APPLICATION FORM - Submission Details

Submission Date : 11/03/2019 12:41 am

Unique Submission ID	277
Terms and Conditions acceptance	Yes
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Document	
Document Number	

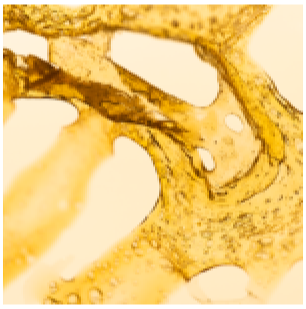
Prize Category	Conscious Innovation Projects
Project Title	The Shellworks
Source of the used material	Waste Lobster Shells
Type of plastic involved	Chitosan Bioplastic
Other materials involved	
Years of production	
Edition	
Weight and Dimensions	
Manufactured by	
Describe your project accurately and how you developed your idea	The Shellworks is a series of new manufacturing processes that turn seafood waste into biodegradable, recyclable bioplastic. In order to develop the project, we built a series of custom machines that extract, form and recycle the material, which we believe could be used as a replacement for various single-use plastics. The project uses chitin; the world's second most abundant biopolymer. Chitin is found in crustaceans, insects and fungi, but it needs to be chemically extracted from the source before it can be turned into the material. Once we have extracted these nanofibers, we use the chitosan powder and household vinegar to turn it into a bioplastic, ready for forming. The Shellworks project began by looking into possible alternatives to plastic that would be biodegradable and sustainable. We looked at waste streams and questioned whether there were ways to utilise them as recycled plastics. Interestingly, we actually found that there was an often overlooked waste stream in the form of crustacean shells that can be transformed into biodegradable plastic. Crustacean shells have locked within them a very interesting biopolymer called chitin. Biologically chitin plays a similar role to keratin in animals and cellulose in plants, which historically were some of the bases of early plastic development. Realising this led us to believe that perhaps chitin could work in a similar way. These chitin nanofibers are wrapped in layers of protein and minerals and are what allow the shells to transition between areas of differing hardness. The aim of the project was to develop a method to extract this biopolymer and use it as a basis for a bioplastic. Once we had built an understanding of what the processes could be, we set out to collect waste shells from local restaurant chains and headed to the lab to try to extract the chitosan. After some tweaking, we were able to extract the chitosan using a dilute acid and alkali solution. The resulting powder was then tested with vinegar and indeed produced a bioplastic. Through further testing

we were able to tweak the ratios and percentages of vinegar to chitosan and this allowed us to obtain vastly different properties in the final bioplastic. We were able to achieve things that ranged from solid and opaque to flexible and transparent. This was very exciting for us because it opened up what the possibilities of the material could be moving forward. One of the greatest challenges, as recorded by research that has previously been conducted, is how to form the material. Chitosan bioplastic does not behave like conventional plastics and dries by evaporation. After a series of experiments, we realised that we would have to create our own custom machines to be able to form the material in a controlled way. The aim of the machines was to look at existing industrial processes and with our newly acquired knowledge of chitosan bioplastic adjust the processes so that they would be able to work with the material. We developed three custom machines named Sheety, Vaccy and Dippy. Sheety is a controlled drying environment that allows us to get consistently flat sheets of material and is a stationary modification of a roll to roll sheet former. Vaccy is a custom hydromorphic vacuum former. Our material does not behave like a conventional thermoplastic and so we have to use steam instead of heat in order to soften it for forming. Finally Dippy works by means of a heated die dipping in and out of a solution of our material, this works by layering up and evaporation resulting in rigid 3D forms after about 8/9 dips over a 20 minute period. We tested our custom machines to prototype potential applications, each of which exploits a specific property of the material to demonstrate its potential. These prototypes range from anti-bacterial blister packaging and food-safe carrier bags to self-fertilising plant pots A final discovery in the project was that the material with hydration can be easily recycled back into the base solution and immediately reformed. The benefit here is that any offcuts of scrap pieces during our prototyping process could be reused without complication. If chitosan bioplastics were to be widely adopted this would mean that year on year the stock material could, in fact, increase if recycling systems were in place. But failing this, chitosan bioplastics can act as a non-polluting fertiliser at the end of life, meaning even if people did not want to recycle, they could simply cut up their items and place them in plant pots at home or outside! By designing scalable manufacturing processes, applications tailored to the material, and eco-positive waste streams, we believe we can demonstrate how chitosan bioplastic could become a viable alternative for many of the plastic products we use today. We hope that The Shellworks will help others to reimagine what manufacture could be as we move to an era of consciousness around what and how we produce things.

Picture 1 - Cover

Picture 2 - Designer Portrait

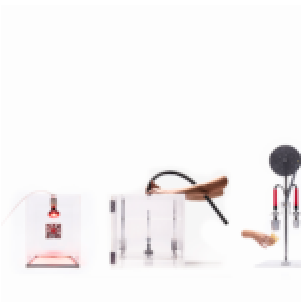
Picture 3

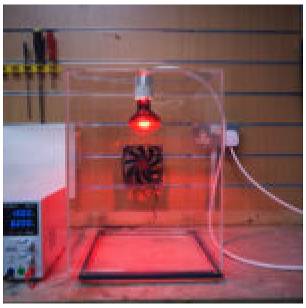


Picture 4

Picture 5

Picture 6



Picture 7	
Picture 8	
Picture 9	
Picture 10	
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