifies a third index value indicating the degree of influence that attached matter on the water contacting surface of the vessel has on an increase in resistance that occurs during the voyage of the vessel in the environment indicated by the parameter acquired by the parameter acquisition means for the period, and specifies the second index value based on a plurality of the third index values that were specified.

[0022] In the apparatus according to the tenth aspect, as an eleventh aspect, it is possible to use a configuration in which the index value acquisition means acquires the first index value for each of a plurality of types of anti-fouling paint, and the index value specification means specifies the second index value for each of the plurality of types of anti-fouling paint.

[0023] In the apparatus according to the seventh aspect, as a twelfth aspect, it is possible to use a configuration including: an influence degree acquisition means for acquiring a measurement value for the degree of influence that the attached matter on the water contacting surface of the vessel has on an increase in resistance that occurs during the voyage of the vessel in the first period; and an index value correction means for, for each of a plurality of the

first periods, correcting the first index value based on the parameter acquired by the parameter acquisition means and the measurement value acquired by the influence degree acquisition means.

[0024] Also, the present invention proposes, as a thirteenth aspect, a program for causing a computer to execute: processing for acquiring a parameter relating to an environment in which a vessel is placed; processing for acquiring a first index value indicating a likelihood of occurrence of fouling of a water contacting surface of the vessel per unit time in the environment; and processing for specifying a second index value indicating a likelihood of occurrence of fouling of the water contacting surface of the vessel in a first period in the environment, based on the first index value.

[0025] Also, the present invention proposes, as a fourteenth aspect, a computer-readable storage medium permanently storing a program for causing a computer to execute: processing for acquiring a parameter relating to an environment in which a vessel is placed; processing for acquiring a first index value indicating a likelihood of occurrence of fouling of a water contacting surface of the vessel per unit time in the environment; and processing for specifying a second index value indicating the likelihood of the occurrence of fouling of the water contacting surface of the vessel in a first period in the environment, based on the first index value.

Advantageous Effects of the Invention

[0026] According to the first aspect of the present invention, the company that operates the vessel or the like can obtain objective information relating to the likelihood of the occurrence of fouling of the vessel accompanying a voyage of the vessel in a certain period.

[0027] According to the second aspect of the present invention, the company that operates the vessel or the like can know the decrease amount of the anti-fouling paint or the anti-fouling component contained in the anti-fouling paint accompanying a voyage of the vessel in a certain period.

[0028] According to the third aspect of the present invention, the company that operates the vessel or the like can know the decrease amount of the anti-fouling paint or the anti-fouling component contained in the anti-fouling paint accompanying a voyage of the vessel over a long period.

5 [0029] According to the fourth aspect of the present invention, the company that operates the vessel or the like can know the remaining amount of the anti-fouling paint or the anti-fouling component contained in the anti-fouling paint coating the vessel body at a certain point in time.

[0030] According to the fifth aspect of the present invention, the company
10 that operates the vessel or the like can specify the appropriate anti-fouling paint from the viewpoint of the decrease amount of the anti-fouling paint or the anti-fouling component contained in the anti-fouling paint.

[0031] According to the sixth aspect of the present invention, a more accurate decrease amount of the anti-fouling paint or the anti-fouling
15 component contained in the anti-fouling paint is specified compared to the case in which the index value is not corrected.

[0032] According to the seventh aspect of the present invention, the company that operates the vessel or the like can know the degree of the increase in the resistance that occurs during the voyage of the vessel
20 accompanying the advancement of fouling of the vessel body in a certain period.

[0033] According to the eighth aspect of the present invention, the degree of the increase in the resistance that occurs during the voyage of the vessel is specified more accurately in comparison to the case in which the decrease
25 amount of the anti-fouling paint or the anti-fouling component contained in the anti-fouling paint is not used as a parameter.

[0034] According to the ninth aspect of the present invention, the degree of the increase in the resistance that occurs during the voyage of the vessel is specified based on the vessel speed of the vessel, fuel consumption, and the
30 like.

[0035] According to the tenth aspect of the present invention, the company that operates the vessel or the like can know the degree of the increase in the resistance that occurs during the voyage of the vessel over a long period.

[0036] According to the eleventh aspect of the present invention, the company that operates the vessel or the like can specify the appropriate anti-fouling paint from the viewpoint of the degree of increase in the resistance that occurs during a voyage of the vessel.

[0037] According to the twelfth aspect of the present invention, the degree of increase in the resistance that occurs during the voyage of the vessel is specified more accurately in comparison to the case in which the index value is not corrected.

[0038] According to the thirteenth or fourteenth aspect of the present invention, the apparatus according to the first aspect of the present invention is realized by a computer.

Brief Description of Drawings

[0039] FIG. 1 is a diagram showing an overall configuration of a vessel body fouling risk management system according to an embodiment.

FIG. 2 is a diagram showing a basic configuration of a computer to be employed as hardware for a terminal apparatus according to an embodiment.

FIG. 3 is a diagram showing a basic configuration of a computer to be employed as hardware for a server apparatus according to an embodiment.

FIG. 4 is a diagram showing a functional configuration of a terminal apparatus according to an embodiment.

FIG. 5 is a diagram illustrating a data configuration of a parameter table to be stored in a terminal apparatus according to an embodiment.

FIG. 6 is a diagram showing a functional configuration of a server apparatus according to an embodiment.

FIG. 7 is a diagram illustrating a data configuration of a paint decrease amount master table stored in a server apparatus according to an

embodiment.

FIG. 8 is a diagram illustrating a data configuration of an attachment strength master table stored in a server apparatus according to an embodiment.

5 FIG. 9 is a diagram illustrating a data configuration of a resistance increase amount master table stored in a server apparatus according to an embodiment.

FIG. 10 is a diagram illustrating a data configuration of a log table stored in a server apparatus according to an embodiment.

10 FIG. 11 is a diagram illustrating a fouling risk display screen displayed by a terminal apparatus according to an embodiment.

FIG. 12 is a diagram illustrating a fouling factor display screen displayed by a terminal apparatus according to an embodiment.

15 FIG. 13 is a diagram illustrating a fouling risk display screen displayed by a terminal apparatus according to a modified example.

