Antifouling gels against cyprids of barnacle (*Amphibalanus amphitrite*)

Takayuki MUROSAKI[1], Takaya NOGUCHI[1], Akira KAKUGO[1], Hidemitsu FURUKAWA[1], Yoshihito OSADA[2], Jian Ping GONG[1], Yasuyuki NOGATA[3], Kiyotaka MATSUMURA[4], Nobuhiro FUSETANI[5]

[1]*Graduate school of Science, Hokkaido University, Japan,* [2]*Riken, Japan,* [3]*Central Research Institute of Electric Power Industry, Japan,* [4]*International Graduate School of Arts and Sciences, Yokohama City University, Japan,* [5]*Graduate school of Fisheries Sciences, Hokkaido University, Japan*

Tel & Fax : +81-11-706-2635, E-mail : murosaki@sci.hokudai.ac.jp

Marine fouling organisms cause serious problems in the world. In particular, barnacle is the most popular marine fouling organism. Tributyltin (TBT) was the most popular antifouling agent and exhibits high antifouling performance. However, TBT will completely be baned to use in the world by 2008, due to its high endocrine disruption effect. So looking for new alternative antifouling material is an urgent task. The available antifouling technologies have been applied on solid state surfaces. It is reported that a hydrogel is able to inhibit germination of algae's zoospores (Y. Katsuyama et al., 2002) and some hydrogels have been found to exhibit inhibition to barnacle's cyprid settlement (K. Rasmussen et al., 2002). However, only limited gels have been tested. Needless to say that the antifouling mechanism of gels against barnacles is poorly understood. In this study, settlement tests were performed on several synthetic gels with different charges. Its a results, cyprids clearly avoid to settle on hydrogel surfaces compared to polystyrene. The electric nature of hydrogels is less important, but the elastic modulus of hydrogels seems to make a difference for inhibition effect against the cyprid settlement.

Introduction

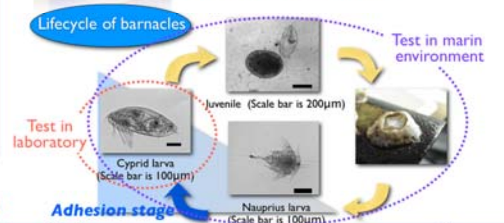
Background

Economic problem

Gel = *Soft & Wet material*

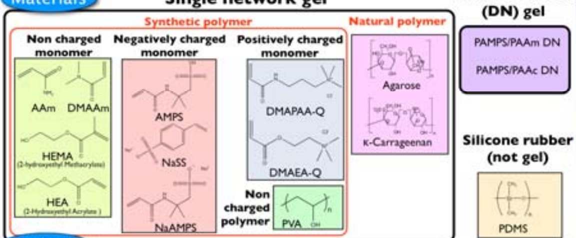
- **Low elasticity :** $\frac{1}{10,000} \sim \frac{1}{1,000,000}$ of solid
- **High water content :** 70% - 90% in weight
- **Extremely low friction :** $\frac{1}{10} \sim \frac{1}{1,000}$ of solid

Lifecycle of barnacles

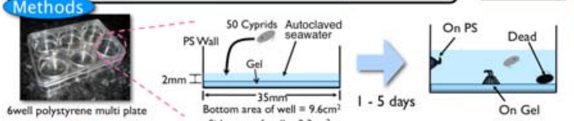


Test in laboratory

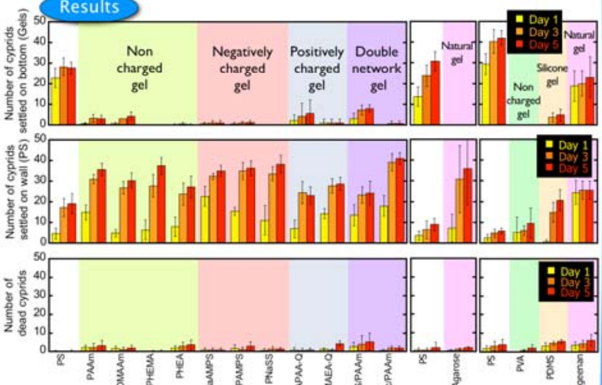
Materials



Methods

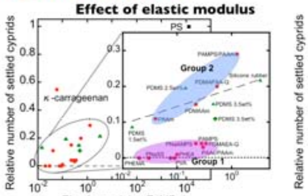


Results



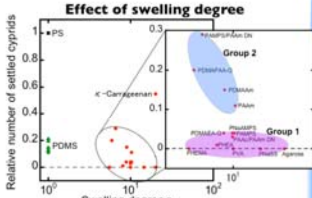
- ***Cyprids were settled on PS wall instead of on the gel bottom.***
- ***Cyprids avoided to be settled on the all gel surface.***
- ***No toxic effect.***

Effect of elastic modulus



*Hydrogels can be categorized into two groups by the chemical species. Group 1 shows no dependence of **E** and **q**, however group 2 shows the dependance .*

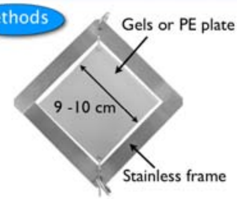
Effect of swelling degree

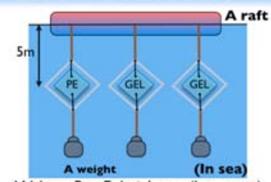


The elasticity, rather than the swelling degree, might be important for the cyprid settlement, on group 2.

Test in marin environment

Methods



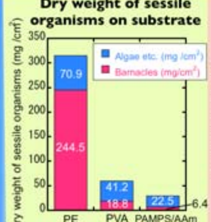


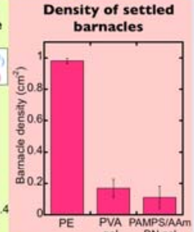
Wakasa Bay, Fukui, Japan (Japan sea)
*collaborated with Hashimoto kogyou Ltd.

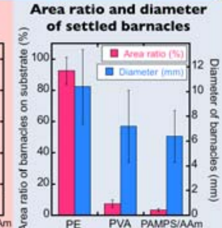
Test term: 2007/5/10 - 2008/4/3 Total 330 days

Results

	Before exposure → After exposure (330 days)	Barnacles on substrate	Morphology of bottom surface	Substrate modulus (MPa)
PE (plastic)			Flat (1.5cm)	151
PVA gel			Rough (1.5cm)	0.09
PAMPS/PAAm DN gel			Slightly concave (1.5cm)	1.25







Conclusions

- Antifouling effect of gels were found both in laboratory test and in marine environment.
- The antifouling behavior of gels can be categorized into two groups. Group 1 shows very low settlement without ***E, q*** dependence. Group 2 shows relatively high settlement with ***E, q*** dependence.
- Gels from group 1 (PVA), and group 2 (PAMPS/PAAm DN) show similar antifouling properties in marine environment.