

# Straw pellets in the digester

Farmer Bernd Pommerehne from Lüchow (Mecklenburg-Western Pomerania) is replacing maize with straw pellets. He produces these with his "Premos" pelleting press from Krone, either directly in the field or on the farmyard. His experience is very positive.

**B**ioenergie Lüchow GmbH & Co. KG near Rostock on Germany's north coast is an early biogas pioneer. "We have three plants, the first of which dates back to 2004," says managing director Bernd Pommerehne. The company operates ten combined heat and power plants (CHPs) in total. "But we find ourselves constantly having to reinvest to keep up with changing requirements. Currently it's the exhaust gas treatment system. So we plan to get out of electricity generation as soon as possible," he says.

As an alternative, they plan to switch to producing biomethane for the fuel market. Both the gas price and the proceeds from the greenhouse gas quota appear more attractive to him than the feed-in tariff provided under Germany's Renewable Energy Act (EEG), which comes with several strings attached.

## COOPERATING WITH LIVESTOCK FARMERS

But biomethane for the fuel market is an attractive proposition only when the

## KEEPING IT BRIEF

**In future, the digesters** of bioenergy company Bioenergie Lüchow GmbH & Co. KG will produce biomethane mainly from waste material.

**Plant operator Bernd Pommerehne** uses straw pellets in the mix, which he produces on his farm with a Krone pelleting press.

**The straw he uses** comes from his own fields as well as from local cattle farmers, who receive digestate in return.

**Straw yields as much gas** as maize, or even more, says Bernd Pommerehne.

forces with neighbouring cattle farmers and has plans to expand the following business model from this year:

- He takes care of the straw logistics – either pelleting the barley and wheat straw from his own fields and nearby farms or forming it into square bales, removing it from the field and storing it.
- But he doesn't buy the straw. His role as a service provider is to pellet or bale it, then store and transport it.
- The farms provide manure free of charge, which Bernd Pommerehne transports to the digesters using his own machines.
- In return, the farms receive digestate to use as fertiliser. Bernd delivers the solid fraction of the separated digestate to farms that are further away.

## STRAW IN THE SUBSTRATE MIX

The farmer has already done some preliminary experiments with straw manure: unshredded long-stalk straw soon produces floating layers in the digester, because it floats to the surface of the fermentation tank. So he has to shred the manure before feeding it into the digester. This is what initially attracted him to straw pellets, because the straw is already cut. He has been using them for a year now. Every day, each plant receives the following substrate mix: 20 tonnes of maize silage, 25 tonnes of cow manure, 6 tonnes of poultry manure, 25 tonnes of beet pulp from a laagoon and 6 tonnes of straw pellets.

"We layer up the substrates in the feed unit, which has a push floor," he explains. The maize and straw pellets go on top of the manure, and the beet pulp is pumped straight into the digester. "We plan to stop using maize and beet in future and focus on farmyard manure instead," he adds.

gas is produced from waste materials such as slurry, manure or straw. To this end, Bernd Pommerehne has joined



△ Bernd Pommerehne handle the straw with his own machine fleet.



Photos: Heil

△ No special equipment is needed to add straw pellets to the substrate mix; they are simply tipped into the feed unit.





△ Bernd Pommerehne is impressed by the ease of handling and high gas yields of straw pellets.

### PELLETING IN THE FIELD

Bernd uses the Krone Premos 5000 pellet harvester to produce the pellets. The machine produces 16mm pellets in two contra-rotating and interlocking die rollers without chopping the straw first. The mobile pellet harvester can be used both as a mobile field machine and as a stationary pellet mill in the yard. “We want to pellet as much straw as possible in the field. Therefore we have ordered a second pellet harvester which will allow us to operate double shifts in 2023,” explains Bernd. As the plan is to harvest 2,000 hectares of straw, one

Premos processes around 20ha in 24 hours and two machines could manage 40ha.

In 2022, the farm harvested 450ha of straw, picking up 3.5 tonnes of straw per hectare and producing 60 tonnes of pellets a day. He also discovered that the pellet harvester worked well as a square baler – even at night when there’s dew on the ground. At this point, it’s worth mentioning that for Bernd Pommerehne it’s not so much the strength of the pellets that matters, but the use of pressure and temperature to breakdown the straw.

### STATIONARY OPERATION

In future, Bernd plans to pellet half the straw in the field and bale the rest into square bales for subsequent pelleting in the yard. To save fuel, he operates the pellet harvester’s pto with a 400kW electric motor. “The machine consumes more energy in stationary mode, because the square bales first have to be shredded with the milling drums,” he explains.

The 400kg square bales are transported by a telehandler to the feed table which slowly feeds them into the machine. In stationary mode the ma-

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◁ A covered former maize clamp serves as a store for finished straw pellets.



△ Bernd Pommerehne's colleague uses the telehandler to load the bale shredder.

chine can pellet around 100 bales in eight hours, which equates to 5 tonnes of straw pellets per hour. "With further optimisations we're aiming for 8-9t per hour," he adds. The finished pellets are stored in covered silage clamps. The storage system works well, with only the top layer of pellets swelling slightly when they absorb moisture from the ambient air. "We're not aiming to produce pellets that are completely firm and tight. That would only be necessary if we were selling to horse owners, for example, or if we needed high densities for efficient transport. For our purposes, it doesn't matter if they are a little crumbly," he explains. The advantage of this is that the machine can put through higher rates.

