Thomas Hartung from Aarstiderne at the stirling engine, which is going to cover the company's heat requirement and 60 percent of its electricity requirement from now on. In the background, you can see the pyrolysis reactor, which partly supplies gas to the stirling engine and partly supplies coke for soil improvement.

photo: torben skøtt/biopress

Carbon is just as important as energy

The Danish eco-company Aarstiderne has recently inaugurated an advanced gasification plant with an appurtenant stirling engine that is not just going to produce electricity and heat. The aim is for half the fuel to be converted into coke, which Aarstiderne will use to improve the fertility of the soil.

By Torben Skøtt

Is it better to burn straw in the power plants than to plough the straw into the ground? Offhand, most people would probably say yes, but we can no longer ignore that when we use straw in the power plants, we have to deduct the amount of carbon that will be lacking the soil.

The explanation for this is that Denmark, as one of the few countries in the world, has chosen that changes in the soil's carbon balance should be included in the climate balance. This means that we can no longer settle for keeping track of the amount of greenhouse gases that we emit into the atmosphere. In the future, we also have to be able to account for whether we have increased or eaten into the soil's carbon storage.

The reason that the carbon content in the soil can affect the climate balance is that the amount of carbon added to the ground, for example by ploughing down the straw, no longer appears in the atmosphere as CO_2. However, there is actually a constant exchange of carbon between soil and atmosphere, which means that, in practice, it can be difficult to work out the balance, and the fact is that many have criticised the scheme of encouraging creative bookkeeping.

But carbon in the soil is not just about a larger or smaller emission of greenhouse gases. When the soil contains a lot of carbon, it is good at holding on to water and nutrients, and this is of particular significance to organic farmers, who do not have the possibility of supplementing with artificial fertiliser.

The world's first

At Aarstiderne, who supply organic fruit and vegetables to 40,000 families in Denmark, the fertility of the soil is a vital factor. Therefore, it is not surprising that precisely Aarstiderne could recently inaugurate the world's first plant able to convert biomass into energy as well as a product containing coke, which can be used for soil improvement.

The core of the plant is a pyrolysis reactor, where half the biomass is converted into gas and the other half is converted into coke. Subsequently, the gas is burned in a boiler, which partly supplies heat for the company and partly runs a stirling engine, which is connected to an electric power generator. In that way, Aarstiderne can use the new plant to get more fertile soil, cover the entire heat requirement and 60 percent of the electricity requirement.

– It may seem paradoxical that we only convert half the biomass into energy, but for us, it is a matter of a long-term strategy aimed to increase the carbon storage of the soil, explains Thomas Hartung, who is a co-owner of Aarstiderne. He is convinced that the coke fraction from the plant is a much better soil improvement product than the unprocessed biomass.

– If you leave straw on the ground, 95 percent is turns into CO_2, and only 5 percent is retained in the ground. If we choose to convert straw into coke instead, we can store about half of it in the ground, and in this way, we can increase the carbon storage of the soil, explains Thomas Hartung.

The Indians knew it

Using coke to increase the carbon storage of the soil and thereby improve fertility is not a new invention. According to Thomas Hartung, a Dutch researcher named Wim Sombroek discovered some very fertile soil types along the Amazon river in Brazil in the 1950s.

That area is otherwise characterised by exhausted soil, but it turned out that in connection with the Brazilian Indian's settlements along the river, there were areas that consisted of a very dark and very fertile soil.

Further analyses showed that the areas were thousands of years old, and that the black colour was due to supply of some kind of charcoal or coke. Thus, the Indians must have known already back then that charcoal can improve the fertility of the soil significantly.

Serendipity

Serendipity is a term for a situation where you find something interesting while looking for something completely different. For Aarstiderne, this is a recurring phenomenon, and therefore, they have chosen to establish a development company of that name. The first assignment of the company will be to commercialise that ideas and patents contained in the new combined energy and soil improvement plant.

Serendipity works closely together with Stirling Denmark, who have handled the technical installations, and there, they expect that they will be spending the next months to correct various teething troubles in order for the plant to be able to start fully automatic operation at the beginning of the new year.

– This is the first time that we have supplied a plant of that type, explains Lars Jagd, who is the manager of Stirling Denmark. The company, which is based on 15 years of development work, is specialised in the production of stirling engines driven by heat produced outside the engine. This can be heat from a wood chip boiler or a boiler fed with gas from a pyrolysis reactor, which is the case at Aarstiderne.

In connection with pyrolysis, the biomass is heated without the presence of oxygen. In this way, there is a cleavage of the material, creating a gas, which can be used for heating, and coke, which can be used for soil improvement or as solid fuel. Pyrolysis is a type of simple gasification where you only convert part of the material into gas - a technique that is for example used for production of charcoal.

– A major advantage of pyrolysis is that we can use practically all types of biomass and waste, and the temperature is so low that there is no risk that the coke fraction can contain harmful substances, explains Lars Jagd. According to his assessment, there is great potential for that type of plant, as it is possible to work with difficult fuels, which would be particularly attractive in the developing countries. ■