

# Paints & Coatings and Anti-Foulings

## The science of Selektepe

The marine biocide Selektepe will soon be available to the entire shipping market. I-Tech AB R&D Director Lena Lindblad holds the distinction of discovering the substance that is on the verge of revolutionising marine anti-foulings

Over 2,000 species contribute to the biofouling that afflicts ships' hulls. Developing the right products to deal with hard and soft invertebrates, bacteria and algae is complex, but the business rewards can be great. Fouling, after all, is the phenomenon routinely degrading hull hydrodynamics; if not controlled, ship fuel costs may rise by anything up to 80%.

The demand for product resilience in harsh shipping environments in the face of tightening environmental regulation has placed scientific expertise at a premium. Marine coatings must themselves be formulated to last; bringing new solutions from laboratory to market in turn requires long term commercial commitment, but also prolonged personal dedication from R&D staff.

During 2014, I-Tech AB secured approvals for Selektepe in China, South Korea and Japan, which combined represent an estimated 64% of world market demand for anti-fouling paints. In the EU, representing a further 18%, the UK HSE also issued notification that Selektepe meets EU Biocide Product Directive evaluation earlier this year. Final EU approval, confirming the biocide's inclusion within the list of substances deemed non-harmful to humans or the environment, is expected at an EU Chemical Agency meeting in February 2015. In 2014, I-Tech also entered a first of its kind supply agreement with Chugoku Marine Paints Ltd (CMP) for use of Selektepe in commercial anti-fouling paints.

It is a measure of the dedication required, but also the uncertainties unleashed by the EU BPD, that the journey from laboratory tests to UK HSE case file submission itself took nearly a decade.

The selective approach nonetheless involved exhaustive tests of candidate biocides, and one substance stood out by producing a counter intuitive reaction in marine organisms - medetomidine. At first, it was believed that the biocide stimulated cement secretion but brought about an apparently paradoxical reduction in the rate of larvae settling. However, that hypothesis was misguided. Rather, it was a stimulation of the barnacle larvae motility that caused the prevention of settling.

Necessary test repetitions also confirmed astonishing initial findings; medetomidine was "almost a thousand times more effective than a conventional marine biocide, gram for gram," according to Lindblad. Follow up research traced the root of the conundrum to the response of the barnacle larval octopamine receptor to medetomidine.

If stimulating the barnacle larvae's swimming behaviour made them unable to attach to a painted surface, it was also the case that the effect was temporary, disappearing as soon as the barnacle left the surface. It was 'reverse stimulation', rather than toxicity, that achieved the desired anti-fouling effect.

"Focusing on barnacle settlement meant that we could solve the worst problem more effectively" says Lindblad now. "The Selektepe name presented itself in a way, as a reflection of the agent's highly selective action."

Lindblad's discovery and her expertise have been widely acknowledged. She holds an associate professorship in Zoophysiology, at Göteborg University, and is a part time Project Leader at Vicore Pharma working with the safety toxicology programme and regulatory affairs.

She has academic publication credits covering pharmacology and zoophysiology, as well as her anti-fouling research. She is also Project Leader for the EU FP7 SeaFront programme to develop environmentally-friendly marine coatings.

In addition to these credentials, the timeliness of her discovery is not in doubt. By 2002, the tributyl tin used day in day out by the shipping world on ships hulls had been banned

worldwide. While effective, alternative biocides acting in the same way – such as copper and zinc – were viewed as substances that would ultimately be subjected to regulatory restriction. Lindblad's report of her initial contacts with the traditional coatings industry reflects the many uncertainties facing the sector at the time.

## Many unknowns

"We faced many unknowns on what their views would be on efficacy, suitability and how Selektepe would be introduced into the paint matrix. But the marine coatings suppliers were frank that they would not invest in biocide development, and that this was a matter for the biocide companies themselves. Much of the uncertainty came from the fact that, by 2003-2004, the EU BPD was taking shape but was still very unclear. The response from the paint manufacturers led I-Tech to become fully focused on regulatory necessities."

Meanwhile, selectivity was a function of medetomidine production, as well as its action. Its best known application was as a sedative for veterinary use, but Lindblad's search for a source alighted on producers turning out small batches, amounting to 20-40 kg a year. "This was a long way from the 2 t a year our plans envisaged," she says.

Mercifully, by this point the significance of I-Tech's work had been attracting attention elsewhere. The Swedish Foundation for Strategic Environment Research (MISTRA) acted as a critical sponsor, bridging the gap between what Lindblad describes as "research for research's sake and an industrial project."

By 2008, progress had attracted Volvo Group Venture Capital, supporting a cooperation with Volvo Penta to industrialise Selektepe. The agreement led on to field tests that provided a methodology that would later be invaluable when the product came to the attention of CMP, as well as a production arrangement with global life science company Cambrex Corporation. The field tests of Selektepe, "Perhaps we were extremely naïve at the very beginning, thinking that once everyone could see the laboratory results they would be happy. Really, it was a case of two steps forward, one step back as we sought funding, regulatory approval, production partners and market acceptance. What I can say is that, without MISTRA and Volvo, there would be no product in the market."

The "greatest challenge of all" facing momentum, according to Lindblad, was the unfolding EU BPD covering substances permissible for biocide use. By 2005-2006,



Selektepe being applied



Lena Lindblad

Lindblad headed I-Tech's Regulatory Affairs management team, assembling the dossier for Selektepe®. Few can doubt the test of dedication involved; the 15,000 page BPD (EU98/8) consists of 1,000 files in 71 folders, and refers to 70 investigations regarding human and environmental safety.

However laudable its aims, from the biocide developer's point of view, the EU BPD has also proved expensive. As well as the cost of required studies and evaluation fees, the evaluation process itself has been subject to change over time.

There have also been issues around lack of transparency in decision making, lack of agreement between EU member states, information blind spots and limited responses to queries; not to mention the non-adherence of Member States to regulations in place. At times, it has appeared the greatest beneficiaries of the Directive have been the legal profession.

Today, Lindblad is philosophical over the EU BPD's long gestation which over the time has become BPR. "On the plus side, the goal is a defined regulatory structure for marine biocides that will provide a predictability that the marine biocides sector has been lacking," she says. "Long term, the result will be time and cost savings for the companies using approved products."

And, after a decade and a half bringing Selektepe to market, work on what Lindblad proudly calls "my research" is far from complete. "Of course, we have come a long

way, all the time answering questions to show that we know exactly what we are doing, what the mode of action is, the effects of temperature, the small quantities of biocide per litre of paint required, and so on.

"Now, questions focus on our cost-competitiveness with the alternatives (which we are), whether the product will last three years (which it will) and how it performs in paint compared to conventional biocides (it's better)."

Throughout her journey, Lindblad says she has never lost sight of the basic proposition that the environmental responsibility imperative must be grounded in realism. "Sustainability is a selling point if there is a market need, if performance is equal to or better than the conventional solution and if the sustainable option is cost competitive. Coming up with less than that is not meaningful," she says.

"From our own experience, we know that shipowners are a straightforward group. They have not been satisfied with the alternatives offered to them after the phase-out of TBTs. The coatings industry itself is well aware that new biocides might be needed quite quickly due to new regulations."

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