



Non-Confidential Description  
**Novel Environment-Friendly Coatings for Marine Applications**  
Technology Case: RFT-133

### Invention Summary

The fouling of surfaces exposed to an aquatic environment is a serious problem. Fouling can inhibit the performance of marine vessels (significantly increasing fuel usage) and can lead to the spread of unwanted organisms to non-indigenous harbors, having a devastating effect on local ecosystems.

Many commercially available antifouling and biocidal coatings have been linked to environmental problems (for example, toxins from paint flakes). NDSU scientists have developed proprietary and novel, silicone-based compounds which incorporate tethered biocide moieties, and which can be used in coating formulations to prevent or reduce fouling by marine life and related substances on ship surfaces.

### Benefits

- **GREEN TECHNOLOGY!** Tethering of biocide may reduce leaching of hazardous chemicals. NDSU anti-fouling coatings improve fuel economy for marine vessels.
- Prevent or reduce fouling of ship hulls and other surfaces by aquatic organisms.
- Effective anti-fouling properties.

### Invention Premise

This NDSU technology is an anti-fouling material for use in a marine environment which includes a copolymer having a carbon and/or silicone backbone with a pendant biocidal group, as well as an optional pendant fouling release group. The figure on the right shows an example of marine testing (20-day immersion) on two NDSU coating compositions as compared to two commercially available compositions.

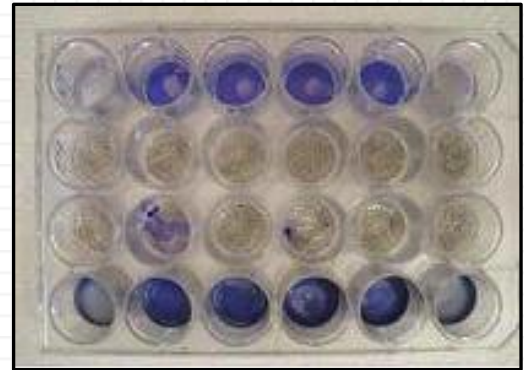


Row 1

Row 2

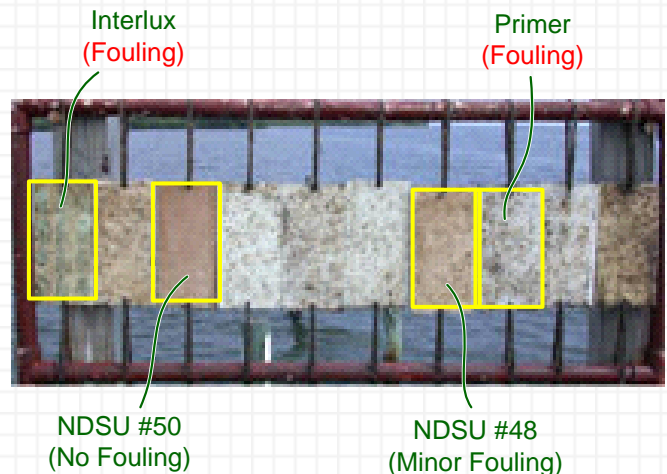
Row 3

Row 4



Row 1 – Reference  
Row 2 – NDSU Experimental  
Row 3 – NDSU Experimental after Water Jet  
Row 4 – Intersleek Topcoat

Note: Blue = Growth of *Halomonas pacifica*



## Patents

Protected by issued US Patent 7,544,722, and pending national phase patent applications in Europe and Japan, filed from PCT/US04/031140. Two additional PCT patent applications related to this technology have been filed with fully preserved worldwide PCT patent rights.

## The Lead Inventor



### **Philip Boudjouk, PH. D.**

VP for Research, Creative Activities and Technology Transfer

Dr. Philip Boudjouk was named NDSU's first Vice President for Research, Creative Activities and Technology Transfer in March 2000. Boudjouk has been active as a teacher, researcher, and member of the NDSU Department of Chemistry faculty since 1973. He earned his bachelor's degree at St. John's University, Jamaica, N.Y., and his doctorate in chemistry from the University of Wisconsin-Madison. Prior to his appointment at NDSU, he held a Teaching and Research Fellowship at the University of California at Davis for two years. During his tenure as Vice President, research expenditures at NDSU have increased from \$44 million to \$115 million.

Boudjouk's research career has focused on organometallic chemistry with emphases on organosilicon compounds, polymers, catalysis, materials research, and sonochemistry. He has more than 130 refereed publications in international journals and holds 19 patents. He has been the thesis advisor for 20 Ph. D. students and 22 M.S. students. Boudjouk has been a guest lecturer at over 40 universities in Europe and Asia.

From 1992-2000, Boudjouk served as Project Director for the North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR). The ND EPSCoR program is widely recognized for its success in promoting and administering millions of dollars in federal contracts with research faculty throughout the North Dakota University System.

He has received numerous awards for teaching and research, including being named the Chamber of Commerce Distinguished Professor (1985) and University Faculty Lecturer (1985). He received the first annual Research Award from the College of Science and Mathematics (1992) and in 1998 he was named the Jordan A. Engberg Scholar, the first endowed professorship at NDSU.

## Inquiries

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