

TRAINING MATERIAL

Title:

The use of **scrubber water** as fertilizer

Training:

Main features of the subcategory

Scrubber water is a N rich liquid solution recovered from waste stripping /evaporation process, mainly in the form of ammonia water. The ammonium ion in solution exists in equilibrium with unionized (free) ammonia that can volatilize depending on pH and temperature. Concentrated ammonia water from stripping/evaporation process usually contains 10-15% ammonia which can be concentrated up to 20% by an extra distillation step. The product can be used directly as a fertiliser or as secondary raw product for fertiliser production.

Input material

Liquid fraction of waste streams rich in mineral nitrogen, including urine or slurry from animal husbandry, effluent of anaerobic digestion, effluent from wastewater treatment plant etc.

How to produce?

The scrubber water can be recovered from waste streams by stripping or evaporation process. Evaporation (or ammonia stripping) is based on water and ammonia vapour pressure. By bringing the liquid fraction to its boiling point through heating, a large part of the water will evaporate and volatile components (like ammonia) transfer to the gas phase which will be re-absorbed in the water in a later stage. The closed environment in evaporator helps to increase the recovery of ammonia into the solution. Another benefit of evaporation process is brought by the use of vacuum which lower the boiling point and reduce the energy demand for heating. Generally, it is suggested that the pH to be raised to about 11 and the feed temperature at 70 °C in order to reach maximum ammonia removal efficiency. In practice, it has been found that elevating the pH of the input stream leads to considerable operating costs. Instead, for most biogas plants, residual heat is usually available from the combined heat and power (CHP) system and is often present in excess. Therefore it is more reasonable to raise the temperature instead of pH. In theory, the recovery rate of ammoniacal N could be 60-75% at a feed temperature of 80 °C.

Typical nutrient content and availability for plants

The scrubber water recovered from manure or digestate by evaporation usually contains 10-20% of N in mineral form, which is directly available for plants. The NH_3 -water (ID:1527) is a liquid fertilizer with 14%N. It is a potential RENURE fertilizer which is processed manure fractions and has the value to replace chemical fertilizers.

Examples for ammonia water products available on the NUTRIMAN Farmer Platform

- https://nutriman.net/farmer-platform/product/id_1527 (Netherlands)



Figure 3 VP-Hobe system for NH_3 water production (ID:1527)

There is one ammonia water product from VP-Hobe which is selected in the NUTRIMAN project. The NH_3 -water is produced using the VP-Hobe Manure Valorisation system. The input pig manure or digestate is first separated into a solid and a liquid fraction. Separation takes place in a flotation unit and in a belt press sieve. A reverse osmosis unit processes the liquid fraction into a retentate concentrated-N/ K_2O product and a permeate product to be processed in the clean water production. The concentrated-N/ K_2O product will be further de-watered in an evaporator. The liquid passes through a falling film evaporator with mechanical vapour recompression. Heating the liquid in the evaporator causes water to evaporate. A vacuum lowers the boiling point, less energy is needed than when evaporating at normal atmospheric pressure. The ammonia in the incoming liquid is removed from the product flow by stripping and concentration into NH_3 -water (14% N). The evaporator further produces a Potassium concentrate (25% DM), ammonium sulphate by scrubbing the vapour coming out of the evaporator.

Fields of application in agriculture: crop, dosages, application method and practical recommendations.

The ammonia water (ID:1527) can be applied in conventional farming with vegetables, grass, maize, grain. Application can be done using liquid manure injection systems. Low emission application techniques are compulsory to prevent ammonia volatilization. The recommended application rates depend on the crop needs and soil analyses. Currently max 170 kg N/ha as livestock manure (230-250 kg N/ha for derogation farms in NL).

Benefits for farmers

High N liquid inorganic fertilizer derived from processed animal manure. The production and usage of RENURE fertilizers allows farmers to process their (excess) livestock manure into a RENURE fertilizer. In the Netherlands this product is a potential RENURE fertilizer which means that application will no longer be defined as livestock manure in the Nitrates Directive and its application will no longer be limited to 170 kg N/ha.

Bottlenecks of application. Potential risk or limitation.

Under the current regulations, the ammonia water recovered from animal manure is still treated as livestock manure and needs to follow the limit of max 170 kg total N per hectare (230-250 kg N/ha for derogation farms in NL).

Another concern about the field application of the scrubber water is the ammonia volatilisation. Since the pH of recovered ammonia water is usually high (e.g. ± 10), which gives even at normal ambient temperatures (15 °C) 75% of the total ammonium in the solution to be present as ammonia gas (NH_3) and thus increase the potential of N loss via volatilisation. Therefore, reducing the pH to neutral, using solutions with a low ammonium concentration (1-3%) or a mix of ammonium solution with manure or compost can prevent ammonia losses to the air.

Legal framework for usingSpecific national legal conditions

The ammonia water (ID:1527) follows the Dutch fertilizer act (Meststoffenwet). It is allowed as pilot RENURE fertilizer in NL which means that application is no longer defined as livestock manure in the Nitrates Directive. The product has a pilot approval pending the official acknowledgement by the EC. Therefore application is not limited to max 170 kg N/ha.

EU Fertilising Products Regulation

Currently the scrubber water from VP-Hobe (ID:1527) may fit in the EU Fertilising products regulation 2019/1009 PFC 1 C I (b)(i) as a straight liquid inorganic macronutrient fertiliser.

Economic evaluation of the application of the products

Costs for farmers will be approximately €20-40 per ton ex works.

Best management practice guideline, taking into account of specific conditions of the given territory, for the use of the product to the specific applications (soil improvers, growing media, organic fertilisers etc.).

Application doses

The application rates of the ammonia water (ID:1527 → scrubber water) depend on crop needs and soil analyses. Currently max 170 kg N/ha as livestock manure in terms of the Nitrates Directive. (230-250 kg N/ha for derogation farms in NL).

How to store, apply to land, machinery needs.

Highly concentrate scrubber water is corrosive to facilities made from copper, copper alloys, aluminum alloys and galvanized surfaces. Therefore the containers for this product should be avoid those materials. Due to the high ammonia content, it is recommended that the product should be stored and transported in closed low-pressure tanks and kept cool without direct expose to the sunlight.

For more information:

- https://nutriman.net/farmer-platform/product/id_1527 (Netherlands)