BIOFOULING MONITORING

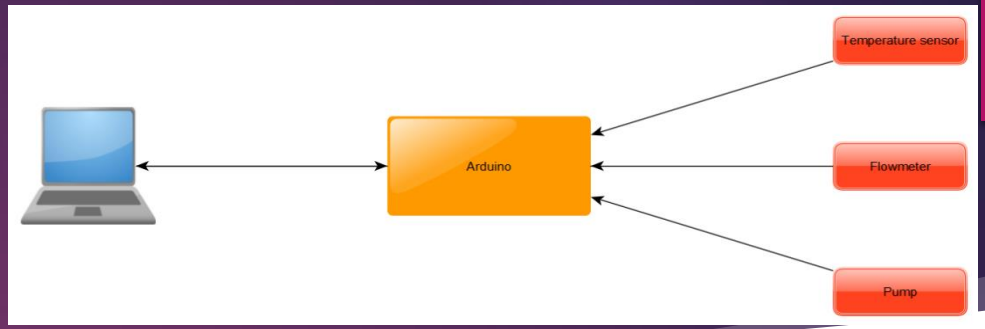
SIMONA GHITA MIHAELA HNATIUC

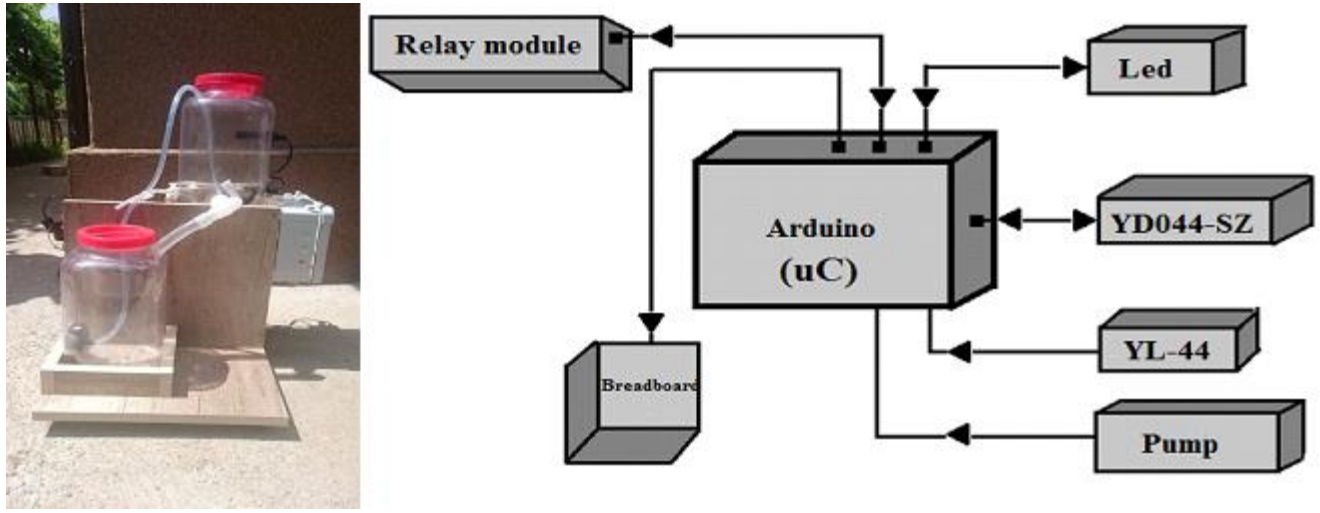
MARITIME UNIVERSITY CONSTANTA, ROMANIA

Abstract

- The biofouling prevention methods is a new research area. This paper presents a study of biofilm evolution (microbiota) on different surfaces, monitoring different parameters. For this research, the tests are achieved on samples as naval steel painted with different antifouling paints, and liquid wood samples introduced into the dynamic marine water system. The main parameters observed during the test are water temperature and flow. The microfouling samples are observed under the epifluorescence microscopy and quantification of biofilm using specific software. Using MATLAB software, we develop the prediction methods for biofouling prevention using the environmental parameter. The test system use the two boxes placed on the different higher, using an acquisition card the sensors data are sent to the computer for analysis.

