

CHEMICAL ANALYSIS

(Mineral concentrate obtained from co-digested pig manure at Groot Zevent Vergisting)

Mineral Concentrate

0.8 % (± 0.5 %)	N water-soluble ammonium nitrogen as NH ₄
0.4 % (± 0.5 %)	S water-soluble sulphur
0.8 % (± 0.5 %)	K ₂ O water-soluble potassium
<0.03%	P ₂ O ₅

Solution: typical properties

Density:	1,0 kg/l
pH:	7.5 to 8.5

Description

Mineral concentrates are produced from manure or digestate through a process of solid/liquid separation followed by reverse osmosis. The concentrate after reverse osmosis is here referred to as mineral concentrate. Mineral concentrates contain at least 90% of the nitrogen in the form of ammonium (NH₄) which is fully water-soluble and plant-available. Though primarily used as an N fertiliser, these mineral concentrates also contain notable levels of other macro-nutrients including potassium and sulphur but not phosphate. The composition may differ depending on the origin (production plant) of the concentrate. Mineral concentrates can be used as N/K/S fertiliser on grassland and arable land.

The use of mineral concentrate as an alternative for synthetic N fertiliser is beneficial in terms of lowering greenhouse gas emissions since it reduces long-distance transport of manure and lowers the use of synthetic N fertiliser within the region of the plant.

Application

Mineral concentrates should be applied by means of injection in order to prevent ammonia emissions. In the Netherlands and in Flanders (Belgium) this is in force in national regulations. JRC proposed this as a criteria for all RENURE materials that have a pH above 5.5. If applied correctly, the nitrogen use efficiency of mineral concentrates is similar to that of artificial nitrogen fertilisers. Mineral concentrates typically contain less than 1% N which is low compared to synthetic fertilisers and this may require adjustment of application equipment used for injection of artificial fertilisers in order to apply the desired amounts.



⁽¹⁾ Criteria proposed by Joint Research Centre (JRC) for potential categorisation of so called RENURE materials is a proposal and not active legal framework. For more information on this study please see : Huygens D, Orveillon G, Lugato E, Tavazzi S, Comero S, Jones A, Gawlik B, Saveyn HGM, Technical proposals for the safe use of processed manure above the threshold established for Nitrate Vulnerable Zones by the Nitrates Directive (91/676/EEC), EUR 30363 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21539-4, doi:10.2760/373351, JRC121636.

Mineral concentrates can be blended with other liquid fertilisers such as ammonium-sulphate, liquid urea, ammonium nitrate or mixtures thereof. An example of a blend is the Green Meadow Fertiliser produced by Groot Zevert Vergisting in Beltrum. Blending typically leads to a higher N content in the fertiliser and optimised ratios between nitrogen, potassium and sulphur in order to meet crops requirements. A point of concern upon blending is the formation of H_2S or N_2O which are formed as a result of biological processes leading to reduction of sulphate or nitrate. Mineral concentrate of demonstration plant GZV was found to contain low amounts of biodegradable organic matter and can therefore be safely mixed with other fertilising products. However, for other processing plants, this must be confirmed in laboratory experiments before blending is applied in practice.

Mineral concentrates that contain sulphur should not be mixed with animal manure because this increases the risks for formation of H_2S gas which is toxic and lethal. As with applying animal manure, growers should be aware of the potential risks of H_2S when using mineral concentrates.

Mineral concentrates can be used at the start of the growing season and, for grassland, throughout the growing season. In terms of weather conditions, it is advised to apply on a moist soil but not rainy days in order to avoid leaching.

Recommendation

Recommendations of the fertiliser ordinance and official advice have priority.

The application rate of mineral concentrates depends on:

- the nitrogen requirement of the crop or crop rotation
- nitrogen supplying capacity of the soil
- the potassium requirement of the crop or crop rotation and soil K status
- the sulphur requirement of the crop or crop rotation
- the amount of mineral N present in the soil (N_{min} method)
- Soil K status
- the quantity of nutrients applied through organic fertilisers, manure and organic soil amendments.

Mineral concentrates are part of a fertilisation plan. This plan designates the application rates of all nutrients for all crops given a known soil fertility status. Mineral concentrates contain the macro-nutrients nitrogen, potassium and sulphur and it's application dosage should therefore fit the demand for these three nutrients. Exceedance of the advised application rates should be prevented. A sulphur dosage above the crop uptake has a negative effect on the uptake of micro-nutrients and leads to leaching of sulphate to groundwater. Overfertilization of potassium on grassland could contribute to Hypomagnesiemie in cows. Since mineral concentrates contain nitrogen, potassium and sulphur in ratio's different from crop demand, blending with nitrogen fertilisers is preferred in order to adjust nutrient ratio's to meet crop demand and prevent overfertilization of a particular nutrient.

The values shown in the table can be taken as a guideline for the fertilisation of some important crops.

Crop	Application rate		
	kg N ha ⁻¹	Kg K ha ⁻¹	kg S ha ⁻¹
Cereals	150 - 230	90	10 - 20
Oilseed rape	200	90	70
Corn, maize	180	120	25
Sugar beet	160	160 - 280	34
Grassland	400	400	40



Storage

Storage tanks are to be designed in accordance with water regulations. They must be designed in such a way that uncontrolled leakage of liquid can be ruled out. Steel alloys, plastics (PVC, nylon, PE, Polyester), nozzles (ceramic, plastic or stainless steel) are suitable materials for storage and application of the product.

Mineral concentrates have a neutral to high pH and it is therefore advised to store mineral concentrate in covered storage tanks in order to minimize emissions of ammonia. Mixing of mineral concentrate with animal manure and storage of the mixture could lead to formation of toxic gases including hydrogen-sulphide gas. This practice should therefore be discouraged.

Relevant regulations

Mineral concentrates from manure or digestate of manure are designated as animal manure. However, regulations changes are foreseen that will allow mineral concentrates to be used as an alternative for synthetic/chemical fertilisers (i.e. beyond the 170 kg N/ha from animal manure as prescribed in Annex III of the Nitrates Directive), if the processing plant meets criteria for RENURE (REcovered Nitrogen from manURE) fertilising products. These criteria include, amongst others, a $N-NH_4/TN$ ratio of $>90\%$ and a TOC/TN ratio < 3.0 g/g. The European Commission has not yet decided on acceptance of RENURE fertilising products as alternatives to chemical fertilisers. Once agreed, and the criteria comes into force within the framework of the Nitrates Directive, this will broaden possibilities for the use of these mineral concentrates.

In the Netherlands, farmers can already use mineral concentrates from manure as part of a temporary pilot project. To comply, the concentrates should meet criteria set by the government of the Netherlands. These include, amongst others, NH_4-N/TN ratio of $>90\%$ and a P_2O_5/N ratio of <15 kg/kg.

Mineral concentrates are not allowed in organic farming, because processed animal manure is not accepted in organic farming.

