

## HOW A PARTNERSHIP BETWEEN A UNIVERSITY AND THE MARINE INDUSTRY IS PREPARING FOR CHANGE

PDM Neptec Ltd (PDM) and Portsmouth University are using a DTI Knowledge Transfer Partnership (KTP) to develop accelerated life testing of underwater cable connector assemblies. This is providing PDM with the knowledge to evaluate new processes and materials as the marine industry prepares for the effects of environmental legislation and the inevitable impact on processing materials.

PDM have extensive experience in delivering reliable connectivity solutions for subsea applications but formerly had limited facilities for accelerated life testing. Under the KTP, the Applied Electrochemistry and Microbiology Group at Portsmouth University evaluated lifetime performance in aggressive marine environments. They explored new research and exposure trial testing to deliver knowledge that can be used by PDM. The goal of the project was the development and testing of novel primer/polymer systems in order to promote the optimal stability of underwater electrical connector and cable assemblies in marine, oil and gas, and defence applications.

The KTP used the PDM engineering team to provide in-house technical support and assistance with the development projects. The University assigned and managed the KTP student and focused the resources of the group to address the issues as they developed. This approach gave the student the opportunity to find the solution for real problems and to see their work yield results. Plus the approach developed the expertise of the PDM engineering team and created links between PDM and the wider research community. Therefore the combined effect of this approach was to transfer knowledge and increase the competitiveness of UK manufacturing.

Starting in 2007, the project sought to establish the baseline performance level of moulded assemblies. Test structures were designed to measure adhesion and the project began with comparisons of standard ASTM salt spray tests, flowing seawater tanks, and an exposure raft in Langstone harbour. These tests used a lot of resources and took a long time to provide results. This important phase created the baseline measurements on current products with the results showing that tests in flowing seawater were comparable with full immersion tests on the seaborne raft without the complexity and concerns associated with keeping structures in the harbour. These flowing seawater trials are ongoing.

In the marine industry an important potential failure mechanism in subsea cable connector assemblies is Cathodic Delamination. This is the failure of metal-to-polymer bonds due to localised reactions that occur on cathodically polarised metal surfaces while immersed in an electrolyte, the sea. This phenomenon is characterised by the loss of adhesion between the polymer and metal substrate that results in system failure. The KTP enabled the cathodic potentials detrimental to polymer-to-metal bonds to be identified and polyurethane material systems are being designed to resist the effects of this. Thus offering longer life expectancy for all PDM manufactured moulded assemblies and encapsulated components in the subsea environment.

To provide faster feedback, PDM have constructed a test cell for life testing where the effects of cathodic delamination can be accelerated. Dave Nicholson, the PDM Applications & Engineering Manager, sees real cost and time benefits with the cathodic delamination effects now being generated in tens of hours and so providing quicker feedback to new developments.

This delamination problem is well known, and the industry has developed processes based on customer experience with delivered products, in PDM's case since 1982. However, the industry needs to be ready to deal with changes to materials as a direct result of the REACH and COSHH legislation and the selection of primers and polyurethane catalysts. Mercury is commonly used as a catalyst in polyurethane, and the environmental impact is under review, even at the very low levels found in the underwater electronic cables and connectors manufactured and distributed by PDM. (Mercury is already banned in Norway to protect the salmon farming industry).

Responding to this legislation, new material systems are being evaluated to respond to legislation that seeks to eliminate the use of mercury in polyurethane systems. PDM is working with polyurethane suppliers and developing in-house processes to ensure that these changes do not diminish the current performance levels of these important cable assemblies in deep marine environments.

In addition to this work on cable assemblies, the test cell can also be used to evaluate corrosion problems for materials and coatings in harsh underwater environments and has shown the benefit of the KTP in not just addressing specific concerns but also enhancing the capabilities of both parties that can be applied to other related problems, providing real benefit to the company and the University. With the Knowledge Transfer Partnership, PDM is at the forefront of this work and will continue to supply connectors and cables for underwater usage that provide users with the lifetime they require.