

Protecting Offshore Structures from the Creatures Below.mp3

[00:00:00] Thank you very much for joining us today and welcome to the Explorathon Lunch Bytes podcast, a chance for you to hear about some of the latest research projects coming from the University of Aberdeen while you enjoy your lunch break. Explorathon 2020 is a weeklong programme of events being brought to you by the University of Aberdeen and other Scottish universities as part of European Researchers' Night, which this year takes place on the 27th of November. European Researchers' Night is a Europe wide public event which tries to bring researchers closer to the public and this week, amongst other events, the University of Aberdeen is bringing you a daily podcast, giving you the opportunity to hear from some of our local researchers about their projects in a range of different disciplines. All events being run as part of the Explorathon 2020 programme can be found on the website at www.explorathon.co.uk and the programme is being funded by the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie Actions Grants Agreement 955376. After listening to today's podcast, please let us know any comments or feedback by contacting us on Twitter or Facebook @ernscot or use the hashtag #explorathon20. You can also put any questions or comments to us by email, by contacting the university's Public Engagement with Research Unit at peru, and that's spelt P-E-R-U, @abdn.ac.uk.

[00:01:41] The National Decommissioning Centre was opened in 2019 as part of the Aberdeen City Region Deal. It is a partnership between the University of Aberdeen and the Oil and Gas Technology Centre. The centre is working to become the global leader in addressing decommissioning challenges, including coming up with solutions to deliver the 35% reduction in decommissioning costs as set by the regulator in 2016. One major cost in decommissioning is the removal of offshore structures. These structures, which weigh hundreds of tons, are required to be removed. However, there are natural marine organisms that cling to these structures and they can add hundreds more tons of weight to the structures. Fouling, to give it its scientific term, could add millions of pounds to decommissioning project, as well as cause damage to the offshore structure during the life cycle. So I'm joined today by Jessica Gomez-Banderas, whose PhD studies through the National Decommissioning Centre is seeking to find new compounds which could prevent the fouling of offshore structures, improving safety during the life cycle and also reduce costs in decommissioning. Jessica, thank you for joining me.

[00:02:59] No problem. Thank you for having me, Rachel.

[00:03:02] So your PhD study is looking at the fouling of marine structures. What is fouling and what does it mean for offshore decommissioning?

[00:03:11] So fouling describes the buildup and growth of organisms on unwanted surfaces. So in the context of oil and gas, fouling refers to the growth of marine organisms on subsea structures. Fouling can be either micro or macro fouling. So micro fouling is your tiny, tiny organisms like your bacteria and fungi which build up and form a slimy layer on your subsea structures and this slimy layer attracts bigger foulers such as barnacles, mussels, corals and macroalgae which then settle on the surface also and they form a thick entrustment which is really, really difficult to remove. Fouling can be a really big issue for oil and gas industries because it's actually really costly to remove and maintenance needs to be carried out on a routine basis and if it's not removed prior to decommissioning, then a fouling can also add hundreds of tons to the total weight of the structure, which are already really, really heavy, which makes it more difficult and more costly to remove these

structures from the marine environment come the time of decommissioning so it's a big problem.

[00:04:25] So what do companies currently do, or have previously done, to control and remove fouling?

[00:04:32] Removing fouling is usually done using ROVs which are remote operating vehicles, so it's like little robots which go and they kind of scrape off all the fouling. Or the fouling is removed manually once the structure has been taken onshore for decommissioning and this is done using power jets and other hefty equipment onshore. So it's not really an easy task to remove the fouling. Typically, oil and gas companies will actually use some sort of anti-fouling paint which is used to coat their structures as a kind of preventative measure to stop fouling from growing in the first place. But these paints tend to be quite ineffective and recent studies are actually showing that some of them show really toxic effects towards marine life which is something that we don't want. We want to protect the marine environment; we don't want these toxic chemicals being released into our oceans.

[00:05:28] So what is it that your PhD project seeks to do?

[00:05:32] My project focuses on trying to find a natural, environmentally friendly and sustainable anti-foulant to prevent fouling from growing on oil and gas structures which will really help to cut decommissioning costs. I study marine organisms which don't show fouling on their own outer surfaces to see if they're producing any compounds as like a chemical weapon to stop other creatures from settling on their surfaces. Currently I'm working on some really nice species like marine sponges and corals and even starfish, which is really nice. The ideal outcome of the project is that I manage to find an effective compound which works well to prevent fouling and which can hopefully later on be turned into a product for use within the oil and gas industry.

[00:06:16] So how is it that you analyse the compounds that are in the creatures that don't have fouling?

[00:06:28] So we do a range of purification steps. So to begin with we will do a chemical extraction which basically means adding methanol to the tissues of the organisms and adding this methanol multiple times will actually extract all of the compounds, well, the majority of the compounds from the organism's tissue. So as you can imagine, at that point, it's a very complicated mixture of lots of different compounds which are produced within the organism. So from there we need to simplify, simplify, simplify, using a range of chromatographic techniques, so these are just different techniques which separate out compounds according to their properties. And the goal at the end is to isolate pure compounds so then we can use analytical techniques like NMR and mass spectrometry in order to give information to solve the structures of the unknown compounds that we have in front of us. So it's quite a lengthy and complicated process, but very rewarding at the end when you manage to isolate pure compounds and you manage to figure out their structures and even more rewarding when the compounds are completely new and no one has reported them before.