Description of Embodiments

[0040] Embodiment

Hereinafter, vessel body fouling risk management system 1 according to an embodiment of the present invention will be described. FIG. 1 is a diagram showing an overall configuration of vessel body fouling risk management system 1. Vessel body fouling risk management system 1 is a system for managing the likelihood of the occurrence of fouling (hereinafter referred to as “fouling risk”) caused by the attachment (hereinafter simply referred to as “fouling”) of foreign matter such as organisms (hereinafter referred to as “attached matter”) to the water contacting surface (hereinafter referred to as “vessel body”) of vessel 8. Vessel body fouling risk management system 1 includes terminal apparatus 11 arranged on vessel 8, server apparatus 12 for performing data communication with terminal apparatus 11 via communication satellite 9, and terminal apparatus 13

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arranged on land, for example.

[0041] Terminal apparatus 11 acquires parameters that influence fouling of the vessel body of vessel 8 and transmits the parameters to server apparatus 12. Also, a crew member or the like of vessel 8 uses terminal apparatus 11 to browse data accumulated in server apparatus 12.

[0042] Server apparatus 12 specifies index values indicating fouling risk based on parameters transmitted from terminal apparatus 11 and accumulates them. In the present embodiment, an index value indicating a remaining amount of an anti-fouling paint or an anti-fouling component contained in the anti-fouling paint (hereinafter referred to as “paint remaining amount”), and an index value indicating a degree of influence (hereinafter referred to as “resistance increase amount”) that fouling of the vessel body has on an increase in resistance that occurs during a voyage of the vessel (hereinafter simply referred to as “resistance”) are used as the index values for the fouling risk of the vessel. Specific examples of an index value for the paint remaining amount and an index value for the resistance increase amount will be described later.

[0043] A worker of a company that operates vessel 8, a staff member of a company that coats vessel 8 with the anti-fouling paint, a staff member of a company that manufactures the anti-fouling paint, or the like uses terminal apparatus 13 to browse the data accumulated in server apparatus 12.

[0044] Note that although only one each of vessel 8 and terminal apparatus 11 are shown in FIG. 1, there are normally multiple vessels 8 and terminal apparatuses 11. If there are multiple vessels 8 and terminal apparatuses 11, server 12 specifies the index values for the fouling risk based on the parameters sent from terminal apparatuses 11 regarding multiple vessels 8 and accumulates them. Also, although only one terminal apparatus 13 is shown in FIG. 1, the number of terminal apparatuses 13 changes depending on the number of users browsing the data stored in server apparatus 12.

[0045] The hardware configurations of terminal apparatus 11 and terminal

apparatus 13 are computers for general terminal apparatuses. FIG. 2 is a diagram showing a basic configuration of computer 10 employed as hardware for terminal apparatus 11 and terminal apparatus 13. Computer 10 includes: memory 101 that stores various types of data; processor 102 that performs various types of data processing according to programs stored in memory 101; communication IF 103, which is an IF (interface) for performing data communication with another apparatus; display apparatus 104 such as a liquid crystal display for displaying images to a user; and operation apparatus 105 such as a keyboard that receives user operations.

[0046] Note that an external display apparatus that is connected to computer 10 may be used instead of display apparatus 104 built in computer 10. Also, an external operation apparatus that is connected to computer 10 may be used instead of operation apparatus 105 built in computer 10.

[0047] The hardware configuration of server apparatus 12 is a computer for a general server apparatus, for example. FIG. 3 is a diagram showing a basic configuration of computer 20 employed as hardware for server apparatus 12. Computer 20 includes: memory 201 that stores various types of data; processor 202 that performs various types of data processing according to programs stored in memory 201; and communication IF 203 for performing data communication with another apparatus.

[0048] FIG. 4 is a diagram showing a functional configuration of terminal apparatus 11. That is, computer 10 functions as an apparatus including the configurations shown in FIG. 4 by executing data processing according to a program for terminal apparatus 11. Hereinafter, functional constituent units of terminal apparatus 11 shown in FIG. 4 will be described.

[0049] Parameter acquisition means 111 acquires various types of parameters relating to the environment in which vessel 8 is placed (including the voyage state of vessel 8). Examples of the parameters acquired by parameter acquisition means 111 include deadweight, wind speed, tidal speed, water temperature, vessel speed, position of vessel 8

(hereinafter simply referred to as “position”), and fuel consumption per unit time. Among these parameters, the water temperature, vessel speed, and position are used as parameters that have an influence on the fouling risk of the vessel body in the present embodiment. Vessel 8 includes various types of measurement apparatuses, such as a water temperature meter, a vessel speedometer, and a GNSS (Global Navigation Satellite System), and parameter acquisition means 111 continuously acquires various types of parameters such as the water temperature, vessel speed, and position measured by these various types of measurement apparatuses. Note that parameter acquisition means 111 may acquire a parameter input by a crew member or the like of vessel 8 (e.g., a trim value or the like measured visually by a crew member of vessel 8 who does not have a trim meter), for example, in addition to the parameters measured by the measurement apparatus.

[0050] Storage means 112 stores parameters acquired by parameter acquisition means 111. FIG. 5 is a diagram illustrating a data configuration of a parameter table storing parameters acquired by parameter acquisition means 111. The parameter table is a collection of records for each period of a predetermined length of time. Representative values (e.g., average values and most recent values) of the parameters acquired in a target period are stored in the records in the parameter table.

[0051] Returning to FIG. 4, the description of the functional configuration of terminal apparatus 11 will continue. Upon each elapse of the predetermined time, for example, transmission means 113 reads out untransmitted parameters from the parameter table stored in storage means 112 and transmits them to server apparatus 12.

[0052] FIG. 6 is a diagram showing a functional configuration of server apparatus 12. That is, computer 20 functions as an apparatus including the configuration shown in FIG. 6 by executing data processing according to a program for server apparatus 12. Hereinafter, functional constituent units

of server apparatus 12 shown in FIG. 6 will be described.

[0053] Reception means 120 receives the parameters transmitted from terminal apparatus 11. That is, reception means 120 fulfills a role as a parameter acquisition means in server apparatus 12. Note that the transmission source of the parameters received by reception means 120 is not limited to terminal apparatus 11, and for example, parameters that are input to terminal apparatus 13 by a worker for a company that operates vessel 8 or the like and are transmitted from terminal apparatus 13 may be received by reception means 120 of server apparatus 12.

[0054] Storage means 121 stores various types of data. Storage means 121 stores a paint decrease amount master table, an attachment strength master table, a resistance increase amount master table, and a log table. Hereinafter, the data configurations of these tables will be described.

