New technology for reduction of air pollution from farms

Chemical technology and new sensors for purifying the air will make it possible for farmers to control ammonia emission at the same time as remediating odour from livestock production. This can contribute to a significant reduction of the total air pollution in the Western world.

Researchers will develop new technology that can very accurately measure airborne emissions of ammonia and odours from animal production facilities at the same time as retaining the pollutants.

They are focusing on ammonia in particular because it is converted in the atmosphere to particles that are harmful for humans to breathe.

"Ammonia and odours are some of the major environmental problems in agriculture, but ammonia is also a useful fertiliser if we can retain the gas. Our aim is therefore to develop technology-based methods to monitor air pollution in animal housing and limit emissions into the atmosphere," says Associate Professor Anders Feilberg. Livestock production is currently responsible for a substantial part of air pollution in Denmark.

Chemical cleaning with great potential

In collaboration with leading Danish technology companies, the university researchers have been working on chemistry-based air purification for a number of years. On this basis, they will now develop a new technology and a finished prototype of a purification plant that can remove odours and ammonia in livestock production.

"We know that acid-base processes are effective in reducing ammonia emissions from animal housing, and we expect that a new oxidation process can also be used to remove odorous substances. We'll therefore integrate two different technologies in a chemical purification plant that can deal with large amounts of ventilation air," says Associate Professor Feilberg.

The new chemical technologies will work via a filter tower with different kinds of packing materials that can retain ammonia gas from the ventilation air by continuously irrigating it with different chemical liquids. The researchers are already well advanced with their research in the laboratory. Their major engineering challenge now is to make the purification plant both reliable and economically viable.

If they succeed, this can be very important for the technology's commercialisation opportunities, according to Associate Professor Feilberg.

"We're going after an advanced chemical technology solution that can work efficiently and economically on a full scale outside the laboratory. If it works, we can expect considerable global demand," he says.

New sensors will monitor ammonia vapours and odours

In addition to designing methods for cleaning the air, the researchers will develop new sensors that can very accurately measure ammonia emissions from animal housing.

"We're working on different types of sensors, which can each in their own way record the level of air pollution with a high degree of detail. We'll also make the measuring instruments significantly smaller and cheaper in terms of design, production and operation," says Associate Professor Feilberg.

One of the sensors is optical and it will measure the amount of ammonia in the air by illuminating the gas with laser beams. The technology is based on basic engineering research in photonics that can be integrated into very small computers. This provides farmers with an opportunity to monitor continuously, and thereby produce a time-resolved image of the pollution situation. Another sensor is based on NMR spectroscopy. It works by recording the relationship between nitrogen and potassium atoms in the slurry, and can eventually be an inexpensive and accurate instrument for measuring ammonia emissions.

The researchers also have a number of other ideas in the pipeline, and the project's total number of monitoring and cleaning technologies will provide the farming industry with better opportunities to adapt to current environmental legislation.

"If farmers can carry out accurate monitoring of ammonia emissions from animal housing, they can also make their operations more efficient. And if they can clear the air of ammonia at the same time and collect it for fertilising purposes, they'll also be able to significantly reduce the environmental impact," says Associate Professor Feilberg.