[00:07:46] So what have you discovered so far through your PhD?

[00:07:50] Up until this point in my PhD I've been working on trying to isolate some pure compounds from my marine species that been working on and so far I have managed to

isolate some compounds from both the marine sponge and a marine coral. And it looks like some of these compounds have actually never been recorded to have been produced from these species before which is really, really nice. I'm also in the middle of designing a test and this is bioassay test so I can try all my compounds against different bacteria and, for example, barnacle and mussels which we know grow on subsea structures. So it's to test my compounds to see if they stop these organisms from growing basically and then I can see if my compounds are good anti-foulants that could potentially be used within the oil and gas industry. So I hope to have my assay set up by the end of the year and hopefully I can test the compounds that I've already discovered and I hope to get some really, really good results, fingers crossed.

[00:08:53] So your testing of the compounds, what does that involve?

[00:08:57] So the bioassay that I'm going to focus on is going to see if my compounds can prevent the growth of the biofilm, which is what I mentioned before which is the primary layer made up of different bacteria and fungi. So, I've looked at different papers and looked at how other researchers have conducted this and have managed to actually obtain some bacterial strains which are key strains, key bacteria involved in marine biofouling. So what I'll do is I'll have this thing called a 96-well plate and I'm going to put my bacteria in the plates and then I will dissolve my compounds and I will put them in the plates with the bacteria. And the basic idea is to see whether my compounds stop the bacteria from growing a biofilm layer within the plate. So hopefully I can get a good idea of whether my compounds are active or not against these key organisms, these key bacteria.

[00:10:00] And your project involves a partner. What's their involvement in your work?

[00:10:06] Yeah, so I'm really fortunate that my project has a partner called Tritonia Scientific Diving and they are a cohort of divers and they dive and collect my samples for me which is really, really great because I actually can't dive. So whenever I need more samples and, whether it's some starfish or maybe some corals, they're basically a personal diving service for me. So they'll collect whatever I need whenever I need it. And an added bonus is that they're actually based out on the west coast of Scotland in Oban which is absolutely beautiful so I love going out there to visit them and I even get to go out on the boat with the divers, which is really nice. And while they go and do the difficult part I just relax on the boat and enjoy the scenery, so it feels like a mini holiday when I go to visit.

[00:10:52] And where are the next steps for your work?

[00:10:55] So they bio activity test that I mentioned is going to be my main focus for the little while, and I still have a lot of different marine species that are waiting to be worked on. So it's going to be a case of testing these species for their activity so I can see if any of them look promising so I know which ones to move forward with to try and isolate hopefully the pure compounds which are responsible for their anti-biofouling activity. So I'm going to be very, very busy. I'm also interested in learning some more about paint chemistry just in case I do manage to find some winning compounds which are effective, it would be good to know how to actually incorporate them into anti-fouling paints for the future.

[00:11:40] And do you think your learning and your results will be relevant for other industries involved in marine activity like shipping or offshore renewables?

[00:11:51] Yeah, so artificial coatings are used in shipping and renewables so what I will discover will definitely be applicable to these industries as well. The shipping industry does tend to use slightly different coatings because ships need to move through the water so it's slightly different technologies they do use for ships. However, the general idea between all of the anti-fouling coatings is very much the same. So if I do manage to discover something new and effective then I'm sure it will be able to be adapted to be used in any maritime time industry, not just for oil and gas.

[00:12:26] And has any industry companies been interested in in your work, those that are involved in the maintenance of offshore structures or in decommissioning?

[00:12:38] So there are a lot of companies which are interested in the general idea, not specifically in my project that I know of as yet, because like I was saying the coatings can be quite toxic and they don't want environmental protection agency's to be coming after them. And they're always looking for new technologies and new solutions because with the current regulations, some of the current anti-fouling solutions might become banned as they do tend to get banned over the years once they know more about how they work and how they leach into the environment and whether they're toxic. So, yeah, it is really important for the industries and I think once I get further into my project and I start discovering more and I start publishing some results out there, I do think I will get quite a lot of interest from industry.

[00:13:35] Thank you very much for the overview of your work. Jessica, I wish you all the best moving forward.

[00:13:40] Thank you Rachel, I had a really great time. Thank you.

[00:13:44] We hope you enjoyed today's podcast, but for now, thanks for joining us and keep an eye out for our other Explorathon Lunch Bytes podcasts. As I said at the beginning, we love to get your comments and feedback, so please use the hashtag #explorathon20 or tag us on Twitter or Facebook @ernscot. You can also email the university's Public Engagement with Research Unit by emailing peru@abdn.ac.uk. If you're interested in finding out about the other events taking place as part of Explorathon 2020, you can visit the website at www.explorathon.co.uk. Bye for now.