[0055] FIG. 7 is a diagram illustrating a data configuration of a paint decrease amount master table. The paint decrease amount master table is a table indicating decrease amounts (hereinafter referred to as “paint decrease amounts per unit time”) of an anti-fouling paint or an anti-fouling component included in the anti-fouling paint per unit time according to various combinations of water temperature and vessel speed. In the present embodiment, the anti-fouling paint that coats the vessel body is a paint film consumption type of anti-fouling paint, and the remaining amount of the anti-fouling component included in the anti-fouling paint is proportional to the paint film thickness of the remaining anti-fouling paint. Accordingly, in the present embodiment, the decrease amount of the paint film thickness of the anti-fouling paint per day (mm/day) is used as the paint decrease amount per unit time. For example, a second record in the paint decrease amount master table illustrated in FIG. 7 indicates that the film thickness of the anti-fouling paint decreases at a speed of 0.037 mm per day if vessel 8 voyages at a vessel speed of 1 knot in water with a water temperature of 10°C.

[0056] As shown in FIG. 7, when the vessel speed is 0 knots, or in other words, when vessel 8 is stopped or moored, the paint decrease amount per unit time differs according to the amount of time for which the vessel continues to be stopped or moored. In general, when the amount of time for which the vessel continues to be stopped or moored increases, the paint decrease amount per unit time decreases. Accordingly, when the time of stopping or mooring continues, fouling of the vessel is more likely to advance.

[0057] FIG. 8 is a diagram illustrating a data configuration of the attachment strength master table. The attachment strength master table is a table indicating the strengths of attachment to the vessel body (hereinafter referred to as “attachment strength”) of organisms in various bodies of water through which vessel 8 may voyage.

[0058] FIG. 9 is a diagram illustrating a data configuration of a resistance increase amount master table. The resistance increase amount master table is a table indicating index values for the resistance increase amount per unit time (hereinafter referred to as “index values for the reference resistance increase amount per unit time”), which are to serve as references corresponding to various combinations of vessel speed and paint decrease amount per unit time.

[0059] In the present embodiment, R_k shown in Equation 1 below is used as an index value for the resistance increase amount.

[Equation 1]

$$R_k = C_k / S_k^3 - C_0 / S_0^3 \quad \cdot \cdot \cdot \quad (1)$$

[0060] Note that C_0 is the fuel consumption per unit time (tons/day) when vessel 8, which has an unfouled vessel body, voyages at vessel speed S_0 (knots). Also, C_k is the fuel consumption per unit time (tons/day) when vessel 8, in which the degree of fouling of the vessel body is k , voyages at vessel speed S_k (knots).

[0061] Note that vessel speed S_0 and fuel consumption per unit time C_0 are

obtained by carrying out correction based on parameters such as the wind speed, tidal speed, and deadweight (parameters other than the resistance increase amount accompanying fouling of the vessel body, which have an influence on the vessel speed and the fuel consumption per unit time), and are the vessel speed and fuel consumption per unit time in the case where vessel 8, which has an unfouled vessel body, voyages through a reference environment (e.g., in an environment in which wind speed is 0 m/sec, tidal speed is 0 m/sec, deadweight is 10,000 tons, and the like). Similarly, vessel speed S_k and fuel consumption per unit time C_k are obtained by carrying out correction based on parameters such as the wind speed, tidal speed, and deadweight, and are the vessel speed and fuel consumption per unit time in the case where vessel 8, in which the degree of fouling of the vessel body is k , voyages through a reference environment.

[0062] It is known that the vessel speed is approximately proportional to the horsepower cubed if vessel 8 voyages in an environment with the same wind speed, tidal speed, deadweight, and the like. Since the fuel consumption per unit time is approximately proportional to the horsepower, the vessel speed is approximately proportional to the fuel consumption per unit time cubed. Accordingly, when vessel 8 with an unfouled vessel body voyages, C_0/S_0^3 takes an approximately constant value, regardless of the magnitude of vessel speed S_0 . Similarly, when vessel 8 with a vessel body fouling degree of k voyages, C_k/S_k^3 takes an approximately constant value regardless of the magnitude of vessel speed S_k . When vessel body fouling degree k increases, C_k/S_k^3 increases. Accordingly, R_k shown in Equation 1 fulfills the role of an index value indicating the magnitude of the resistance increase amount accompanying fouling of the vessel body.

[0063] The index values for the reference resistance increase amount per unit time shown in the resistance increase amount master table (FIG. 9) indicate increase amounts of index value R_k when vessel 8 voyages for one day through a body of water with an attachment strength of “1”. For

example, the first record in the resistance increase amount master table illustrated in FIG. 9 indicates that index value R_k increases by 0.118 accompanying advancement of the fouling of the vessel in the case where vessel 8 voyages through a body of water with an attachment strength of “1” at a vessel speed of 5 knots and the paint decrease amount per unit time at that time is 0.035 mm/day.

[0064] The data stored in the paint decrease amount master table, the attachment strength master table, and the resistance increase amount master table differs depending on the type of the anti-fouling paint. These tables are created for each type of anti-fouling paint by the company that operates vessel body fouling risk management system 1 or the like based on performance data of the anti-fouling paint obtained from the company that manufactures the anti-fouling paint, the water depths of bodies of water, the types of organisms inhabiting the bodies of water, and the like, for example, and these tables are stored in storage means 121.

[0065] FIG. 10 is a diagram illustrating a data configuration of a log table. The log table is a table for accumulating various types of parameters that reception means 120 continuously receives from terminal apparatus 11, and accumulating various types of data generated by server apparatus 12 using these various types of parameters. The log table is provided with “body of water”, “corrected vessel speed”, “intra-period paint decrease amount”, “cumulative paint decrease amount”, “paint remaining amount”, “intra-period R_k increase amount”, “estimated R_k ”, and “actual R_k ” as fields for storing the various types of data generated by server apparatus 12. The data stored in these fields will be described later.

[0066] New records are added to the log table each time the combination of parameters received from terminal apparatus 11 changes. Data indicating the period for which the combination of parameters received from terminal apparatus 11 is maintained is stored in the “period” field of the log table. When a new record is added to the log table, data indicating the period for

which the combination of parameters was maintained is stored in the “period” field of the record (hereinafter referred to as “current record”) prior to the new record.

