

REAL-WORLD APPLICATIONS

There are numerous applications of this data in health and medicine, and industry. Biofilms cause multiple infections in the human body including IV infections and a more serious disorder, Cystic Fibrosis. There is no cure to CF, partly because the difficulty of reproducing the environment of the human body. A comprehensive understanding of the properties that cause the detrimental biofilm growth is unknown and thus finding a treatment to Cystic Fibrosis is a challenge. The data of this experiment shows that a hydrophobic surface grows thicker biofilms. This might suggest that if the human body has bacteria with similar characteristics to those in pond water, then the surface growing the infectious biofilm may be hydrophobic.

There is a multitude of applications of the results of this experiment. For example, the results of the experiment are useful to the Navy. Biofilms tend to grow on ships' hulls; this is referred to as fouling. The additional weight and the tremendous increase in friction causes more fuel to be needed to run the ships. Furthermore, the biofilms can accelerate the corrosion of the metal, leading to more frequent repairs. This can cause millions of dollars in extra expenses to the



Navy. The conclusion that hydrophilic substrates grow thinner biofilms suggests that a coating of hydrophilic material on ships' hulls would lessen the biofilm growth.

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The Effect of Surface Chemistry on Pond Water Biofilm Growth

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PURPOSE

Determine by experimentation which types of surfaces provide the best habitat for biofilms

HYPOTHESIS

A hydrophobic surface will be the best environment for microorganisms in pond water to nucleate biofilms. This hypothesis is based on Professor Kate Queeney's previous results, which showed thicker nucleating films on hydrophobic surfaces in a controlled model system. This project further extends her work to a real environment using pond water.

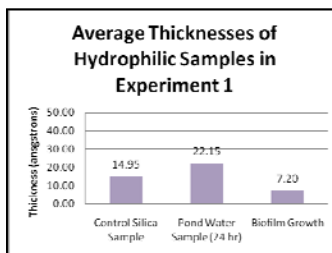
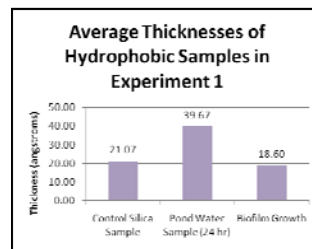


ABSTRACT

This project explored the effects of surface chemistry on pond water biofilm growth. Biofilms are aggregations of bacteria on a solid immersed in an aqueous solution. The purpose of the project was to determine, using ellipsometry, which of the two silicon-based substrates, hydrophobic and hydrophilic, is better suited to growing nucleating biofilms in a local pond. The twenty-four-hour submersion period was used to grow a nucleating biofilm, which usually involves a first stage in which a protein conditioning film is laid down. The results of the experiments indicated that the hydrophobic habitat allows microorganisms to grow thicker biofilms. Puffers Pond in Amherst, MA pro-

EXPERIMENTAL DESIGN:				
Independent Variable: Surface Chemistry	Hydrophobic Si Samples		Hydrophilic Si Samples	
Levels of IV:	0 hours	24 hours	0 hours	24 hours
Prepared Media:	Control	Control	Control	Control
Independent Variable: Surface Chemistry (Substrate)				
Dependent Variable: Biofilm Growth				
Constants: Pond water, immersion period, environment, method of immersion and removal (plastic tweezers), container type, sample color, position in water				

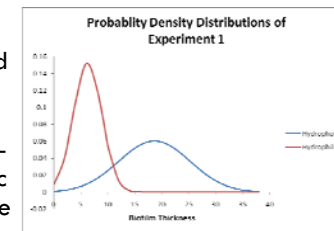
vided the pond water for the project. Due to the limited previous research in this area, the first step was to determine the period of time that is best suited to growing a nucleating pond water biofilm. Once this was ascertained as twenty-four hours, the hydrophobic silicon samples and hydrophilic silicon samples were compared for biofilm growth when submerged in pond water. After this period, they were brought to Professor Kate Queeney's Lab, where they were analyzed for biofilm growth using ellipsometry. The ellipsometry technique measures the thick-



CONCLUSION

The purpose of the experiment was to investigate the effect of different silicon substrates on biofilm growth. Hydrophobic and hydrophilic silicon samples were submerged in pond water and the growth of biofilms was measured. Hydrophobic silicon samples grew significantly thicker biofilms than the hydrophilic silicon samples. The average difference in biofilms thickness between the two types of samples in the first experiment was 11.40 angstroms. This was found to be significant as the mean thickness of the hydrophilic silicon sample was 22.15 Å and mean thickness of the hydrophobic silicon sample was 39.67 Å. This large difference strongly

suggested that the hydrophobic sample pro-



vides a better environment for pond water microorganisms to form biofilms. Student t-test results confirmed the findings and showed that the differences are statistically significant.

XPS testing of the composition of the samples showed that the surfaces of the samples contained oxygen, carbon, silicon, nitrogen, and small amounts of other elements. The data fully supported the hypothesis that hydrophobic silicon samples would grow better biofilms

than hydrophilic samples if submerged in local pond water. These findings corroborated with the earlier results of Professor Queeney



X-Ray Photoelectron Spectroscopy (XPS)

and further confirmed that hydrophobic silicon samples possess a better habitat for microorganisms to grow biofilms. Future research could include experiments on the effect of surface topography on biofilm growth.

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