Xeducation

IN THE FIRST OF FIVE IN AN INTERVIEW-LADEN FEATURE, EPPM ASKS TU DELFT GRADUATE, MATERIALS ENGINEER, AND CARBONX FOUNDER AND CEO RUTGER VAN RAALTEN ABOUT HOW PLASTICS CAN ENGINEER THE FUTURE.

Rutger van Raalten

COMING FROM ACADEMIA, WHAT SUPPORT DID YOU RECEIVE WHILST STARTING UP?

We are affiliated with Delft University of Technology and CarbonX was founded in 2014 after an infamous Friday afternoon experiment, which resulted in the finding of this new material. It was very exciting, but we had no clue what to do with it. Instead of getting a spherical carbon structure, as expected, we made this fibre-containing porous network; TU Delft afterwards helped in filing for patents and then we all wondered what to do with it. The incubators were less active and the University didn't really have the ability to do anything further so – long story short – I came up with a plan to test this material and see how we could bring it to market. A pitch event at the YES!Delft incubator then introduced us to the venture capitalist we still work with today.

Being located at the incubator, we operate and control our own lab space with support functions and subsidies facilitated by the university, the government and TNO, but the only way we still depend on TU Delft is for equipment for scanning electron microscopy or transmission electron microscopy – which they allow us to make use of to characterise the material.

WHAT ARE THE MAIN AREAS OF APPLICATION?

We have recently moved into security, automotive, and even space-based applications. One of the biggest challenges, and also one of the most fun markets to work in, is the space sector. Here in the Netherlands are some of the most well-known space agencies, with whom we collaborate. They look at three key pillars: thermal and electrical conductivity, and light-weighting, all of which we can definitely help with.

Thermal conductivity is very important as heat needs to be conducted through lightweight composites, but, if you look at an epoxy material or a honeycomb structure, there is usually carbon filaments wherein conductivity is great, but the fibres aren't always aligned, causing areas of poor heat transfer. This is something we're now working on by adding our 3D networked carbon material to the resin to address the 'hotspots'.

It's not all about thermal conductivity per se, it's about getting the additive properly embedded into the resin without affecting viscosity, and then preferably at low density so it can be lightweight. While carbon is a very welcome candidate, any metal or mineral will outweigh the benefits based on conductivity alone, so there is definitely a gap to fill.

Industrial rubber goods, e.g. seals, conveyor belts and hoses, is where we see some traction of customers who will benefit. A substitute for the carbon they already use, but with better performances, anti-static hoses are now amongst our main applications and the markets we really focus on. In the meantime, we are working with global car manufacturers too, who are testing and prototyping our material. A much slower process, but they are seeing benefits with rolling resistance and friction, which could reduce CO_2 emissions and improve heat transfer.

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WOULD THE ENGINEERING WORLD BE JUSTIFIED IN BECOMING EXCITED ABOUT PLASTICS AGAIN?
What we're trying to do is change the focus on plastics and elastomers as a more durable and long-term compound rather than a single use, low-quality material. This is definitely a fantastic material that can be reused, it has beneficial properties, we just need to add the right features to make it even more valuable so that the way people use it will change.

The way we're using plastics took a wrong turn, and people should look at it again from a high-value engineering perspective.

This is something I cannot emphasise enough, it is about carbon productivity – a measure of the value created from a carbon source. You can use carbon as a fuel or you can make building materials from it, or you can use it in applications that last longer and reduce emissions when it is properly used. It also opens up new design opportunities. You can design lithium ion batteries with a higher energy density because we now develop heat shields that can deal with the additional heat generated.

SO THE COMPOUND HAS ENVIRONMENTAL ABILITIES AS WELL AS AUGMENTED ENGINEERING CAPABILITIES?
Exactly. One of the main technical features is that you can add it without affecting processing, so viscosity or hardness doesn't change as normally happens when you add carbon, nanotubes or graphene, or specialty carbon blacks. Rubbers stay flexible, which helps with reinforcement and the transfer of heat and electrons. If you can transfer that into applications you can lower friction in dynamic properties, including in conveyor belts, resulting in less energy use – it's the same for a tyre: you reduce CO2 emissions because you use less fuel or energy.

COULD THAT THEN HELP OTHER COMPANIES BOOST PRODUCTION?
Sure. One of the ideas that the conveyor belt compounders came up with involved faster belt speeds with higher load capacities, tensile strength and elongation. So yes, we could definitely improve productivity for our customers because they can now run longer lasting belts that can withstand higher loading capacities and at faster speeds.

WHICH NEW MATERIALS OR PROCESSES HAD TO BE DEVELOPED TO CREATE CARBONX'S PROPERTIES?
What we found out – the hard way – was that we cannot make changes in the industry or get industry to adapt to our product, we had to adapt to the industry. One of the benefits we've seen is that CarbonX can be processed on standard equipment pretty well, mainly due to the larger particle structure. Also, the network structures can withstand high pressures and forces. CarbonX provides new safety design opportunities too, as it can conduct away excessive heat or prevent uncontrolled anti-static discharge. Luckily, the processing equipment is the same, but the settings have to be slightly adjusted. A common mistake we see happening is that most of our customers initially treat the material as a delicate nanotube or graphene, resulting in too little shear and poor mixing. We always encourage them to give it a proper beating.

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