[0067] Returning to FIG. 6, description of the functional constituent units of server apparatus 12 will continue. When a new record is added to the log table, parameter correction means 122 specifies a corrected vessel speed obtained by correcting the vessel speed of the new record based on the deadweight, wind speed, tidal speed, and the like of the new record. The corrected vessel speed specified by parameter correction means 122 is an estimated value of the vessel speed of vessel 8 in the case where it is assumed that vessel 8 performs a voyage with a horsepower corresponding to the fuel consumption per unit time indicated in the new record, in a reference environment (e.g., an environment in which the wind speed is 0 m/sec, tidal speed is 0 m/sec, deadweight is 10,000 tons, and the like). The corrected vessel speed specified by parameter correction means 122 is stored in the “corrected vessel speed” field of the new record.

[0068] Also, when a new record is added to the log table, parameter correction means 122 specifies the body of water corresponding to the position of the new record, in accordance with map data stored in advance in storage means 121, for example. The body of water specified by parameter correction means 122 is stored in the “body of water” field of the new record.

[0069] Each time a new record is added to the log table (FIG. 10), index value acquisition means 123 reads out the period, water temperature, vessel speed, and body of water from the current record, reads out the index values corresponding to those parameters from the paint decrease amount master table (FIG. 7), the attachment strength master table (FIG. 8), and the resistance increase amount master table (FIG. 9), and transfers them to index value specification means 124.

[0070] More specifically, if the vessel speed of the current record is 0 knots, index value acquisition means 123 reads out a paint decrease amount per

unit time corresponding to the combination of the water temperature and vessel speed of the current record and the amount of time for which the vessel speed of 0 knots continues, which is indicated by the period of the current record and the period of a record read-out in the past, from the paint decrease amount master table (FIG. 7). If the vessel speed of the current record is not 0 knots, index value acquisition means 123 reads out the paint decrease amount per unit time corresponding to the combination of the water temperature and the vessel speed of the current record from the paint decrease amount master table (FIG. 7).

[0071] Next, from the attachment strength master table (FIG. 8), index value acquisition means 123 reads out the attachment strength corresponding to the body of water read out from the log table. Also, from the resistance increase amount master table (FIG. 9), index value acquisition means 123 reads out the index value for the reference resistance increase amount per unit time corresponding to the combination of the vessel speed read out from the log table and the paint decrease amount per unit time read out from the paint decrease amount master table. Index value acquisition means 123 transfers the read-out paint decrease amount per unit time, attachment strength, and index value for the reference resistance increase amount per unit time to index value specification means 124.

[0072] Each time a new record is added to the log table (FIG. 10), index value specification means 124 reads out the period from the current record and receives the paint decrease amount per unit time, attachment strength, and index value for the reference resistance increase amount per unit time corresponding to the current record from index value acquisition means 123.

[0073] Index value specification means 124 calculates the intra-period paint decrease amount by multiplying the length of time of the period read out from the log table by the paint decrease amount per unit time received from index value acquisition means 123. The intra-period paint decrease amount is an amount of anti-fouling paint that dissolves in the period corresponding

to the current record. Index value specification means 124 stores the calculated intra-period paint decrease amount in the “intra-period paint decrease amount” field of the current record.

[0074] When the intra-period paint decrease amount is stored in the current record of the log table, index value specification means 124 adds the intra-period paint decrease amount of the current record to the cumulative paint decrease amount of the record prior to the current record to calculate a new cumulative paint decrease amount. The cumulative paint decrease amount is an amount of anti-fouling paint that has dissolved in the period from the time when coating with the anti-fouling paint was last performed on vessel 8 to the current time. Index value specification means 124 stores the calculated cumulative paint decrease amount in the “cumulative paint decrease amount” field of the current record.

[0075] Also, index value specification means 124 calculates the intra-period R_k increase amount by multiplying the attachment strength received from index value acquisition means 123 and the length of time of the period read out from the log table, by the index value for the reference resistance increase amount per unit time received from index value acquisition means 123. The intra-period R_k increase amount is an index value indicating an increase amount of resistance accompanying fouling of the vessel body that has advanced in the period corresponding to the current record. Index value specification means 124 stores the calculated intra-period R_k increase amount in the “intra-period R_k increase amount” field of the current record.

[0076] When the intra-period R_k increase amount is stored in the current record of the log table, index value specification means 124 calculates a new estimated R_k by adding the intra-period R_k increase amount of the current record to the estimated R_k of the record prior to the current record. Index value specification means 124 stores the calculated estimated R_k in the “estimated R_k ” field of the current record.

[0077] Also, index value specification means 124 reads out the corrected

vessel speed and the fuel consumption per unit time from the current record of the log table and calculates R_k according to Equation 1 described above using read-out corrected vessel speed S_k and read-out fuel consumption per unit time as C_k . Hereinafter, “actual R_k ” will be used in order to distinguish
5 R_k calculated by index value specification means 124 according to Equation 1 from the above-described estimated R_k . Index value specification means 124 stores the calculated actual R_k in the “actual R_k ” field of the current record.

[0078] The estimated R_k and the actual R_k calculated by index value
10 specification means 124 are both index values indicating the increase amount of the resistance accompanying fouling of the vessel body that has advanced in the period from the time when the vessel body of vessel 8 was last cleaned to the present time.

[0079] From storage means 121, remaining amount acquisition means 125
15 reads out data (hereinafter referred to as “reference-time remaining amount data”) indicating the remaining amount of paint at the time when coating with the anti-fouling paint was last performed, and transfers it to remaining amount specification means 126. Note that the reference-time remaining amount data is data that is input to terminal apparatus 13 by a worker of
20 the company that operates vessel 8, for example, and is transmitted from terminal apparatus 13 to server apparatus 12.

[0080] When the cumulative paint decrease amount is stored in the current record of the log table, remaining amount specification means 126 calculates the paint remaining amount by subtracting the cumulative paint decrease
25 amount of the current record from the paint remaining amount indicated by the reference-time remaining amount data received from remaining amount acquisition means 125. The paint remaining amount is the current remaining amount of the paint. Remaining amount specification means 126 stores the calculated paint remaining amount in the “paint remaining
30 amount” field of the current record.

[0081] Transmission means 127 transmits various types of data to terminal apparatus 11 or terminal apparatus 13. The functional constituent units of server apparatus 12 have been described above.

[0082] Terminal apparatus 13 gives a request for data relating to the fouling risk of vessel 8 to server apparatus 12 according to a user operation, and displays information relating to the fouling risk of vessel 8 in accordance with data transmitted from server apparatus 12 according to the request. Since terminal apparatus 13 is a general terminal apparatus that receives data transmission from server apparatus 12, description of the functional configuration of terminal apparatus 13 is omitted.

