

Q: What are the bottlenecks for recycling?

A: Harriette: The bottlenecks for recycling. I think I can answer that, but I think it is also good to ask Rudy, because the Emmen region is active in the development of the recycling processes. A bottleneck if you collect, is of course, that a lot of the plastics are dirty or they are mixed up with other plastics, technology is developed to actually separate plastics much better than they could previously. So that is very important. Also important that, when you use plastics and you keep them in the sunlight, for instance, slowly the polymers will degrade. So you can not keep on recycling and recycling. In the end, the polymers have degraded so much, that you don't have any properties anymore. And that is the reason that the chemical recycling, we are working on, is so important. Because then you can really go back to your original building blocks and rebuild the polymer, to have a good property again.

Rudy: Maybe in addition, sorting and washing is important, because when you recycle plastics, and you have a mixture, the mechanical properties will go down very quickly. So you must obtain all the different plastics out of the waste. So sorting techniques are very important. But for some products it is very difficult to do this, because for instance in packaging you have multi-layer plastics, with sometime 10 or sometimes 14 kinds of different layers and you can't separate them again. That is a big issue in recycling plastic packaging. Chemical recycling pilots are taking place in Emmen. There is a new pilot plant in which polyester is chemically recycled, so using some kind of process to go back to the monomers, filter out all of the dirt and then repolymerize to new virgin plastic. So that's promising, but the research is, how much energy does it cost to chemical recycle the plastic. So you must optimize this process to obtain a good business case for recycling plastics.

Q: Can the products you showed also be made from other sources of biomass and if so, why did you chose to make them from wood? That is an interesting one.

A: Virpi: Well, our project is starting from the wood. But of course they can be, as the previous presenter showed, made of other biomass as well. What speaks for wood is that, especially in Finland, most of the wood is certified, so we can point out that it is a sustainable material and we can trace it all the way back to the woods. And wood is very easy to recycle There is a lot of market for recycled wood, wood fiber, so we can use that for different purposes. That might be the best reason. And of course wood will give us, other benefits as well. If it's taken good care of it can, especially now, with the time of Corona, people have understood the value of woods, as people go in the woods here in Finland, when they can't go anywhere else. It has become very popular. The woods are very crowded at the moment, especially in Lapland you can see lots of people, hiking and being outside and enjoying the nature.

Q: Can any biomass be converted to bio-plastics as long as they have carbon, and does the basic materials influence the characteristics of the end products?

Rudy: Maybe theoretically it is possible, but it is not the aim, of course. Because also when you synthesize bio-polymers, you need energy. So you have to look for natural feedstocks that is more obvious to use as a bio-polymer. With regards to bio-composites for instance, we talked about wood, mostly small fibers, but you can also use long fibers from hemp, or jute or flax, and then modify the properties of your bio-polymer. So that is, I think, the benefit of composite, the word already said: you compose a material. And depending on the application you can use different bio-polymers in different fibers to produce a product.

Harriette: I like to add something. Can you use all the biomass components? Yes, in principle you can, but it is important to look at the crop and at the function of the different ingredients that are in the crop. I explained that there are proteins there, starch and sugars and cellulose etcetera. And especially proteins, but also fat and oils, are very important for our food. So the approach that you can take if you have a crop: then you separate the proteins, you bring that to the food industry, and then you are left with starch for instance. And starch is an ideal feedstock to produce all kinds of building blocks. As is said, it takes not much energy, because you can get it out of the plant quite pure, you don't need to clean. So the approach is, you look at a crop, and then you decide which of the ingredients you going to bring to which market, and there you can play the sustainability of the whole system. So that is a very important approach.

Q: How would you assess the magnitude of the contribution of bio-plastics as a replacement for fossil-based products to the solution of the entire climate issue, so below the line is it worth investing in?

A: Harriette: Yes, that is a good question. Presently I'm also working on a project which we called "challenge fossil free" and that is of course the basic question here. We use fossil feedstock, oil, coal, gas, etcetera, mainly for the production of energy, and a little bit for the production of materials. And in order to fight climate change, you have to replace everything, basically. So that means that you have to replace the energy applications, and there is of course a lot going on there with using solar energy, water energy, wind energy, etcetera. So, all those solutions are not carbon based. The carbon is needed in the materials part of the applications and therefore we link the bio-plastics development especially to the materials part where you use fossil oil to produce plastics and materials that we see around us. Which is part of the solution, but you have to do everything, I think.

VZ: Do the other presenters agree with this or have to add something maybe?

Rudy: Yes, I think bio-polymers maybe at the moment, it's a small market, but for the long run bio-plastics is a good solution, but it's not the only solution. When we talked about the recycling of plastics, I think worldwide maybe 10 or 12 percent of the plastics is recycled. In the Netherlands it is between 30 and 40 percent. And there we can make big steps. I think to maybe 80 percent and our government wants 100 percent in 2050. But when you look at the amount of plastic, that at the moment is much more than the bio-based ones. So on the short run, I think recycling of plastics we can also make big steps with regard to our carbon footprint and use of plastic. Because it is a fantastic material, we can not do without it.

Q: How sustainable is the approach, since trees are harvested in making the process? So what plans are there for planting and replacing the harvested trees?

