

Adding more value to slurry:

# Norwegians trial plasma reactor in Northern Ireland

With slurry volumes increasing on all livestock farms across the UK and Europe thanks to the EU-enforced winter spreading ban, farmers are being encouraged to explore new methods of utilising the by-product as a financially rewarding resource. There are numerous options available to separate slurry into solids and liquids, including trials in two countries using a plasma reactor to strip out the nitrogen

**W**hile all livestock farmers know how big a burden too much slurry can be in terms of how to dispose of it, far fewer have grasped the real potential it has if managed more efficiently. With growing global emphasis on reducing ammonia emissions in the future, there will also be a drive, therefore, to reduce the production and use of artificial fertilisers. Experts state these fertilisers are

produced by fossil fuels which are in decline and increasing in price year on year, resulting in the fertiliser manufacturing process becoming unsustainable. With that in mind a greater focus on recycling nitrogen from farmyard manure to produce a high value natural fertiliser is one potential option – and one N2 Agri is exploring. This Norwegian-formed company has developed a unique system that uses a plasma reactor

to strip nitrogen from slurry, farmyard manure and digestate to produce liquid nitrogen, which is available more readily to plants that can feed on it faster. The goal of N2 Agri has two prongs: firstly to help farmers save money on artificial fertilisers by producing their own liquid nitrogen; and secondly to reduce their ammonia emissions, which are coming under heavy scrutiny from the European Commission and beyond.

## Farm facts

### The Bingham family

#### Location

Templepatrick, Co Antrim

#### Farm size

263.7ha

#### No. of milking cows

750

#### No. of replacements

450

#### Feeding system

Zero grazing and silage

#### Energy production

Biogas plant

#### Trials

N2 Agri plasma reactor

*The Bingham family milks 750 cows and has an additional 450 dry cows and followers on the farm.*



Cows in the main milking herd are kept indoors and fed silage.



*The plasma reactor is housed in a container and directs the liquid nitrogen into a IBC collection tank for storage.*

**N2 Agri has set up a demonstration unit on a dairy farm in Northern Ireland milking 750 cows.** Here the Bingham family is keen to reduce the farm's emissions as well as its artificial fertiliser costs. The concept involves passing manure, or in the case of the Bingham farm, biogas plant digestate, through a plasma reactor to produce liquid nitrogen fertiliser. The process, says the firm, will ultimately save farmers up to 20% of their artificial fertiliser costs and also reduce their ammonia production levels.

N2 Agri adds that around 32% of global greenhouse gas emissions come from the agricultural sector and, to challenge this, insists this new concept can eliminate 75-95% of the nitrogen oxide emissions from livestock manure. Main markets for the new technology are bigger livestock farms in the United States and Europe where greenhouse gas emissions are a problem and are being heavily regulated. Although the concept has moved beyond the prototype stage, it is still being tested around the world: one on a pig farm in Denmark and the other on the Bingham farm located near Templepatrick in County Antrim.

**This farm is run by Robin Bingham and his son George.** They installed a biogas plant one year ago and this produces electricity that is supplied into the national grid. In total, the farm has 1,200 cows, including dry cows and followers, and runs a zero grazing system whereby fresh grass is harvested and delivered to the cows daily. The plasma reactor was installed at the farm six months ago on a trial and is already producing liquid nitrogen that has been spread

on test plots at the farm. Farmers who use this system in the future can expect to pay it back in six or seven years with the savings on artificial fertiliser, according to N2 Agri. The process uses a plasma reactor that fixes nitrogen from the air and adds it to the manure. This causes a reaction with the manure and stops ammonia losses as well as emissions of other greenhouse gasses, and additionally removes bad odour.

"Our objective is to empower livestock farmers through the introduction of low cost, scalable fertiliser production on the farm," says Henk Aarts, N2 Agri business development director. "Our ultimate goal is to substitute chemical fertilisers with fertiliser produced locally on the farm from air and renewable energy. And meanwhile we work on a better stable climate and a more sustainable livestock sector. We can also upgrade biogas digestate to a higher value fertiliser with our technology."

**Although the company is trialling two machines in Europe it has plans to embark on more trials farther afield in places such as South Africa.** N2 Agri is partnering with SBI, an innovative plasma welding company based in Hollarrunn, Austria, and together they are using the competence of the University of Vienna for analysis of plasma composition and temperatures.