[0083] FIG. 11 is a diagram illustrating a fouling risk display screen displayed by terminal apparatus 11 or terminal apparatus 13 in accordance with data transmitted from server apparatus 12. The vessel name for identifying vessel 8, the date on which coating with the anti-fouling paint was last performed on vessel 8, the film thickness at the time of painting, the paint name for identifying the type of the anti-fouling paint, and the date on which the vessel body of vessel 8 was last cleaned are displayed on the fouling risk display screen.

[0084] Also, an index value indicating the “ R_k increase speed” is displayed on the fouling risk display screen. The R_k increase speed is a value obtained by dividing the intra-period R_k increase amount of the most recent record in the log table by the length of time of the period of the record, and indicates the advancement rate of the fouling of the vessel body.

[0085] Also, a graph that is generated according to the data in the “period” field and the “paint remaining amount” field of the log table and indicates change over time in the remaining amount of the paint, and a graph that is generated according to the data in the “period” field and the “actual R_k ” field (or the “estimated R_k ” field) of the log table and indicates change over time in the index value of the resistance increase amount are displayed on the fouling risk display screen.

[0086] By viewing the fouling risk display screen, a crew member of vessel 8, a worker of the company that operates vessel 8, a worker of the company that manufactures the anti-fouling paint, a worker of the company that performs coating with the anti-fouling paint, or the like can find out the remaining amount of the paint film thickness of vessel 8 and the resistance increase amount accompanying the advancement of fouling of the vessel body essentially in real time.

[0087] FIG. 12 is a diagram illustrating a fouling factor display screen displayed by terminal apparatus 11 or terminal apparatus 13 in accordance with data transmitted from server apparatus 12. Histograms for the water temperature, vessel speed, and attachment strength are displayed for the period from the day when coating with the anti-fouling paint was last performed on vessel 8 to the current time are displayed on the fouling factor display screen.

[0088] The vertical axis of the histogram for water temperature displayed on the fouling factor display screen indicates the integrated values for time of being at the water temperatures indicated on the horizontal axis in the target period. Also, the vertical axis of the histogram for vessel speed displayed on the fouling factor display screen indicates the integrated values for time of performing voyage at the vessel speeds indicated on the horizontal axis in the target period. Also, the vertical axis of the histogram for attachment strength displayed on the fouling factor display screen indicates the integrated values for time of voyaging in bodies of water with the attachment strengths indicated on the horizontal axis in the target period.

[0089] By viewing the fouling factor display screen, a crew member of vessel 8, a worker of the company that operates vessel 8, a worker of the company that manufactures the anti-fouling paint, a worker of the company that performs coating with the anti-fouling paint, or the like can survey the strength and weakness of factors that have an influence on the fouling of the vessel in the environment in which a voyage of vessel 8 is performed.

[0090] According to vessel body fouling risk management system 1, a crew member of vessel 8, a worker of a company that operates vessel 8, a worker of a company that performs coating with the anti-fouling paint, or the like can correctly determine the timing of adding a coat of anti-fouling paint and cleaning the vessel body, and the specifications (type and paint film thickness) of the anti-fouling paint to be added. Also, according to vessel body fouling risk management system 1, the manufacturing company of the anti-fouling paint can develop an anti-fouling paint with a performance suitable for the environment through which vessel 8 voyages.

[0091] Modified Example

The above-described embodiment can be modified in various ways within the scope of the technical idea of the present invention. Examples of these modifications will be given below. Note that two or more modified examples below may be combined.

[0092] (1) In the above-described embodiment, server apparatus 12 specifies the remaining amount of the paint, the index value for the resistance increase amount, and the like each time a new record is added to the log table (FIG. 10). The timing for specifying the paint remaining amount, the index value for the resistance increase amount, and the like is not limited thereto. For example, it is also possible to employ a configuration in which server apparatus 12 specifies the remaining amount of the paint, the index value for the resistance increase amount, and the like for an unprocessed record in the log table each time a predetermined amount of time elapses.

[0093] (2) In the above-described embodiment, server apparatus 12 specifies the remaining amount of the paint, the index value for the resistance increase amount, and the like for a voyage performed in the past. The target period in which the paint remaining amount, the index value for the resistance increase amount, and the like are specified is not limited to a past period. For example, it is also possible to employ a configuration in which

server apparatus 12 specifies the remaining amount of the paint, the index value for the resistance increase amount, and the like for a planned voyage of vessel 8 in a future period.

[0094] In such a case, reception means 120 of server apparatus 12 receives, from terminal apparatus 13 or the like, a future planned voyage schedule for vessel 8 (vessel route and date of voyage), planned deadweight for the voyage according to the voyage schedule, an estimated value for the water temperature of the body of water through which vessel 8 is to voyage according to the voyage schedule (e.g., average water temperature or the like in a period of voyaging), an estimated value for weather phenomena or marine phenomena encountered by vessel 8 that is to voyage according to the voyage schedule (e.g., average wind speed, average tidal speed, and the like in the period and body of water in which the voyage is to be performed), and the like, and reception means 120 writes the received data in the log table (FIG. 10). At this time, the case described in the above-described embodiment is similar in that a record is added each time the combination of the water temperature, vessel speed, and the like changes, and data indicating the period for which the combination of the water temperature, vessel speed, and the like is maintained is stored in the “period” field.

[0095] Parameter correction means 122, index value acquisition means 123, index value specification means 124, remaining amount acquisition means 125, and remaining amount specification means 126 use the data such as the period, water temperature, and vessel speed relating to the future voyage written in the log table to calculate the body of water, corrected vessel speed, intra-period paint decrease amount, intra-period R_k increase amount, cumulative paint decrease amount, paint thickness remaining amount, estimated R_k , and actual R_k , and store these calculated values in the log table.

[0096] FIG. 13 is a diagram illustrating a fouling risk display screen displayed on terminal apparatus 11 or terminal apparatus 13 in this

modified example. The solid line portion of the graph on the left side shown on the fouling risk display screen illustrated in FIG. 13 indicates transitions in the paint remaining amount specified based on a record relating to a past period of a record stored in the log table, and the broken line portion indicates transitions in the paint remaining amount specified based on the record relating to the future period. Also, the solid line portion of the graph on the right side shown on the fouling risk display screen illustrated in FIG. 13 indicates transitions in the actual R_k specified based on a record relating to a past period of a record stored in the log table, and the broken line portion indicates transitions in the estimated R_k specified based on the record relating to the future period.

