Effectiveness of static antifouling paint on bridge structures in sea water environment

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Introduction

- Engineered structures such as bridges and marine platforms are under constant attack from the marine environment. These structures need to be protected from the influences of the key elements of the marine environment such as saltwater, biological attack and temperature fluctuations.

- When a structure is immersed in seawater, it is rapidly covered by an unavoidable fouling. Its growth is a complex phenomenon and much remains to be understood. In marine environments, over 400 organisms are related to fouling problems. The numerous fouling organisms, according to their size, may be divided into micro-organisms (or so called biofilm, slime, micro-fouling) and macro-fouling.

Introduction

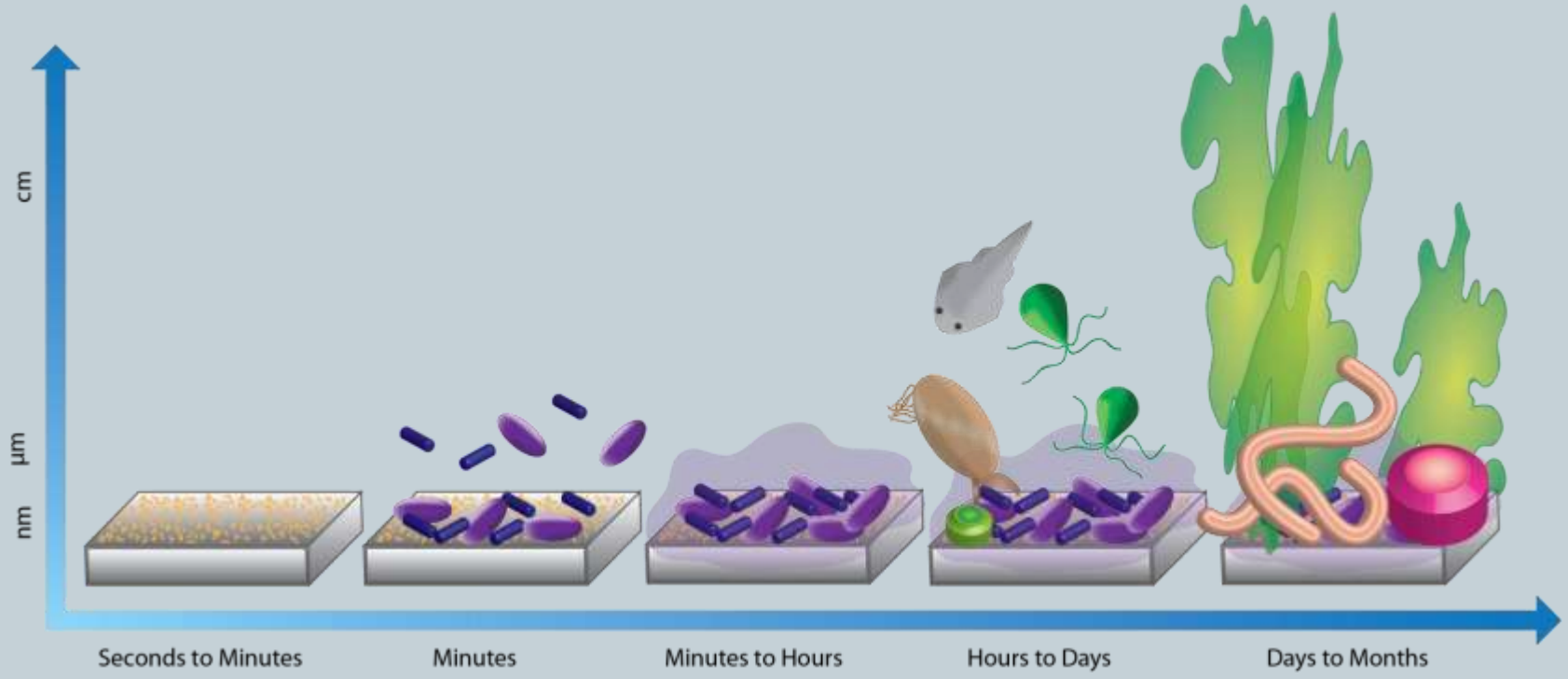


FIGURE - Schematic of Critical Biofouling Stages

(L.D. Chambers, F.C. Walsh, R.J.K. Wood, K.R. Stokes (2006))

