BRUNO LANGLOIS

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Coming back to recycling materials, let us take a look at a very new approach to that. Bruno Langlois, you are with us on video, thank you for taking the time. After 25 years' experience in the chemical industry, Bruno Langlois decided to join a young but promising start-up called Carbios, which is developing a very interesting approach to not only plastic recycling but plastic regeneration. Can you tell us more, Bruno.

Bruno Langlois

Thanks a lot for organizing this meeting and I am sorry not to be with you today. We need to be prepared not to travel at the last minute and that is what happened to me. What Carbios is doing is inspired by nature. If you look at nature, it does not generate waste, at the end of its life, all material is converted back to new raw materials and new life can be generated. Carbios has been looking at enzymes, a kind of proteins, which are capable of accelerating the degradation of materials. Inspired by nature, we have looked at biotechnology tools, which lead to the design of an enzyme that can break down polyester, which is one kind of the plastic being produced massively, about 80 million tons per year, with essentially one-third going into packaging and two-thirds used in the textile industry. This enzyme is capable of breaking down this polymer back to its two original constituents that we use today, and which are produced from oil to make virgin plastic. In a word, what we are doing is the capability to take our waste and to convert it back to raw materials, to reproduce a virgin polyester, one kind of plastic. You have seen the number and it is big.

Today, we are at the demonstration stage, so we are generating all the data that are needed to build the first industrial plant that we plan to have operational in 2025. This plant will be able to convert about 50.000 tons of waste back into raw material, to be further converted into polyester plastic. This is a first step, rather small to address the massive use of plastic, hence the need to build additional capacity to recycle our waste.

We have a biological process with an enzyme that is breaking down like molecular scissors the polymer and the conversion rate has been quite impressive. This has been 10 years of work in the biotechnology, and we are capable of converting 97% of the PET present in the waste in 16 hours. It is also important to say here that we work in water at moderate temperatures because the enzyme does not work in a solvent. In addition, it is working even when there are other materials mixed in the waste and that is critical because when you look at plastics there are sometimes mixtures with other components such as dyes and additives and other polymers. If you look at bottles, you sometimes have a label made of something different and in textiles, you

have an intimate mix of fibres, elastane was mentioned just a few minutes ago. The enzyme will only be able to recover the PET, without physically separating the components and then we can extract the constituents of the PET to remake a virgin-like polyester.

Of course, by doing that we are diverting waste that we produce massively from incineration and landfilling. It is interesting to see that we have multiplied the quantity of waste by 12 in the last 50 years, when the population has been multiplied by less than three. We are obviously going in the wrong direction in terms of producing more and more at lower cost, making objects with lesser value that are quickly thrown away. For example, the average time we wear a textile is six times, I am not saying it is valid for every country it is just an average, and it shows we are going in the wrong direction in terms of waste generation. We are diverting these materials from incineration and landfill, to regenerate them and on the lifecycle analysis we see that we are reducing the CO2 emissions by around 45%, using no solvents and working at a low temperature.

We are building a plant in France which will be operational in 2025 and ramping up in 2026. Carbios is moving to an industrial stage, but as a biotech company we do not want to manage plants, our objective is to develop more enzymes, to improve their efficiency and make sure that we can degrade other types of plastics like polyamide, other polyester, as well as polyethylene, a material that is widely used in the packaging industry.

Lucia Sinapi-Thomas

Thank you, Bruno. I think this is a perfect illustration of how innovation can help us to think differently and to avoid thinking that climate change mitigation will only be done with more of the same.