MATERIAL AND METHODS





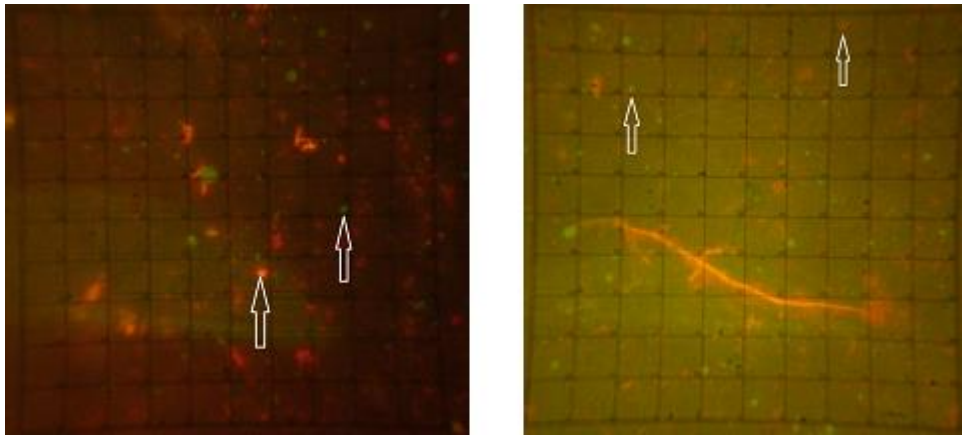
The microcosms system for monitoring, block diagram of water monitoring system

Study of biofilm evolution (microbiota) on different surfaces (e.g. naval steel covered with different antifouling paints; biomaterials such as liquid wood) under the microcosms system (it presents the dynamic characteristics of an intertidal ecosystem transposed to the micro scale - in an *ex situ* system) was take into account.

The microcosm system was chosen to be able to make observations on microbiota evolution in a system with controlled parameters.

The evolution of the microbiota has been achieved using the epifluorescence microscope observations and biofilm quantification was done using specific software (CellC, Image J).