A: Virpi: Well, currently in Finland trees grow more than that they are harvested. So of course you need to be sustainable in forestry. This is also something that we are trying to communicate of course to the consumers, how the forests are maintained. So for example if you cut down a tree, you will plant 4 or 5 to replace it, so of course the whole value chain needs to be sustainable. But at least currently it's most, as I have mentioned, 90 percent of our forests are certified. So in that sense we can communicate this. And the other benefit is that employment issue. So it can employ people in such places around our country where no other jobs are available. So in that way it produces lots of other benefits as well. And of course we are worried about the added value of our product so we are trying to increase the value in that wood based products all the time. I didn't show, but we have lots of high-tech applications for medicine for example, you can make an extract of wood that will solve. For example for prostate problems. Wood is used for casts replacing other materials. That is more sustainable and more environmental friendly, and safe for the people who are working in medicine; so they are not exposed to harmful chemicals when they are forming the casts. So there are lots of applications that are really you can justify the use of wood instead of fossil based plastics, for example. But we try to add value, for example also in the textile industry, that's a big end user. And it can be justified to use wood for manufacturing clothes in the future.

VZ: can you explain to the attendees how clothes can be made from wood?

Virpi: I'm not a chemist, but at least in Finland there are many applications now, where they come into the market, to replace cotton. Because farming or producing cotton is very harmful for the environment, so in that manner wood based fibers for textile fibers is a much more sustainable option.

Harriette: I can add something to that. What you actually can do is: you can dissolve cellulose to make viscose and that is already a very old process. And that is also not so clean. Quite a lot of development has been going on for the last maybe 20 years and maybe even longer to improve the footprint of this process. To use a cleaner solvent in order to dissolve the cellulose and actually in the BLOOM project we made a very nice film of this, which was made by the people from Austria, so that should be available from the website. It explains quite clearly how you can make a T-shirt from a tree.

Q: Are you also working on the degradation of PET? For example how to control the degradation process or is the main focus there on recycling?

A: Rudy: Well, normal PET doesn't degrade in the biological way, so, PLA is a kind of polyester and of course we are studying also at the Wageningen University the bio-degradation behavior. It depends of course on the kind of bacteria you use, the temperature and the humidity. And like I said in my talk, you maybe also modify the degradation behavior by adding another bio-polymer. So influencing the bio-degradation behavior. And of course also natural fibers can adapt or modify the bio-degradation behavior. Because these fibers often contain little water or other bacteria and they can induce also bio-degradation.

Q: What sort of materials are used in bio-composites, are they also renewable or are they recycle materials?

A; Rudy: Yes, well actually talking about bio-composites, but also normal composites, there are all kinds of composites with different mechanical properties. And actually the picture I showed about the water phasing it is more low in its composites, so it's made of grass fibers, so when if you have grass, you can dry these kinds of fibers, actually all the pilot fibers are containing cellulose, so you can use all kinds of cellulose fibers. But actually these water phasing was made out of grass fibers. In combination with a starch-based polymer. So our first water phasing product degraded already in 2-3 week time, so that was not a good application for the water phases. But now we have a version 3.0 and it lasted for a longer time.

Q: How soon do you see the alternative based packaging materials to be taken on board by big companies such as Amazon, you know, as they have grown even bigger during the whole Corona pandemic. And the amount waste that is generating as a company. Are companies selling their bio-based packaging solutions to Amazon? Or can they be convinced to change their packaging? Or what are your thought on that?

A: Rudy: Well, talking about introducing recycled plastics or bio-based plastics or the packaging industry: it's a combination of education, politics and marketing. Because often packaging is used as a marketing issues, and that is a difficult one. So, yes, it's a combination. Politics can influence also the use of packaging, and get a refund for instance, for bottles or bags or whatever. So it's difficult to say it will last 10 years or 20 years or 30 years.

Harriëtte: Politics is true, in the Netherlands we also have a tax system on packaging, and at present it is not effective to actually really support the introduction of bio-based packaging, so that is really a pity. We have been working on this for like 25 years and a couple of years ago, one of the big retailers in the Netherlands, Albert Heijn and also some others, they decided to starting packing their organic fruits and vegetables etcetera in bio-plastics, bio-degradable plastics. And something like that really helps, but on the other hand, as I already showed, many of the materials are very difficult to distinguish, bio-plastics from normal plastics, so that is also one of the reasons why we are doing this project. I mean, as we, as a public, as a general public, ask for more sustainable solutions and we know that they are out there, we can help influence also big companies like Amazon to change their packaging systems.

Virpi: Yes, my last slide was about that survey we rounded up on Finnish consumers in last February. And what we found out in that study compared to 5 or 10 years back, was that the amount or the share of consumers that consider sustainability in their every day choices that had increased quit a lot, actually. It was like 1 in 3 maybe 10 years back and now it was almost 45 percent of consumers consider this issue. So could it do harm for me or does it promote my wellbeing? How ethical and sustainable it is and what does it do for the environment. So this are the things consumers consider when they make their everyday choices. And I think that the consumers are a huge driver, for the industry to change their packaging. And of course the consumers need the information also, regarding bio-based materials, more especially plastics. They don't have that information at all, so they don't know actually how the material performs and what kind of goods you can use it for. And where you may still need more traditional materials. One interesting study I saw a few years back at a packaging conference by Norwegians, was that they were packing some goods, for example fresh vegetables and fruit. And for some people they put a sticker on top of the pack fruit saying "I'm packed so that my shelf life is extended". And then the other people didn't see that sticker.

And once they added that sticker the preference for the packet fruit was much higher, the consumers were informed that why the packaging is there. We know that fruit and vegetable, that is one of the categories that has the most food loss and waste in retail. Once the people know why it's there, than it is easier to accept. So I think this is something we should do all the time. Not forget to educate the consumers, why we pack, why packaging is there. And another thing that I have learned from our studies is that people are not willing to sacrifice the functional properties of packaging for sustainability. So if it's taken away packaging or something that is still is the main purpose, which is to protect the food and make the food eatable, if it fails in that manner, if it spills or if it does something else, the consumers won't buy that package again. So it needs to function. Even though it is more sustainable.