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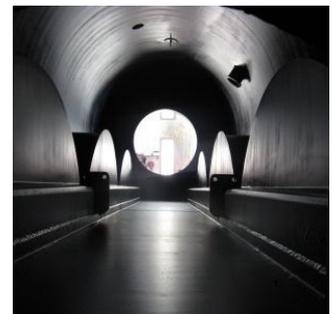
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SyreN⁺



**Sustainable
one pass
fertilisation
with slurry**



SyreN+ system

SyreN+ is an ideal management system for application of slurry. Through a unique process control, the addition of N, P, K and S can be managed automatic and individual on the fly, resulting in a unique fertilizer formula pr. field and crop.

Summed up, the farmer will realise a net saving on fertilizer purchases and operational expense in fertilizer application cost. The environment is protected from ammonia emissions, whereby especially biodiversity and the aquatic environment benefits. Reduction in emissions of climate gasses are achieved through an optimisation of the organic fertilizers and thus, reduced production and use of mineral fertilizers. Also, a considerable amount of CO₂ is captured and stored as increased yield. Air particle pollution is reduced with a potential corresponding to the collective emission from all road traffic. Leaching of nutrients to the ground water is seriously reduced as well as pathogen from slurry. A new value added chain for slurry, may eliminate the need for import of phosphorus to agriculture.

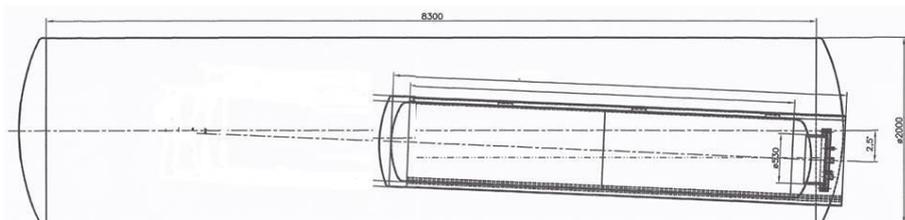
Perspective for SyreN+

When farmers use slurry as plant nutrition source, the plant need for macro nutrition is normally covered except for nitrogen and sulphur. Normally additional fertilizer is therefor applied through a second application of fossil based N and S fertilizer. With the SyreN-system, it is possible to add sulphur to the slurry through dosing sulphuric acid direct into the slurry during application. Normally 1-3 litres of acid are used pr. m³ slurry, which covers the plant need for sulphur. This reduces the slurry pH value and results in a 40-60% reduced ammonia emission from the slurry. With use of the SyreN system, plants need only a reduced amount of nitrogen as a second application.

It is thus, a huge advantage to be able to adjust the nitrogen contend of the slurry, so a second spreading with a conventional fertilizer spreader can be avoided.

Equipment for such adjustments of nitrogen

contend in slurry is called SyreN+. A traditional slurry tanker is not equipped to include conventional fertilizer and the tanker must be redesigned (figure 1). An obvious choice for nitrogen is liquid ammonia, as it is very concentrated. However, it must be stored in a pressure tank. SyreN+ has an integrated ammonia pressure tank in the slurry tank. It is a very safe positioning of the pressure tank and also very easily accessible for refilling. The ammonia pressure tank is inserted into a tube in the slurry tank and can easily be taken out for yearly inspection. The insertion tube is supported inside the slurry tank and bolted on to the rear of the slurry tanker. This design makes it possible to completely demount the SyreN+ system if the slurry tanker is to be used without SyreN+ for a period of time. The ammonia pressure tank can be of different size dependant on slurry tanker and use. The dose rate of ammonia is controlled from the SyreN ISOBus software system that integrates itself into the tractor terminal and a dose rate of 1 – 3 kg pr. m³ should fulfil the plant need for N fertilizer. The injector is placed in the slurry tanker return system.



Figur 1 Ammonia tank integrated in slurry tanker with a side view

Designer slurry – accurate and flexible formula for plant fertilizers.

The SyreN+ system is the first system ever to achieve the ability to create “designer slurry”. This is defined as a system for injection of ammonia, sulphuric acid and other fertilizers to create a one pass fertilization with slurry during application.

Application of slurry and commercial fertilizers have until now been seen as separate operations. A traditional slurry tanker consists of only one big tank for storage of slurry. With the SyreN+ system, the slurry tanker is re-designed so it may hold both slurry and commercial fertilizers. The slurry tanker evolves to a fertilizer formulation system rather than just transport and application of slurry.

