Interview Hansjörg Lerchenmüller

2 February 2023

Bert Beyers: What actually is biochar? Is it something similar to charcoal?

Hansjörg Lerchenmüller: Yes. Charcoal is basically a form of biochar. With charcoal, the starting biomass used in pyrolysis is wood. And biochar is a generalisation, because in addition to wood, you can also use crop residues such as straw or other leftovers, nut shells or whatever, from agriculture or the food processing industry as a raw material.

What is pyrolysis?

It is a thermochemical process in which biomass is processed in the absence of oxygen. In normal combustion, ash remains. In pyrolysis, the combustion process is incomplete because not enough oxygen is supplied. And then up to 50 per cent of the carbon remains. And the coal is then ultimately almost pure carbon.

What can you do with it?

The main applications of biochar in Germany, Austria and Switzerland today are in agriculture. Biochar is added as a soil additive or as an additive to animal feed. This is also known from the charcoal tablet for an upset stomach. This is why biochar is also added to animal husbandry as an additive of one percent and ultimately ends up in the field again via the cow's stomach, thus producing its soil-improving effect.

What is your function at Carbuna?

I am the chairman of the supervisory board of Carbuna, and I am also an investor. In 2018, I realised that the use of biochar is a crucial tool to get carbon out of the atmosphere and into permanent use. Because we already have so much CO_2 in the atmosphere today, it is no longer enough to just reduce CO_2 emissions. Rather, we need to massively engage in taking CO_2 out of the atmosphere and putting it back into the natural carbon cycle on a permanent basis.

In other words, a technique of so-called negative emissions. What is special about biochar in this context?

The special thing about biochar is that I use the photosynthesis of plants. Then I take the biomass produced in this way, pyrolyse it and make a further concentration of carbon. In the process, the carbon becomes durable. With negative emissions, of course, I have to make sure that the carbon does not get back into the atmosphere, in the form of combustion or decay. In the soil, the biochar cannot decompose because there are no biological processes that break down the carbon. Produced at 500 degrees, it is stable virtually forever.

Is the technology of pyrolysis of biomass mature?

An incredible amount has happened in plant technology in the last five years. The pyrolysis process is, of course, thousands of years old. It was also done in the Middle Ages, for example as a basis for making steel, because you need high temperatures for that. In the last 10 to 15 years, there have been many technical developments of machines. Smaller pyrolysis units fit into a sea container. Inside is a process chamber in which defined temperatures prevail and air flows or oxygen supply are controlled specifically and precisely. You have to add a little oxygen to keep the process going. But not so much that all the carbon burns to ash. For larger pyrolysis units, you need a real hall. Depending on the size of the plant, typically between 1,000 and 10,000 tonnes of biomass are needed, for example wood chips or straw. And then between 250 and 2,500 tonnes of biochar come out.

Per year.

Exactly.

Which biomass can be used?

Basically, pyrolysis is very flexible; dry, woody biomass is particularly suitable for it. But it also makes an incredible amount of sense to pyrolyse sewage sludge. And the clear approach is not to cultivate extra biomass for this purpose, as is predominantly done today with biogas in Germany, for example, where extra maize is cultivated. We rely on residual materials throughout. Instead of letting them decay or rot, which at best produces CO2 and at worst methane. Methane has a particularly negative effect on the climate. And now there is another sticking point: the heat transition, it needs heat sources. Pyrolysis produces heat, which can be extracted as local heat or process heat at 90 to 140 degrees. The production of energy is a decisive additional benefit alongside the production of biochar, which improves the agronomic values of the soil.

Does it all pay off yet?

We have seen how energy prices have developed over the last 18 months. They had already gone up massively before the Ukraine crisis. So I have the thermal energy to use in any case. In the meantime, there are also plants that produce electricity.

Does that mean that the existing pyrolysis plants live economically primarily from energy production?

Ultimately, there are four mainstays. The first is heat. Then there is electricity generation, although not at all plants. The third mainstay is the biochar that is sold. And the fourth pillar is CO_2 certificates, which are now sold on the voluntary market.

Does that pay off? Are there still subsidies?

Heat and electricity are not really subsidised. There are a few countries where there are subsidy programmes for electricity from these plants. But essentially it is not subsidised; the plants are financed through the four pillars I mentioned. With the CO_2 certificates, I can realise about 130 to 140 euros per tonne of CO_2 on the market today. All in all, profitable operations can be run in this way.