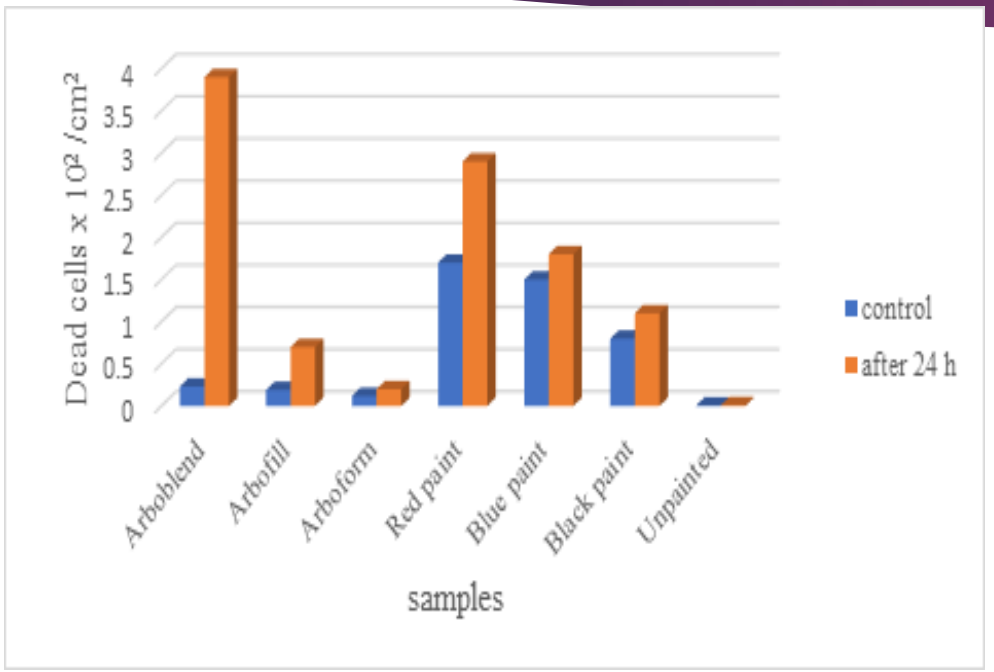
RESULTS AND DISCUSSIONS



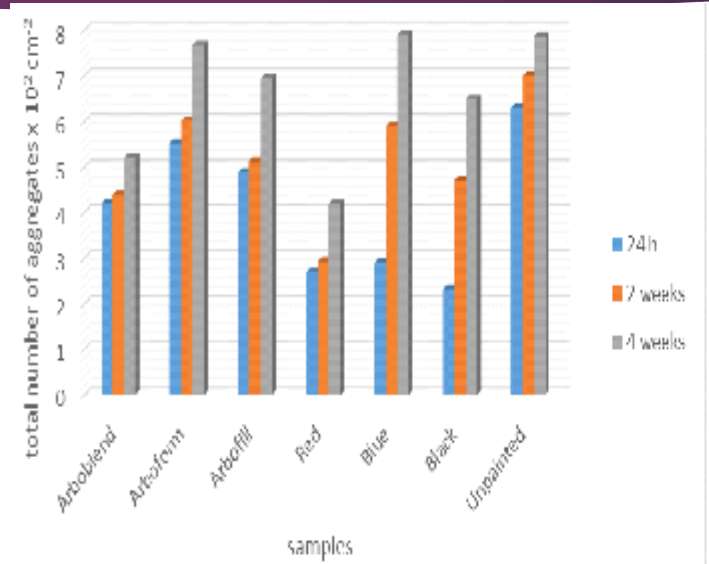
Visualization of living (green) and dead (red) organic fractions from naval steel sample and liquid wood sample

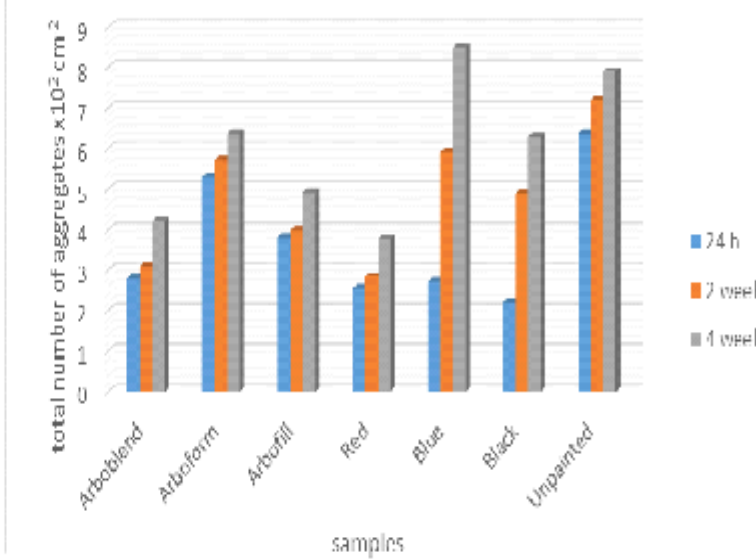
The highlighting of the living microbiota, respectively dead microbiota (which did not withstand the experimental conditions and / or toxicity of the material), was made with the fluorochrome acridine orange (visible in green color for living organic fractions) and propidium iodide (visible in red color for dead organic fractions) on naval steel and liquid wood

RESULTS AND DISCUSSIONS



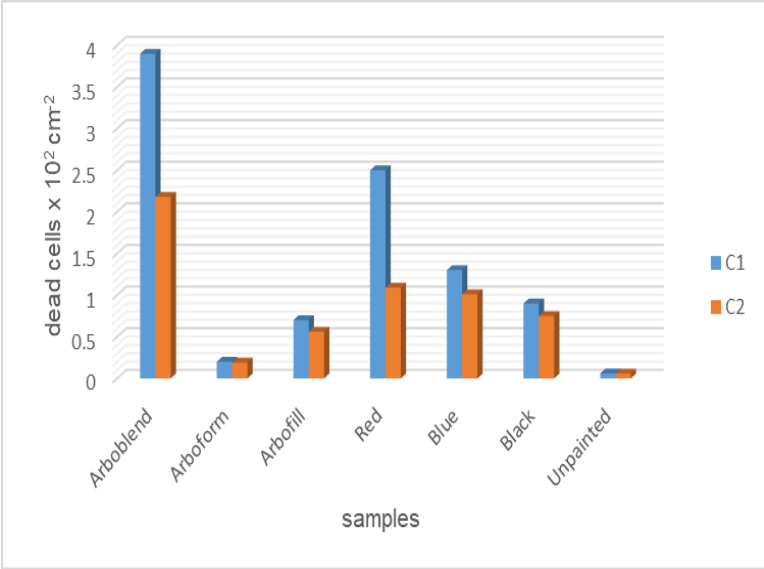
The evolution of dead cells for 7 samples in the adhesion period