[0097] According to this modified example, by viewing the fouling risk display screen, the company that operates vessel 8 or the like can make arrangements with sufficient temporal leeway such that a coat of the anti-fouling paint is added and the vessel body is cleaned at the appropriate timing. Also, by viewing the fouling risk display screen, the company that operates vessel 8 or the like can know in advance the vessel body fouling risk in the case of following the planned voyage schedule.

[0098] (3) In the above-described embodiment, server apparatus 12 specifies the paint remaining amount, the index value for the resistance increase amount, and the like using the paint decrease amount master table, the attachment strength master table, and the resistance increase amount master table that correspond to the anti-fouling paint used on vessel 8. A configuration may be employed in which server apparatus 12 specifies the paint remaining amount, the index value for the resistance increase amount, and the like using the paint decrease amount master table, the attachment strength master table, and the resistance increase amount master table that correspond to another type of anti-fouling paint that is different from the anti-fouling paint used on vessel 8.

[0099] For example, on the fouling risk display screen (FIG. 11), paint

names corresponding to multiple types of anti-fouling paints are displayed as a list in the “paint name” field and the user can select a paint name. When the user selects a paint name from the paint names displayed in the list, terminal apparatus 11 or terminal apparatus 13 transmits the paint name
5 selected by the user to server apparatus 12. Server apparatus 12 calculates the intra-period paint decrease amount, the estimated R_k , and the like in the log table (FIG. 10) using the paint decrease amount master table, the attachment strength master table, and the resistance increase amount master table corresponding to the paint name transmitted from terminal
10 apparatus 11 or terminal apparatus 13, and updates the log table. The graphs on the fouling risk display screen are updated according to the data of the updated log table.

[0100] According to this modified example, a crew member or the like of vessel 8 can know the transitions in the remaining amount of the paint and
15 the resistance increase amount accompanying fouling of the vessel in the case of hypothetically using a type of anti-fouling paint that is different from the anti-fouling paint currently being used. Accordingly, a crew member or the like of vessel 8 can specify the anti-fouling paint that is appropriate for the voyage of vessel 8 by sequentially selecting the paint names of various
20 anti-fouling paints on the fouling risk display screen.

[0101] Also, a configuration may be employed in which server apparatus 12 calculates the intra-period paint decrease amount, the estimated R_k , and the like for every selectable type of anti-fouling paint and provides, to the user, the paint names of the anti-fouling paints that were extracted and sorted
25 according to predetermined conditions (e.g., conditions relating to the length of the period up to when the remaining amount of the paint reaches a predetermined threshold indicating a limit value, and the length of a period up to when the index value for the resistance increase amount reaches a predetermined threshold value indicating a limit value) based on the
30 calculation results.

[0102] (4) A configuration may be used in which server apparatus 12 corrects the paint decrease amount per unit time in the paint decrease amount master table (FIG. 7) based on the measured remaining amount of the paint.

5 [0103] In this modified example, server apparatus 12 includes a decrease amount acquisition means and an index value correction means as functional constituent units. Each time the remaining paint film thickness is measured and input to server apparatus 12, the decrease amount acquisition means calculates the measurement value for the decrease amount of the paint film thickness in the period from the timing when the previous measurement was performed up to the timing when the most recent measurement was performed (hereinafter referred to as “decrease amount measurement period”), and stores it in storage means 121. Measurement of the remaining paint film thickness is performed by a paint film thickness measurement device when vessel 8 enters a dock, for example.

15 [0104] After the measurement values for the decrease amount of the paint film thickness relating to multiple decrease amount measurement periods are accumulated in storage means 121, the index value correction means extracts the record for the period corresponding to the decrease amount measurement period from the log table (FIG. 10) for each of the multiple decrease amount measurement periods. From the paint decrease amount master table (FIG. 7), the index value correction means reads out the decrease amount per unit time corresponding to the combination of water temperature and vessel speed of the extracted record.

25 [0105] The index value correction means specifies the paint film thickness decrease amount in the decrease amount measurement period by adding up the intra-period paint decrease amounts in the record extracted from the log table. The decrease amount is the decrease amount specified by index value specification means 124. For each of the multiple decrease amount measurement periods, the index value correction means adjusts the paint

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decrease amount per unit time read out from the paint decrease amount master table (FIG. 7) such that the decrease amount of the paint film thickness specified by index value specification means 124 approaches the measurement value of the decrease amount of the paint film thickness
5 calculated by the decrease amount acquisition unit. The index value correction means updates the decrease amount master table using the adjusted paint decrease amount per unit time.

[0106] According to this modified example, the index value used to specify the remaining amount of the paint is corrected based on the measured paint
10 remaining amount. As a result, the accuracy of the paint remaining amount specified by server apparatus 12 increases.

[0107] Also, a configuration may be used in which the index value correction means corrects the attachment strength in the attachment strength master table (FIG. 8) and the index value for the reference resistance increase
15 amount per unit time in the resistance increase amount master table (FIG. 9) based on the actual R_k (measurement value for the degree of influence on the increase in resistance that occurs during a voyage of the vessel) specified by index value specification means 124 (an example of an influence degree acquisition means). In this case, every time the attachment strength stored
20 in the attachment strength master table and the index value for the reference resistance increase amount per unit time stored in the resistance increase amount master table are modified, the index value correction means repeats the processing for calculating the estimated R_k using the data accumulated in the log table, and adjusts the attachment strength and the
25 index value for the reference resistance increase amount per unit time such that the estimated R_k is closer to the actual R_k . The index value correction means updates the attachment strength master table using the adjusted attachment strength and updates the resistance increase amount master table using the adjusted index value for the reference resistance increase
30 amount per unit time.

[0108] In this case, the index value used to specify the estimated R_k is corrected based on the actual R_k specified based on the calculated vessel speed and fuel consumption per unit time. As a result, the accuracy of the estimated R_k specified by server apparatus 12 increases.

