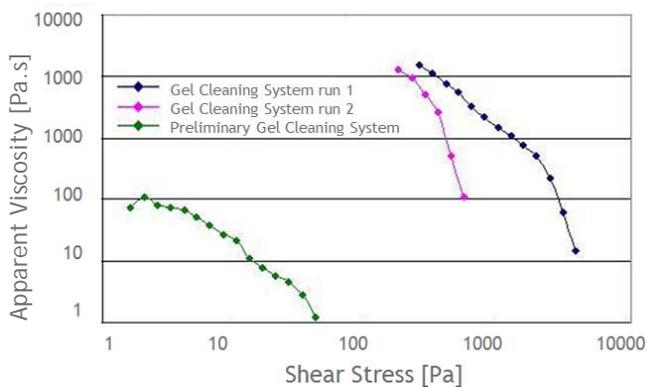


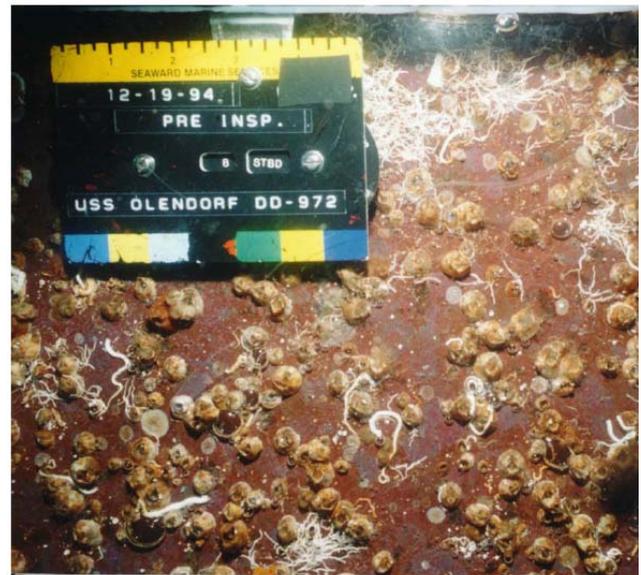
# How to Clean a Boat

## Summary

A serious issue for any water-borne craft is that of marine fouling. Seaweed and sea life are remarkably adept at fixing to boat hulls. This condition causes two problems, firstly a substantial loss in hull efficiency, increasing power consumption and reducing range. Secondly, it increases the risk of species migration and entry in to sensitive environments. However, cleaning large boats is costly and time consuming due to the need to dry-dock and manually clear the bio-burden. An ideal solution would avoid the need to dry-dock the boat.



The issue of marine fouling has been a problem since well before the days of Admiral Nelson and John Paul Jones. Traditional techniques involve use of materials that discourage or retard growth, such as copper bottoms in wooden sail boats or more sophisticated materials in modern ships. However, fouling still occurs and the only truly effective method is complete dry-docking and mechanical removal. The Naval Coastal Systems Station contracted Cambridge Polymer Group to develop a new method of cleaning large boats *in situ* without the expense and difficulty of dry dock or time consuming mechanical abrasion. The solution was to be applied by divers using a gun applicator and was required to minimize the amount of mechanical effort required and protect the underlying surfaces.



## Discussion

The primary requirements for the system described above are a system that can erode marine fouling, that is environmentally safe and that is easily applied and removed. Cambridge Polymer Group developed a slow-dissolving hydrogel formulation based on muriatic acid that could be "painted" on to the hull underwater, resisted dissolution for the working time and then exhibited a yield stress tuned to allow it to slough off as the boat moved. Simple dilution rendered the acid compound safe for aquatic life.

## Applications

- Basic rheology and formulation engineering can often be leveraged to develop new and novel solutions to existing problem
- The ability to test concepts and analyze outcomes is critical for success in these kinds of projects