Is the CO2 really sequestered? Isn't there any cheating going on?

In the meantime, there are mature and trustworthy certification systems, because with CO_2 certificates it is really important to do it right - there must be no "double-counting". There are three things you have to do to create high-quality CO_2 sink certificates: You have to track the carbon cleanly to be sure that the carbon is also permanently sequestered, and for that you need a digital tracking system for the plant carbon. The second thing that is needed is a closed contractual chain, because it must be ensured via the value chain that in the event of misuse or fraud, the culprit can be held liable. And thirdly, there needs to be an independent certification standard and independent auditing of the entire process. Only in this way, and only together across the entire value chain, will this climate service be created. Such a trustworthy certification standard was developed by the EBC and the company carbonfuture then implemented the whole thing with its digital tracking system and software platform in such a way that trustworthy CO_2 sink certificates can be created and traded.

Are there other applications for biochar besides agriculture?

For example, as an aggregate in concrete. If you mix 1 to 2 percent biochar into the concrete, then the properties of the concrete improve and at the same time, yes, you bind the carbon into the matrix of the concrete. And there the charcoal is locked away forever, it never enters the atmosphere again.

Let's talk about orders of magnitude. How big is the market for biochar in Germany or Europe at the moment?

At the end of last year, we had about 60,000 tonnes of production capacity in Europe. The European Biochar Industry Consortium is an association of companies that looks after the commercialisation of biochar and the associated processes. We are about 80 members today, and growing. And we monitor the available production capacity every year.

60,000 tonnes of production capacity - what will become of it?

We estimate that with this 60,000 tonnes of production capacity, about 35,000 tonnes of biochar will have been produced in 2022. The difference between capacity and production is mainly because about 25,000 tonnes of production capacity alone were installed in the course of 2022, and of course they did not all come on stream in January, but on average in the middle of the year.

You mentioned the climate problem earlier and we are talking about millions of tonnes of CO_2 that would have to be removed from the atmosphere. That means you are facing a huge expansion of production.

In 2022, the 35,000 tonnes of biochar will have removed about 100,000 tonnes of CO2 from the atmosphere. This figure should not be seen in isolation. The context is: we have an exponential growth of this technology. We have had an average market growth rate of about 70 per cent over the last two years and growth will remain at least at this level in 2023.

What about ten years from now? What are your ideas or wishes?

They are more than wishes. I worked in the solar industry for ten years. I founded a solar company in 2005 and was in the solar industry for eleven years, where I was able to witness how an industry went from an absolute niche to a mainstream energy technology. And why? Because the exponential growth realised an immense cost reduction. The solar cells got better, the cells got thinner, the efficiencies got higher. The production technology became cheaper. But the competitiveness of photovoltaics also changed because innovative financing concepts entered this industry.

And you are now transferring this experience to biochar?

Exactly, we have seen what happens when a technology develops over 20 years with high growth rates. That's exactly what we want to do now with biochar. And if we look ahead, we see this 70 percent growth rate also for the next few years. After all, it's all about a vision: how do we get to the point where we can get so much carbon out of the atmosphere and store it permanently? If we keep to our growth path, we will be climate-relevant by 2035 or 2040. And by climate relevant, I mean that we can provide about a third of the negative emissions needed to reach Net Zero.

Please give me a figure for 2035 or 2040.

My goal is to remove 200 million tonnes of CO_2 from the atmosphere in Europe with biochar. I can't retire before then.

You're only talking about Europe now. But man-made climate change is a global problem. What about developing countries? Will the technology work there, too, or is it all too complicated?

With the plants in Europe, we are really talking about absolute high-tech plants. The transfer to developing countries will certainly be able to go hand in hand with somewhat lower demands on the plant technology. Take India, for example. There, immense amounts of biomass, for example harvest residues from rice production, are simply burnt. And that immediately leads to CO_2 emissions. But it also leads to smoke and respiratory pollution. If plants were put into operation there that would use these residues by pyrolysis, that would be a huge step forward. And you can also use plants that are simpler and less automated, for example.

Is there actually enough biomass?

The simple answer is yes - to be climate-relevant in 2035 to 2040. There is no question that there is enough biomass for this. We have to prevent biomass from rotting uncontrollably. And the other thing we have to avoid, if possible, is that biomass is burnt. The combustion process has to change towards pyrolysis. And that will happen. We can already see that today.