Introduction

The succession of fouling organisms is generally considered in four main stages:

- 1st : The adsorption of organic and inorganic macromolecules immediately after immersion: the primary film,
- 2nd : The transport of microbial cells to the surface, and bacteria immobilization on the surface,
- 3rd : the bacterial attachment to the substrate is consolidated through extra-cellular polymer production, forming a microbial film on the surface
- 4th : Corresponds to the development of a more complex community with the presence of multicellular species, micro-algae, debris, sediments on the surface, and the last stage is the attachment of larger marine invertebrates such as barnacles, mussels, macroalgae.

Introduction

In bridge structures, biofouling can increase the dead load about 5 kg/m^2 of pile and accelerate the corrotion process. (Walters, 1996)

Introduction

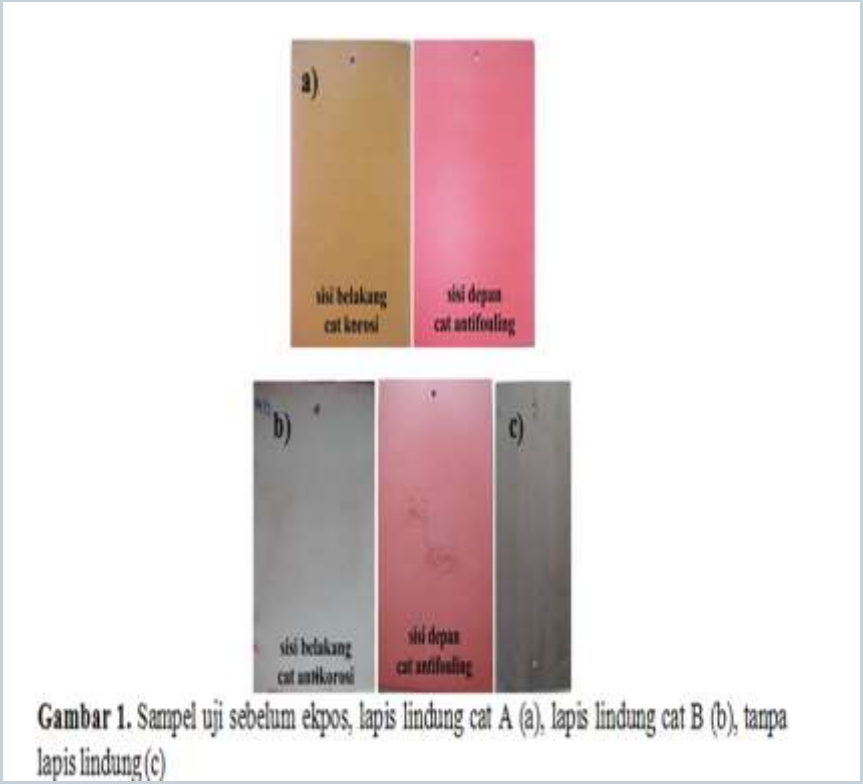
To overcome the fouling that occurs then used a protective coating in the form of antifouling paints. which is a type of paint that serves to minimize the occurrence of fouling through the process of prevention of attachment and biofilm growth on the surface of the substrate.

In this research, we used an antifouling paint with CuO and ZnO based as Biocide agents

Material and Methods

Material

The test sample in the form of a steel plate with a size of 20 x 25 x 0.3 cm, consisting of a steel plate with a layer of corrosion protection paint on the front side and the steel plate protected by layers of antifouling paint on the rear side. Before the paint is coated on steel plates, do sand blasting on the plates corresponding to ISO 8501-1. Blank sample made from of a steel plate without the protection layer with a size of 7.5 x 15 x 0.3 cm (Code sample: C).