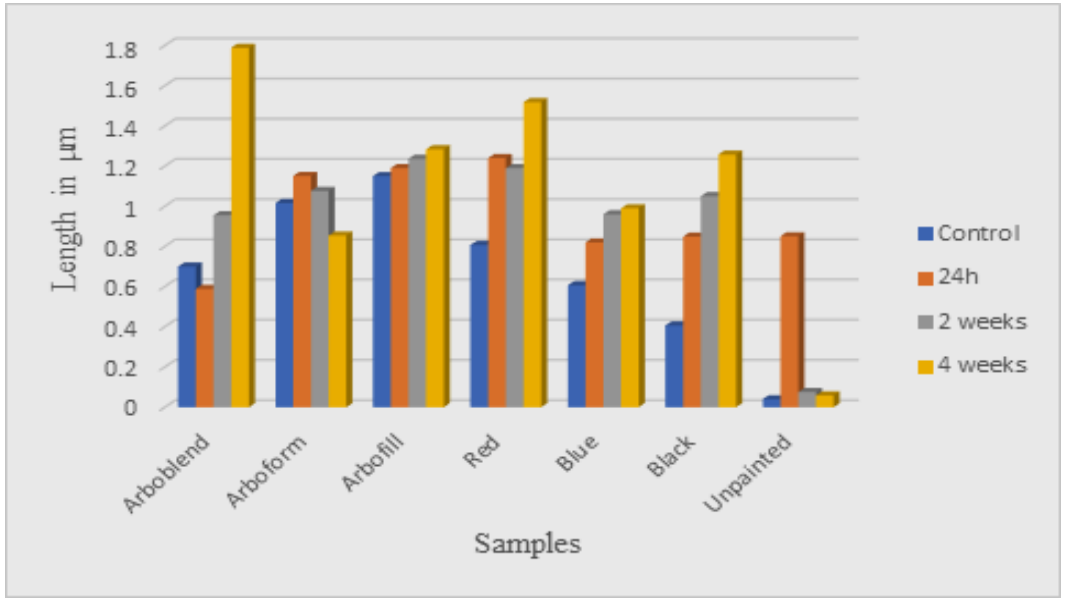


By the end of the experiment, the bacterial monolayer (known as biofilm) was maintained for 2 weeks for liquid wood samples, except for Arboblend which remained in the monolayer for 3 weeks). The samples covered with antifouling paint had a different evolution due to the appearance of rust spots on the surface of the samples in compartment C2 where the presence of oxygen accelerated the oxidation reaction of the naval steel.