5 [0109] (5) In the above-described embodiment, a portion of the processing performed by server apparatus 12 may be performed by terminal apparatus 11. For example, the following configuration may be employed. Terminal apparatus 11 includes parameter correction means 122, index value acquisition means 123, index value specification means 124, remaining
10 amount acquisition means 125, and remaining amount specification means 126, which are included in server apparatus 12 according to the above-described embodiment. Also, storage means 112 of terminal apparatus 11 stores various types of data stored by storage means 121 of server apparatus 12 according to the above-described embodiment.
15 Terminal apparatus 11 specifies the paint remaining amount, the estimated R_k , the actual R_k , and the like and accumulates them in the log table, and each time a predetermined amount of time elapses, for example, terminal apparatus 11 transmits the untransmitted data in the log table to server apparatus 12. Server apparatus 12 stores a copy of the log table stored by
20 terminal apparatus 11 in storage means 121 and stores the data transmitted from terminal apparatus 11 in the log table in storage means 121.

[0110] According to this modified example as well, a crew member or the like of vessel 8 can use terminal apparatus 11 or terminal apparatus 13 to access server apparatus 12 and view the fouling risk display screen and the
25 fouling factor display screen.

[0111] (6) In the above-described embodiment, the anti-fouling paint was of a paint film consumption type, but the anti-fouling paint used on vessel 8 for which the fouling risk is managed by vessel body fouling risk management system 1 is not limited to being of a paint film consumption type. If an
30 anti-fouling paint that is not of a paint film consumption type is used on

vessel 8 managed by vessel body fouling risk management system 1, the decrease amount and remaining amount of the paint film thickness in the above-described embodiment can be rephrased as a decrease amount and remaining amount of an anti-fouling component contained in the anti-fouling paint.

[0112] (7) In the above-described embodiment, server apparatus 12 uses the water temperature, vessel speed, and position of vessel 8 to specify the index values for the paint remaining amount and the resistance increase amount. The parameters used to specify the index values for the paint remaining amount and the resistance increase amount are not limited to the water temperature, vessel speed, and position of vessel 8. For example, other types of parameters, such as wave height, draft, and water depth and water temperature of body of water through which the voyage is performed may be used to specify the index values for the paint remaining amount and the resistance increase amount.

[0113] (8) In the above-described embodiment, server apparatus 12 receives the parameters measured on vessel 8 from terminal apparatus 11 and uses them. The parameters used by server apparatus 12 need not be parameters measured on vessel 8. For example, server apparatus 12 may receive the water temperature, wind speed, tidal speed, and the like, which are transmitted from a server apparatus that transmits various types of data relating to weather phenomena and marine phenomena, and server apparatus 12 may use them.

[0114] (9) In the above-described embodiment, server apparatus 12 specifies the index values for the paint remaining amount and the resistance increase amount as index values for the fouling risk of the vessel body. The index values for the fouling risk of the vessel body specified by server apparatus 12 are not limited to these.

[0115] For example, a configuration may be employed in which server apparatus 12 calculates the index values for the fouling risk of the vessel

body based on the histograms displayed on the fouling factor display screen (FIG. 12). In this case, for example, weight values corresponding to the values on the horizontal axes of the histograms are stored in storage means 121. Server apparatus 12 multiplies the weight values corresponding to the values on the horizontal axes of the histograms by the values indicated by the vertical axes of the histograms and adds the results in order to calculate an index value for the fouling risk of the vessel body. The index value calculated in this manner does not directly indicate the paint remaining amount and the resistance increase amount, but indicates how high the likelihood is that the vessel body has been fouled.

[0116] (10) In the above-described embodiment, parameter correction means 122 of server apparatus 12 specifies the vessel speed in the case where it is assumed that the fuel consumption per unit time is maintained, as the corrected vessel speed. Instead of this, a configuration may be employed in which parameter correction means 122 specifies the fuel consumption per unit time in the case where it is assumed that the vessel speed is maintained, as the corrected fuel consumption per unit time. In this case, when the estimated R_k is calculated in accordance with Equation 1, index value specification means 124 uses the vessel speed received from terminal apparatus 11 as S_k and uses the corrected fuel consumption per unit time specified by parameter correction means 122 as C_k .

[0117] (11) In the above-described embodiment, the estimated R_k , which is the index value for the resistance increase amount, is specified in accordance with Equation 1. Any index value may be used as the index value for the resistance increase amount, as long as it is an index value that is correlated with the resistance increase amount accompanying fouling of the vessel body. Accordingly, the index value for the resistance increase amount may be specified according to a calculation equation, correlation table, or the like that is different from Equation 1.

[0118] Also, in the above-described embodiment, the vessel speed and fuel

consumption per unit time are used to specify the index value for the resistance increase amount. The parameters used to specify the index value for the resistance increase amount are not limited to the combination of the vessel speed and the fuel consumption per unit time, and any combination of parameters may be used to specify the index value for the resistance increase amount, as long as it is a combination of a parameter correlated with the vessel speed, and a parameter correlated with the fuel consumption per unit time. Examples of parameters correlated with vessel speed include the propeller rotation rate. Also, examples of parameters correlated with the fuel consumption per unit time include the horsepower of the motor used to propel the vessel. Accordingly, any combination, such as the vessel speed and horsepower, the propeller rotation rate and fuel consumption per unit time, or the propeller rotation rate and horsepower, for example, may be used to specify the index value for the resistance increase amount.

[0119] (12) In the above-described embodiment, terminal apparatus 11, server apparatus 12, and terminal apparatus 13 are realized by general computers executing processing in accordance with programs. Instead of this, at least one of terminal apparatus 11, server apparatus 12, and terminal apparatus 13 may be constituted as a so-called dedicated apparatus.

[0120] (13) In the above-described embodiment, the program that is executed by computer 10 in order to realize terminal apparatus 11 may be downloaded to computer 10 via a network such as the Internet, for example, and may be permanently stored in a storage medium, distributed, and loaded to computer 10 from the storage medium.

Reference Signs List

[0121]	1	Vessel body fouling risk management system
	8	Vessel

	9	Communication satellite
	10	Computer
	11	Terminal apparatus
	12	Server apparatus
5	13	Terminal apparatus
	20	Computer
	101	Memory
	102	Processor
	103	Communication IF
10	104	Display apparatus
	105	Operation apparatus
	111	Parameter acquisition means
	112	Storage means
	113	Transmission means
15	120	Reception means
	121	Storage means
	122	Parameter correction means
	123	Index value acquisition means
	124	Index value specification means
20	125	Remaining amount acquisition means
	126	Remaining amount specification means
	127	Transmission means
	201	Memory
	202	Processor
25	203	Communication IF

CLAIMS

1. An apparatus, comprising:

a parameter acquisition means for acquiring a parameter relating to
5 an environment in which a vessel having a water contacting surface coated
with a certain type of anti-fouling coating material is placed;

an index value acquisition means for acquiring a first index value
indicating a likelihood of occurrence of fouling of the water contacting
surface per unit time corresponding to the parameter; and

10 an index value specification means for specifying a second index
value indicating the likelihood of the occurrence of fouling of the water
contacting surface in a first period in the environment, based on the first
index value.