The pellets either go straight to the digester or to livestock farmers for use as bedding. Some farmers have already installed automatic bedding systems in their sheds for this purpose. The benefit for cattle farmers is that they can operate smaller bedders when spreading pellets than when using square bales.

#### PELLETING COSTS OF €80 TO €90/T

The costs for mobile pelleting with the harvester running behind a 380hp trac-

tor are around €80 to €85/t. Stationary pelleting comes in at €90/t – with €60 for the pelleting and €30 for baling, transporting and storing the square bales. Bernd Pommerehne gets the electricity from one of his biogas plants. "We produce a surplus and thus have our own power available for around 15ct/kWh," he calculates. In addition, he has roofed over two silage clamps which were previously used for storing maize but are now used for pellets. He plans to install solar panels on the roofs and use this electricity on the farm too.

#### HIGH GAS YIELDS

The straw pellets have a high gas yield. The German Association for Technology and Structures in Agriculture (KTBL) puts it at 373m<sup>3</sup> biogas per t of fresh matter and 290l methane per kg of organic dry matter (l/kg oDM). In other words, slightly less than maize silage (355 l/kg oDM). "However, in our plants we have found that straw pellets produce significantly higher gas yields than maize," says Bernd Pommerehne.

In his experience, the pressure combined with a roller temperature of 60 to 80°C ensures that the straw's wax layer is fully pre-digested during pressing. This makes the use of pellets more attractive than chopped straw. But for

Bernd Pommerehne, that is not the only benefit of using pellets.

- As further benefits, he can produce pellets in-house using his own machines, whereas for maize silage he needed a contractor with a harvesting fleet.

- And he doesn't have to buy the pellet harvester, he can hire it. Krone supplies them for a basic fee combined with an hourly rate. In Bernd Pommerehne's case, it adds up to €175 per operating hour (plus €40/h for the tractor, €60/h for diesel and €25/h for the operator). This scheme increases the farm's liquidity.

- Although the ha/hr performance of the pellet machine is lower than that of a square baler, the end result is straw pellets that do not require interim storage followed by rehandling for further processing – and that cuts down on labour.

- The biogas plant does not need modifying for digesting straw pellets which can easily be filled in with the existing equipment.

- Inside the fermentation tank, the pellets support the desulphurisation process of the substrate, ensuring that no hydrogen sulphide is produced.

#### COMPARING THREE METHODS

Bernd Pommerehne is in close contact with two other biogas producers. All three use straw as a substrate, but are supplied with the materials in three different ways. "One uses thermal hydrolysis, another briquettes. In 2024 we will compare which method works best for straw digestion," he explains.



◁ The pellets are a bit crumbly. This is because Bernd Pommerehne operates the pellet harvester at maximum throughput rates. But that's not a problem in the digester.

Photos: Heil

## RESEARCH PROJECT

### When it pays to use straw pellets

In some circumstances straw pellets can provide a worthwhile alternative substrate to maize. This is the findings of the “StroPellGas” research project conducted by the University of Göttingen and the HAWK Hildesheim/Holzmin-den/Göttingen University of Applied Sciences and Arts. For two years, these researchers studied the mobile and stationary ways of pelleting straw and the suitability of pellets as a biogas substrate and conducted a survey of around 300 biogas plant operators from all over Germany.

#### KEY FINDINGS:

- Straw pellets offer plant operators a high degree of flexibility. They can be used straight away, without requiring

any modifications to the feeding, pumping or mixing equipment.

- Although pelleting is costly and time-consuming, it results in a high level of straw compaction as well as a certain amount of pre-digestion. This is helpful during both transportation and fermentation.

- The pellets break down easily in the digester and produce roughly twice as much biogas as maize per tonne of fresh matter – 0.45 tonnes of straw pellets being the equivalent of one tonne of maize.

- Straw pellets are an ideal substitute for substrates with a low DM content such as slurry or sugar beet.

- The equivalence price for maize is €86-144/t, which means at this price straw pellets are equivalent to maize.

- Pellets can make up to 10 percent of the substrate. This ratio has proven to be a workable proportion, because DM contents will increase rapidly in the digester if the ratio increases. The actual ratio depends very much on the sub-

strate mix and the plant itself.

- Straw pellets break down very well in the digester, yielding a fugate factor (liquid phase) of 0.36. This means that the volume is reduced by 64%.

- Mobile pelleting in the field is more profitable than stationary pelleting. The cost-effectiveness of the stationary method increases when it is powered by an electric motor – ideally solar powered – rather than by a tractor.

In conclusion, straw pellets are suitable for farms that pay high prices for substrates such as maize, have smaller digestate storage tanks or want to venture into biofuel production. This is because straw counts as a waste material with a high CO<sub>2</sub> reduction potential. The project partners are currently compiling guidelines for plant operators. [neutec.hawk.de](http://neutec.hawk.de)

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