"We are not in the phase of selling machines yet, but want to show our plasma reactor and explain the working principles to the stakeholders," says Mr Aarts.

"Our reactor is not fully developed, but we want to test it under farm conditions at an



early stage to get experience with different types of manure and biogas digestate and to do field trials on different crops which, on the Bingham farm, are grass plots."

The key argument to convince farmers to use this plasma reactor is to explain how they are losing so much nitrogen from their livestock and slurry, which is later supplemented by artificial fertiliser spread on the ground. In fact, there are 2.13 million tons of ammonia lost on European livestock farms each year, which is a huge loss of potential fertiliser. One of the founders of N2 Agri is Norwegian, Rune Ingels, a chemical engineer who spent almost 30 years working in the fertiliser industry, more recently with Yara, before resigning to embark on his own ideas. "We need above 95% moisture content in the manure to make the system work," points out Mr Ingels. "Slurry has 50% free ammonia but digestate has around 70% free ammonia. Just over 50% of the total nitrogen available in slurry is lost before it can be spread on the ground. However, using our system we can make more nitrogen available for plants, and



Digestate from the biogas plant is run through the plasma reactor.

this is also taken up quicker by the plants increasing their growing rates and yields. There are some tweaks needed to the system the Bingham's are using, as it is primarily installed to test yields at the moment." Dairy farmer George Bingham says the system interested him as it met his desire to farm in a more environmentally friendly way. "Northern Ireland is very heavily populated with livestock, and ammonia emissions are



All the main controls are housed in the container.

becoming more of a problem," says Mr Bingham. "Using this plasma reactor system will help us to farm in a more environmentally friendly way while at the same time sorting out my ammonia emissions. I see this as a potential game changer across the world helping farmers get more from their farmyard slurry and saving them money. For me, reducing my chemical fertiliser bill is one of the main benefits of this system. The system has

only been installed a relatively short time and we have already produced our own liquid nitrogen and spread it on some grass test plots to see if it works."

It is anticipated that a farm with 150 to 200 cows will need one 25kW plasma reactor; therefore a 600-cow herd would need three units. However, the reactors can be scaled to suit the farm, according to Mr Aarts who points out: "We can change the sizes of the reactor to suit the herd. We don't have exact prices as yet, but a reactor will be cheaper than a milking robot."

**Summary:** Farmyard manure is a resource that contains most of the nutrients required by plants. However, the levels of nitrogen in it are too low to achieve a balanced fertilisation of most crops. This becomes an even bigger issue when half of the nitrogen content is lost during storage and spreading.



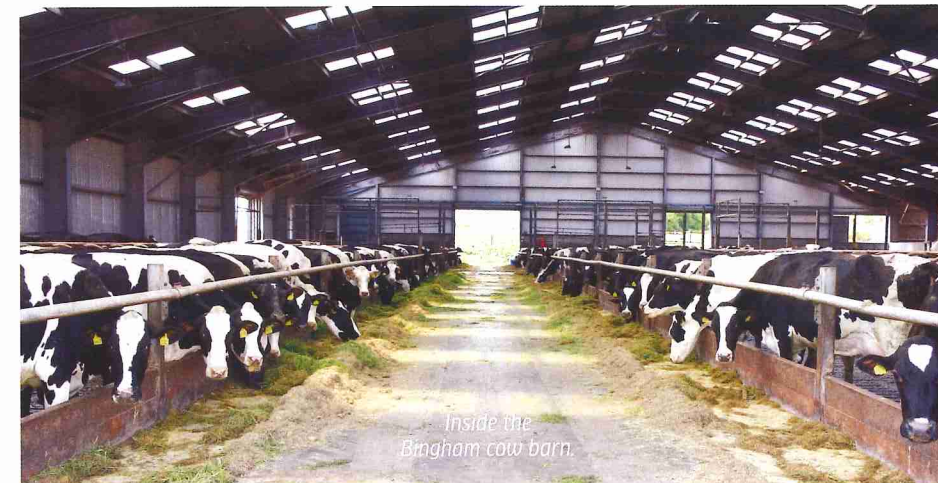
The plasma reactor – not much to look at, but there's a lot going on inside.