The mixing of slurry and fertilizers are individual functions, which in the right sequence create a unique process control system. Mixing of base and acid products is potentially very dangerous. With SyreN+, this problem has been solved optimal with the use of the different functions on the slurry tanker. Ammonia (base) is added when the slurry tanker is being filled / agitated and sulphuric acid (acid) is added during application to a field.

If the slurry is injected into the soil, both ammonia and sulphuric acid dose rates are based on their fertilizer values. If a surface band spreader is used, the sulphuric acid is used to control the slurry pH so there is no ammonia emission. The combination of acid and base in SyreN+ means that the different properties of the chemicals are used to eliminate the negative aspects of the individual fertilizer. It can be argued that the slurry has been turned into a media for surface application of ammonia as ammonium nitrogen and the sulphur in sulphuric acid is used to optimise the plant available nitrogen through eliminating ammonia emission. But of course the media is also a fertilizer in itself.

Slurry foam – avoid run-off effect from slurry

It is well known that slurry can have very different compositions and abilities depending on type of slurry – cattle, swine slurry, de-gassed or separated slurry. With an increased demand for sustainable energy production, the future slurry market is likely to be dominated by pre-treated slurry types. There are however, some serious problems with pre-treated slurry. With the removal of the dry matter, the slurry composition turns very much to a “water” like fluid that increases the likeliness that the slurry will move away from the point where it is applied. This presents not only a very serious environmental problem, but an equally large economical problem as the expensive nutrients in the slurry will be very uneven spread and thus have a poor effect. This problem is not limited to slopes or undulated terrain, but can also be seen on flat land when the field is dry and the slurry has difficulty in penetrating into the soil.

With SyreN+ there is a new perspective – to secure that the slurry stay where it is applied. This is again due to the chemical properties of slurry and the fertilizers used. With the use of +2 litter sulphuric acid pr. m³, the slurry starts to foam. With 3-5 litter pr. m³, all of the slurry turns to foam as the lowering of the pH activates CO₂ to exit the slurry much like shaking a beer bottle and removing the cap right afterwards. The increased pressure and volume of the slurry causes the slurry to spread out on a larger area and that the slurry fluid is captured as foam in a period from 5 to 15 minutes after application. This phenomenon secures a slow release of the fluid to the soil surface when the foam returns to liquid form again. The foam cannot – unlike liquid – move away from where it is applied. This effect means that the nutrients are fixated where we want them to be. They do not run off to form puddles or leak into cracks or holes in the soil with an

automatic yield reduction and environmental “hot-spot” – areas with an increased leaching of nutrients to the ground water basin.

Use of ammonia as a fertilizer without injection

The use of ammonia together with surface application of slurry is new. Traditional use of ammonia requires injection teeth that limits the working with and has high fuel consumption. In addition, the application takes place in an existing operation, which together with a more attractive price on ammonia will potentially give a reduction of 20-30% on purchase of fertilizer.

A solution for phosphorus

The SyreN+ system has the potential to also improve the value chain for application of phosphorus.

If all animal slurry in Denmark was dosed, so that now field / plant were given a higher dose rate of phosphorus, there would be almost no need for import of phosphorus as commercial fertilizer. This would alone in Denmark correspond to an import reduction of 12-14.000 ton phosphorus and a corresponding reduction in the pressure on world phosphorous resources. It would also be an additional saving on purchase of fertilizers of 150 million DKK pr. year.

This vision is within reach with SyreN+ system. In this vision, all slurry application volumes are adjusted to the plant need for phosphorous. This can be achieved by using either a lower volume slurry pr. Ha or by separation of slurry, which very effectively reduces the amount of phosphor in the slurry. The slurry fibre must be send to biogas refinery for degassing. With both using a lower slurry application rate and with separation technique, the slurry can following be adjusted for the N and S value with the SyreN+ system, achieving not only a much higher fertilizer value, but also at a much more attractive price. In this new value chain for slurry, a much more attractive fertilizer product is available for both animal producers and for plant breeders. As this system also ends the problem with eutrophication from ammonia emission, the new slurry chain has the potential for the first time to make all slurry application sustainable.

Advantages with SyreN+

- **One pass fertilization with slurry, adjusted with N, P and S**
- **Acidification effect with sulphuric- and phosphoric acid**
- **Quick plant response to fluid dissolved fertilizers**
- **Very precise spreading**
- **Flexible combination of fertilizer formulas**
- **Reduction in field traffic**
- **Cost reduction on fertilizer purchase**
- **Use of liquid ammonium fertilizer without injection**
- **Ammonium nitrogen is soil reactive – less leaching**
- **Precise dosage of micro nutrients**
- **Preventive use against manganese deficiencies**
- **Lenient treatment of microclimate in soil**