

## **The quality of liquid and solid digestate from biogas plants and its application in agriculture**

*Ola Palm, Swedish Institute of Agricultural and Environmental Engineering - JTI*

In Sweden there are about 13 biogas plants treating organic wastes (2007). The total amount of digestate produced from these plants was 273 000 ton year 2006. All of that digestate was used in agriculture. Both the number of plants and amount of digestate has increased during a 10-year period and will continue to increase due to national goals for disposal of organic waste. Year 2006 about 18 % of the organic waste from Swedish households (corresponding to 135 000 ton) was treated in biogas- or compost plants. The Swedish national goal is to treat 35 % of the organic waste with biological methods year 2010. In Sweden it is not possible any longer to landfill organic waste, thus biological treatment or incineration are the main treatment options available for organic waste.

The yearly amount of phosphorus and plant available nitrogen in the digestate corresponds to 0,9 and 0,7 % of the total amount used in fertilizer in Sweden. Corresponding amount compared with manure (pig and cattle) is 0,6 % P and 1,3 % of plant available nitrogen. Thus, digestate is today and will even in future be a marginal plant nutrient source for agriculture. However, the Swedish food industry pays a lot of attention to digestate. If a farmer should be able to sell e.g. cereals from a field where digestate has been use, the digestate has to be certified through the Swedish Waste Management certification system. The certification system does only allow source separated organic wastes with origins that are specified. Organic wastes from the wastewater sector are not accepted by the certification system. Today (2007) seven biogas plants have digestate that is certified and the number of plants will increase in future.

Two of the Swedish biogas plants that are treating source separated organic waste separated the digester into a liquid and a solid phase. The solid phase (DM 25 – 30 %) will be handled as normal farm manure and will be spread on agricultural land with conventional manure spreaders. The liquid phase is pumpable and will be spread on agricultural land with conventional slurry spreaders. By the separation of the digestate into two phases the plant nutrients is divided too, so that the solid phase is used as a phosphorus fertilizer and the liquid phase as a nitrogen fertilizer. This will make the digestate more attractive for farmers.

Digestate is regarded as an organic fertilizer and has thus to comply with these national regulations. The main issues in the Swedish regulations for organic fertilizers are: coverage of the storage; field application is prohibited during winter months and also during early spring and late autumn in costal areas; maximum 110 kg P/ha during a five-year time period for a single application. This means that rather large storage facilities have to be built.

Liquid digestate, that are applied to the field in the spring before seeding, will give a harvest that is about 90 % of what the farmer will get if mineral nitrogen fertilizer is used. Thus, digestate is a good nitrogen fertilizer and very interesting for farmer to use.

Biogasplants have two products – biogas and digestate. Both products have to be managed in an optimal way in order to get a good economy for the plant. In Sweden it is common to upgrade the biogas to vehicle fuel, as this will give the highest income from the biogas. The digestate, on the other hand, could be a cost if not well managed. Confidence from farmers and food industry is crucial and a dialog with these parties is necessary to turn a cost into an income.

*Average dry matter, volatile solids, nutrient and metal content in liquid digestate from seven certified Swedish biogas plants (2006) and liquid pig and cattle manure.*

<b>Substance</b>	<b>Unit</b>	<b>Average 7 certified biogas plants, 2006</b>	<b>Liquid pig manure</b>	<b>Liquid cattle manure</b>
DM	%	3,9	8,8	9,8
VS	% of DM	66,4	81	84
Tot-N	mg/kg DM	138 526	63 000	40 000
NH <sub>4</sub> -N	mg/kg DM	98 538	41 000	20 000
Tot-P	mg/kg DM	12 162	23 000	7 600
Tot-K	mg/kg DM	36 427	37 000	40 000
Cd	mg/kg DM	0,3	0,17	0,13
Cr	mg/kg DM	9,3	4,1	2,3
Cu	mg/kg DM	113	178	49
Pb	mg/kg DM	4,1	0,95	0,92
Ni	mg/kg DM	9,7	3,2	3,6
Hg	mg/kg DM	0,08	No data	No data
Zn	mg/kg DM	375	635	190