15 2. The apparatus according to claim 1,

wherein the parameter acquisition means acquires water
temperature and vessel speed as the parameters,

the index value acquisition means acquires the first index value
indicating a decrease amount per unit time of the certain type of anti-fouling
20 coating material or an anti-fouling component contained in the anti-fouling
coating material on the water contacting surface, corresponding to the water
temperature and the vessel speed, and

based on the first index value, the index value specification means
specifies the second index value indicating a decrease amount of the certain
25 type of anti-fouling coating material or anti-fouling component contained in
the anti-fouling coating material on the water contacting surface in the first
period in the environment.

3. The apparatus according to claim 2,

30 wherein the parameter acquisition means acquires the parameters

for each of a plurality of periods constituting the first period,

the index value acquisition means acquires the first index value for each of the plurality of periods, and

for each of the plurality of periods, based on the first index value
5 acquired by the index value acquisition means for the period, the index value
specification means specifies a third index value indicating the likelihood of
the occurrence of fouling of the water contacting surface in an environment
indicated by the parameters acquired by the parameter acquisition means
for the period, and specifies the second index value based on a plurality of
10 the third index values that were specified.

4. The apparatus according to claim 3, comprising:

a remaining amount acquisition means for acquiring a remaining
amount of the certain type of anti-fouling coating material or the anti-fouling
15 component contained in the anti-fouling coating material on the water
contacting surface at a start timing of the first period; and

a remaining amount specification means for specifying a remaining
amount of the certain type of anti-fouling coating material or the
anti-fouling component contained in the anti-fouling coating material on the
20 water contacting surface at an ending timing of the first period, based on the
remaining amount of the anti-fouling component and the second index value.

5. The apparatus according to claim 3,

wherein the index value acquisition means acquires the first index
25 value for each of a plurality of types of anti-fouling coating material, and

the index value specification means specifies the second index value
for each of the plurality of types of anti-fouling material.

6. The apparatus according to claim 2, comprising:

30 a decrease amount acquisition means for acquiring a measurement

value of the decrease amount of the certain type of anti-fouling coating material or the anti-fouling component contained in the anti-fouling coating material on the water contacting surface in the first period; and

an index value correction means for, for each of a plurality of the first
5 periods, correcting the first index value based on the parameters acquired by the parameter acquisition means and the measurement value acquired by the decrease amount acquisition means.

7. The apparatus according to claim 1,
10 wherein the parameter acquisition means acquires a vessel speed and a position of the vessel as the parameters,

the index value acquisition means acquires the first index value indicating a degree of influence per unit time that attached matter on the water contacting surface has on an increase in resistance that occurs during
15 a voyage of the vessel, corresponding to the vessel speed and position of the vessel, and

based on the first index value, the index value specification means specifies the second index value indicating a degree of influence that attached matter on the water contacting surface has on an increase in
20 resistance that occurs during a voyage of the vessel, in the first period in the environment.

8. The apparatus according to claim 7, wherein the index value acquisition means acquires the decrease amount per unit time of the
25 certain type of anti-fouling coating material or the anti-fouling component contained in the anti-fouling coating material on the water contacting surface, corresponding to the vessel speed, and acquires the first index value corresponding to the decrease amount per unit time.

30 9. The apparatus according to claim 7 or 8,

wherein the parameter acquisition means acquires the parameter for each of a plurality of periods constituting the first period,

the index value acquisition means acquires the first index value for each of the plurality of periods, and

5 for each of the plurality of periods, based on the first index value acquired by the parameter acquisition means for the period, the index value specification means specifies a third index value indicating the degree of influence that attached matter on the water contacting surface has on an increase in resistance that occurs during the voyage of the vessel in the environment indicated by the parameter acquired by the parameter acquisition means for the period, and specifies the second index value based on a plurality of the third index values that were specified.

10. The apparatus according to any one of claims 9,

15 wherein the index value acquisition means acquires the first index value for each of a plurality of types of anti-fouling coating material, and

the index value specification means specifies the second index value for each of the plurality of types of anti-fouling material.

20 11. The apparatus according to claim 7, comprising:

an influence degree acquisition means for acquiring a measurement value for the degree of influence that the attached matter on the water contacting surface of the vessel has on an increase in resistance that occurs during the voyage of the vessel in the first period; and

25 an index value correction means for, for each of a plurality of the first periods, correcting the first index value based on the parameter acquired by the parameter acquisition means and the measurement value acquired by the influence degree acquisition means.

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12. The apparatus according to claim 11,

wherein the parameter acquisition means acquires the vessel speed of the vessel or a physical amount correlated with the vessel speed of the vessel, and the fuel consumption of the vessel or a physical amount

5 correlated with the fuel consumption of the vessel, as the parameters, and

the influence degree acquisition means calculates the measurement value of the degree of influence based on the vessel speed or physical amount correlated with the vessel speed, acquired by the parameter acquisition means, and the fuel consumption or physical amount correlated with the fuel
10 consumption, acquired by the parameter acquisition means.

13. A program for causing a computer to execute:

processing for acquiring a parameter relating to an environment in which a vessel having a water contacting surface coated with a certain type
15 of anti-fouling coating material is placed;

processing for acquiring a first index value indicating a likelihood of occurrence of fouling of the water contacting surface per unit time corresponding to the parameter; and

processing for specifying a second index value indicating a likelihood
20 of occurrence of fouling of the water contacting surface in a first period in the environment, based on the first index value.

14. A computer-readable storage medium permanently storing a program for causing a computer to execute:

25 processing for acquiring a parameter relating to an environment in which a vessel having a water contacting surface coated with a certain type of anti-fouling coating material is placed;

processing for acquiring a first index value indicating a likelihood of occurrence of fouling of the water contacting surface per unit time

30 corresponding to the parameter; and

processing for specifying a second index value indicating the likelihood of the occurrence of fouling of the water contacting surface in a first period in the environment, based on the first index value.