Fans inside the container keep the kit cool.



Rune Ingels, one of the N2 Agri founders, left, with farmer George Bingham and Henk Aarts, N2 Agri business development director.

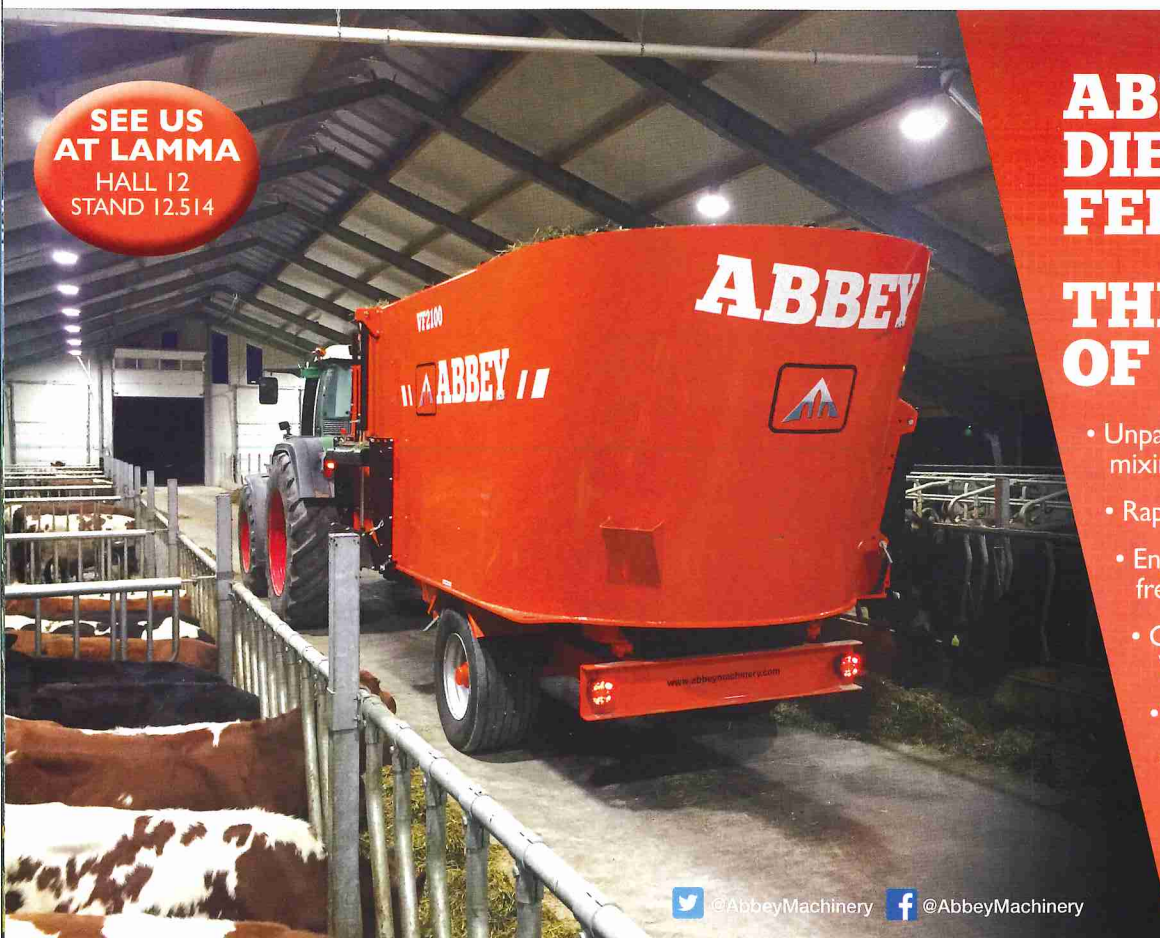


Inside the Bingham cow barn.

Livestock production has come under fire from environmentalists through ammonia and nitrogen losses, which contribute to global warming. However, it is also a huge loss for farmers who are then forced to compensate for this by spending thousands of pounds on artificial fertiliser, the production of which in the future is somewhat unsustainable. By employing this type of plasma reactor technology, farmers like George Bingham are thinking ahead to leave agriculture and the environment in a better place for the next generation.

Chris McCullough

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