RESULTS AND DISCUSSIONS



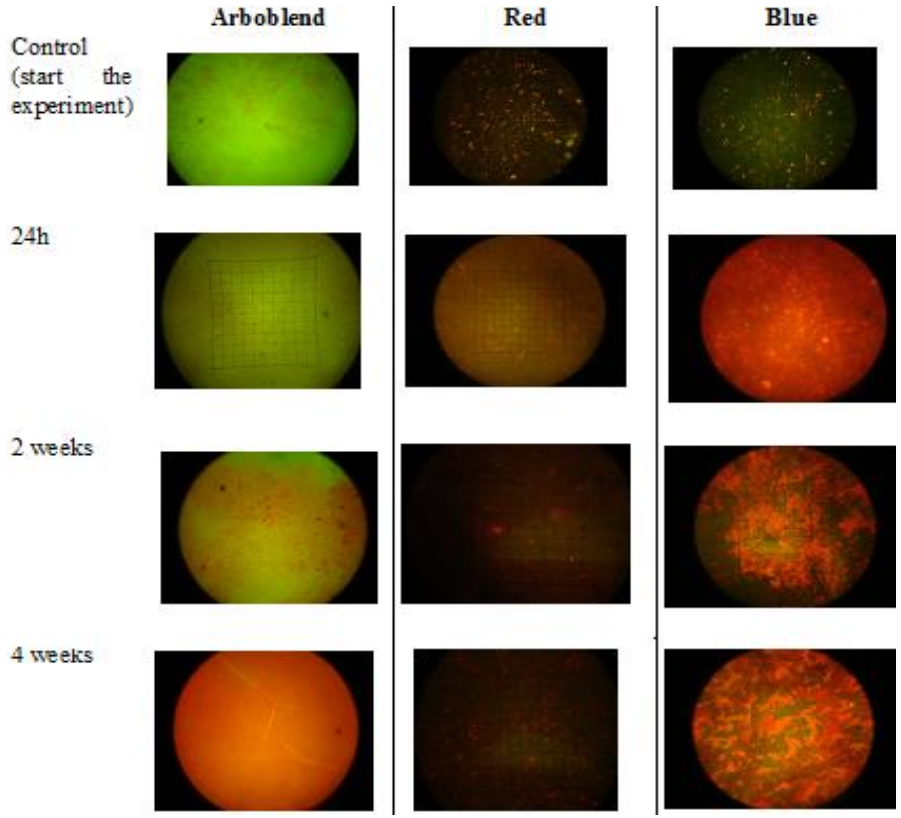
Comparison of the presence of dead bacterial cells in the two containers, after 24 hours from the start of the experiment



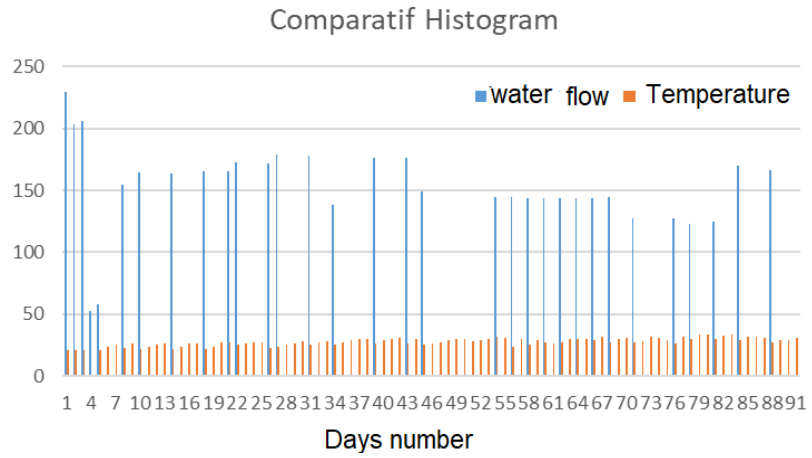
Evolution of the length of dead heterotrophic bacteria

RESULTS AND DISCUSSIONS

Microscopic images showing the evolution of the microbiota in the case of samples with the best positive antifouling effect (Arboblend and red paint- monolayer) or negative effects (blue paint- multistate)



RESULTS AND DISCUSSIONS



Variation of temeperature – orange and water flow – blue during the experiment period

The flow water of the high container to the down is constant equal with 150 [m^3/s] and the water flow of the pump is 200 [l/h]. The most agitate water environment is in the bottom container (C2), which allowed a slowing down of the adhesion of the biofilm.

CONCLUSION

- Biofilm content on liquid wood was lower for samples containing a large amount of lignin (e.g. Arboblend), which has a strong antimicrobial character.
- The evolution of biofilm on the experimental samples were due to physical and chemical characteristics of the surface and also the content of the organic aggregates. The protective character of natural fibers (which are not endowed with antifouling structures) in the case of deposits on the surfaces immersed in a dynamic system is lower compared to the structures containing chemical biocides.
- Attempts to find the best solution for the prevention of biofouling, resort on the one hand to the research of various materials (biomaterials) that have antimicrobial properties and on the other hand to the research of antifouling methods (e.g., physico-chemical or electrical methods).
- The sensors have an important action in biofouling monitoring. The sensors give information about the environment condition which influence the speed of biofouling deposition. In the next research we will use sensors based on a IoT technology placed on the ship to monitor in real time the biofouling deposition.

Acknowledgement

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- Thank you

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