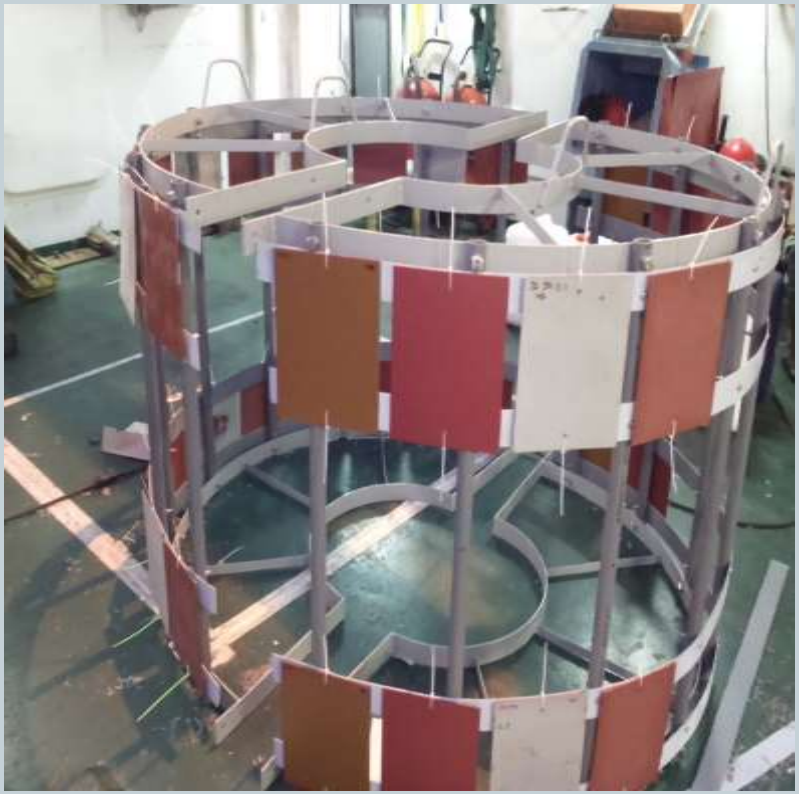


Gambar 1. Sampel uji sebelum ekpos, lapis lindung cat A (a), lapis lindung cat B (b), tanpa lapis lindung (c)

Material and Methods

Material

The size of the samples in accordance with the requirements in ASTM 3623-78 "Standard Test Method for Testing Antifouling Panels in Shallow submergence"



Material and Methods

Methods

The research location is on the bridge pile structures, Mandara Bali Tol, Bali Island. Time exposure for the test samples are six (6) months with a depth of 1, 2, 3 meters above sea level (asl).

Observation Methods

- Determining the growth and rate of corrosion test samples, then seawater do physical measurements, such as temperature, pH, salinity and levels of Dissolved Oxygen (DO) .
- Type of fouling attached after occupational exposures are identified in the Research Center for Oceanography laboratories, LIPI.

Results

Samples After Six Month Exposure: (A) Blank, (B) Anticorrosive Paint, and (C) Antifouling Paint

A

B

C

Based on the results of visual observation of all test sample after immersion for six months in the marine environment, both of sample blank and sample with anticorrosive paint, has been attached by marine fouling, while in the sample with antifouling agent no visible attachment on its surface. it shows that the biocide active substances contained in the paint has a fairly good performance in preventing the attachment of marine organisms on the surface of the sample

Results

the identification of the type of bacteria, obtained two major groups of bacteria that have the potential to be engaging in a test sample are ***Vibrio alginolyticus***. Macrofouling identified attached to the surface of the sample are from the class of ***algae, Polychaeta*** which are a class annelid worms and crustaceans including ***barnacles***.

Vibrio alginolyticus

Balanus sp.

Saccostrea cucullata

Results

The physical properties of the sea water is not much different between any depth, so that similar types of fouling found as shown in Table below

TABLE 1-Physical Properties of Mandara Sea Water

Depth of exposure (m)	Temperature (°C)	pH	Salinity (ppt)	DO (mg/L)
0-1	29,8	8.3	28.9	5.19
1-2	29,8	8.4	28.7	5.08
2-3	29,8	8.4	28.6	5.05

Conclusions

Results showed that after exposure for six months:

1. Anti-corrosion paint and blank was attached by marine fouling, while the antifouling paint did not show any adhesion of marine fouling organisms.
2. Type of microbiologie attached is Vibrio alginolyticus, while macrofouling identified attached to the surface of the samples are from the class of algae, Polychaeta which are a class annelid worms and crustaceans
3. The physical properties of the sea water is not much different between any depth, so that similar types of fouling found

Acknowledgment

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