[Document Name] Description

[Title of Invention] MICROORGANISM TESTING APPARATUS

[Technical Field]

The present invention relates to a microorganism testing method and an apparatus for the method and, in particular, to a microorganism testing method suitable for detecting microorganisms such as living plankton included in ballast water or the like, and an apparatus for the method.

[Background Art]

A ship without cargo sails loaded with ballast water in order to stabilize the ship and discharges the ballast water in a sea area where cargo is loaded.

Ballast water is usually discharged in a sea area different from a sea area where the ballast water is loaded. Therefore, there is a possibility that microorganisms such as plankton and bacteria included in the ballast water are carried to an area other than an original habitat, and problems of destruction of an ecosystem and the like are caused.

In order to cope with such problems, international rules about regulations of ballast water were formulated, and "International Convention for the Control and

N appropriately estimates the number of microorganisms, it is possible to evaluate and apply the ballast water discharge standards (D-2) the same as true evaluation.

Figure 8C is a diagram in which the microbial population n1 detected by the chlorophyll fluorescence emission is subtracted from the microbial population n3 at the time of simultaneously radiating the two kinds of LED light sources 8a, 8b. The set of n3-n1 is such that the set n1 of only phytoplankton is subtracted from the set n3 in which zooplankton and the phytoplankton coexist, and only the population of the zooplankton can be determined.

The [measurement of chlorophyll fluorescence] described in paragraph 0042 and the [measurement of fluorescence by staining liquid] described in paragraph 0047 may be exchanged in order and implemented. Further, the [measurement of both of chlorophyll fluorescence and fluorescence by staining liquid] described in paragraph 0052 may be implemented first.

As described above, according to the present embodiment, there is provided a microorganism testing apparatus provided with the body portion 2, the display/operation unit 3 and the measuring portion 5 optically counting the number of microorganisms in the sample solution S accommodated in the batch-type sample container 4, the display/operation unit 3 and the

[Document Name] Claims

[Claim 1]

A microorganism testing apparatus for estimating permissible populations of living organisms included in ballast water discharged from ships on the basis of number of microorganisms included in a sample water collected in a sample container, and ascertaining whether the ballast water discharge standard is met, the microorganism testing apparatus comprising:

stirring/mixing means adding a sample and a fluorescent staining reagent into a batch-type sample container formed of material transmitting light and performing stirring/mixing of the sample solution;

an excitation light source provided with light sources causing excitation light to be continuously radiated to a radiated surface of the sample container while the sample solution is being stirred by the stirring/mixing means;

light receiving means detecting light of fluorescence emission caused by the excitation light from the excitation light source;

control means converting the light detected by the light receiving means to an electrical signal to detect and count the number of light emissions produced upon the microorganisms passing through a field of view, and calculating the number of microorganisms included in the sample in the sample container from the number of light emissions; and

an operation portion electrically connected to the control means; wherein the excitation light source includes two different kinds of excitation light sources, wherein the excitation light sources being a light source emitting light with a wavelength region causing phytoplankton to emit chlorophyll fluorescence and a light source emitting light with a wavelength region causing microorganisms stained by the fluorescent staining reagent to emit fluorescence, and

wherein the control means comprises a control portion for putting on either or both of the light sources, and an operation portion calculating a permissible number of microorganisms N to be a ballast water discharge criterion after determining each of a microbial population n1 acquired by chlorophyll fluorescence emission, a microbial population n2 acquired by fluorescence emission by the fluorescent staining reagent and a microbial population n3 acquired by both of the chlorophyll fluorescence emission and the fluorescence emission by the fluorescent staining reagent.

[Claim 2]

A microorganism testing apparatus for estimating permissible populations of living organisms included in ballast water discharged from ships on the basis of number of microorganisms included in a sample water collected in a sample container, and ascertaining whether the ballast

water discharge standard is met, the microorganism testing apparatus comprising:

stirring/mixing means adding a sample and a fluorescent staining reagent into a batch-type sample container formed of material transmitting light and performing stirring/mixing of the sample solution;

an excitation light source provided with light sources causing excitation light to be continuously radiated to a radiated surface of the sample container while the sample solution is being stirred by the stirring/mixing means;

light receiving means detecting light of fluorescence emission caused by the excitation light from the excitation light source;

control means converting the light detected by the light receiving means to an electrical signal to detect and count the number of light emissions produced upon the microorganisms passing through a field of view, and calculating the number of microorganisms included in the sample in the sample container from the number of light emissions; and

an operation portion electrically connected to the control means;

wherein the excitation light source includes two different kinds of excitation light sources, wherein the excitation light sources being a light source emitting light with a wavelength region causing phytoplankton to emit chlorophyll fluorescence and a light source emitting light with a wavelength region causing microorganisms

stained by the fluorescent staining reagent to emit fluorescence,

wherein the light sources are provided with their own band-pass filter, and

wherein the control means comprises

a control portion for putting on either or both of the light sources, and

an operation portion calculating a permissible number of microorganisms N to be a ballast water discharge criterion after determining each of a microbial population n1 acquired by chlorophyll fluorescence emission, a microbial population n2 acquired by fluorescence emission by the fluorescent staining reagent and a microbial population n3 acquired by both of the chlorophyll fluorescence emission and the fluorescence emission by the fluorescent staining reagent.

[Claim 3]

A microorganism testing apparatus for estimating permissible populations of living organisms included in ballast water discharged from ships on the basis of number of microorganisms included in a sample water collected in a sample container, and ascertaining whether the ballast water discharge standard is met, the microorganism testing apparatus comprising:

stirring/mixing means adding a sample and a fluorescent staining reagent into a batch-type sample

container formed of material transmitting light and performing stirring/mixing of the sample solution;

an excitation light source provided with light sources causing excitation light to be continuously radiated to a radiated surface of the sample container while the sample solution is being stirred by the stirring/mixing means;

light receiving means detecting light of fluorescence emission caused by the excitation light from the excitation light source;

control means converting the light detected by the light receiving means to an electrical signal to detect and count the number of light emissions produced upon the microorganisms passing through a field of view, and calculating the number of microorganisms included in the sample in the sample container from the number of light emissions; and

an operation portion electrically connected to the control means;

wherein the excitation light source includes two different kinds of excitation light sources, wherein the excitation light sources being a light source emitting light with a wavelength region causing phytoplankton to emit chlorophyll fluorescence and a light source emitting light with a wavelength region causing microorganisms stained by the fluorescent staining reagent to emit fluorescence,

wherein the light receiving means includes two light receiving portions corresponding respectively to the two

different kinds of light sources, and a dichroic mirror for spectrally dispersing the fluorescence due to the excitation light sources to direct thus dispersed fluorescence to the light receiving portions, and

wherein the control means comprises

a control portion for putting on either or both of the light sources, and

an operation portion calculating a permissible number of microorganisms N to be a ballast water discharge criterion after determining each of a microbial population n1 acquired by chlorophyll fluorescence emission, a microbial population n2 acquired by fluorescence emission by the fluorescent staining reagent and a microbial population n3 acquired by both of the41 chlorophyll fluorescence emission and the fluorescence emission by the fluorescent staining reagent.

[Claim 4]

The microorganism testing apparatus according to any one of claims 1, 2 or 3, wherein the excitation light source is arranged such that excitation light orthogonal to the radiated surface of the sample container is caused to be incident to the radiated surface, and a light receiving surface of the light receiving means is arranged such that fluorescence emission is received at an angle orthogonal to the excitation light of the excitation light source.