The newsletter for biogas production – by Schaumann BioEnergy

BioEnergy News

# Silage additives – a crucial resource

## How is SILASIL ENERGY profitable?

*Providing biogas plants with high quality feedstocks all year round requires conservation of crops grown during the vegetative period. During storage, a certain amount of dry matter (DM) and energy losses are unavoidable. However, these losses may vary between 4% to 29% DM, depending on the quality of ensiling and clamp management. Once lost, this energy will no longer be available for biogas generation, increasing substrate costs per kWh. That is why losses must be minimized by optimal harvest and silage management as well as suitable application of a silage additive to achieve the highest possible biogas yield per hectare.*

The basis of any high quality silage is its raw material which is preserved during ensiling by targeted control of specific metabolic conversion of organic nutrients. Inevitably, there will be a certain amount of process related energy and nutrient losses during harvesting and ensiling.

These however, may further be increased by preventable losses, often drastically underestimated in practice. It is mainly soluble and easily digestible organic nutrients (carbohydrates, proteins, fat) that are lost through spoilage by yeasts and moulds, leading to heating (after clamp opening) through aerobic conversion. These losses lead to a significant decrease in the biogas value of the material.

Furthermore, aerobically-instable silages showing contamination from moulds run a high risk of formation of toxic fungal compounds which can trigger inhibition and biological breakdown of biogas plants.

Targeted application of silage inoculants offers the only option of effectively preventing spoilage and minimizing dry matter and energy losses, provided that high pick-up rates are matched by sufficiently high distribution and compaction capacity during ensiling (optimal compaction varies depending on crop type and chop length).

## Fighting yeasts effectively

Chop length should decrease proportional to increasing dry matter content. The more closely this principle is adhered to, the more easily compaction during ensiling can be optimized. High compaction enhances ensiling processes and reduces oxygen-entry into the clamp therefore minimizing aerobic yeast activity and energy losses and maximising biogas yield and process stability. Studies show that insufficient compaction directly promotes yeast growth and decreased aerobic stability (heating). A further step is to also inhibit yeast development under anaerobic conditions. To achieve this, the use of silage additives is mandatory (e.g. effect number 2: prevention of heating).

## Application of silage additives – does it really pay off?

With arable land increasing in value, costs for preventable losses from feedstock preservation rise as well. Silage additives are able to lower these costs, leading them to become a decisive factor in the economic consideration of the entire biogas process. Bearing this in mind, the choice of the right silage additive, reliably providing the desired effects, becomes crucial. Example: Significant increase of methane yield – Use of certified, DLG-tested silage inoculant with effect number 2 (prevention of heating) and 6b (improvement of methane generation value).

Is the use of SILASIL ENERGY.XD still profitable even under ideal storage conditions (no heating)?

Results by Hansjörg Nussbaum *("Effects on methane yields by silage additives on the basis of homo- or heterofermentative lactic acid bacteria", LAZBA Aulendorf (Germany), 2012)* form the basis of the calculation presented here: After 90 days clamp maturation time under optimal conditions (completely anaerobic, optimal compaction) methane losses in the

**Table 1:** Effects of silage additive application calculated to the monetary yield per hectare (surmising a mean methane-hectare-yield of 4,613 Nm$^3$ $CH_4$)

| | **Silage without oxygen stress** (extraction from closed clamp, without heating) | **Silage under oxygen stress** (provoked heating at clamp face) |
|---|---|---|
| Without silage additive application | 119 Nm$^3$ $CH_4$-losses per hectare | 788 Nm$^3$ $CH_4$-losses per hectare |
| With silage additive application | 11 Nm$^3$ $CH_4$-losses per hectare | 60 Nm$^3$ $CH_4$-losses per hectare |
| ***effect by silage additive application** | | |
| Additional gas yield * | + 108 Nm$^3$ $CH_4$-losses per hectare | + 728 Nm$^3$ $CH_4$-losses per hectare |
| Additional electricity yield * (at 3.85 kWh$_{el}$ / m$^3$ methane) | + 416 kWh additional electricity per hectare | + 2,803 kWh additional electricity per hectare |
| Additional yield feed-in-tariff * (at 0.195 € / kWh$_{el}$) | + 81.12 € / hectare | + 546.53 € / hectare |
| Mean costs for silage additives * (at 45 t / hectare x 0.85 € / t) | - 38.25 € / hectare | - 38.25 € / hectare |
| **Additional financial yield per hectare *** | **+ 42.87 € / hectare** | **+ 508.28 € / hectare** |

trial "without silage additive application" were at 2.59 % while the trial "with silage additive application" showed methane losses of only 0.24 %. Therefore, the use of a heterofermentative silage additive resulted in a methane loss reduction of 2.35 %.

In another experiment silage was intentionally exposed to oxygen stress provoking heating in practice often seen at the clamp face after opening. Methane losses in the trial "without silage additive application" increased to 17.08 % while the trial "with silage additive application" showed only a 1.31 % increase. This meant that application of a silage additive reduced methane losses by 15.77 %. By application of the heterofermentative ensiling agent, the silage was significantly protected from energy losses.

Table 1 shows the effects of silage additive application calculated to the monetary yield per hectare. The results show that the use of a silage inoculant in biogas production is profitable in any scenario. Losses due to heating and possible negative consequences upon feeding of substandard silages show as far more expensive.

You can rely on the effect-specific silage additives by Schaumann BioEnergy. The lactic acid bacteria of SILASIL ENERGY.XD increase concentrations of acetic acid, propandiol and propanol with the metabolites acting as efficient stabilisers. Effects of the cutting-edge bacterial strain *Lactobacillus diolivorans* can be determined as early as within 14 days clamp maturation time.

## Silage Contractors

What is the benefit of silage additive application for farmers selling their treated silages to an external biogas operator? They will be able to balance the following effects:

- Loss reduction: more silage is available for sale because less will be lost to spoilage
- Prevention of heating: reduced energy losses during extraction and in temporary storage
- Definably better quality of silages for sale

## Silage Buyers

What is the benefit of silage additive application for biogas operators when buying treated silage from an external farmer? They will be able to balance the following effects:

- Silage treated optimally for use in AD plants (e.g. more acetic acid)
- Secure digester metabolism (silages free from potential inhibitors)
- Optimised digester dynamics (faster methane generation enabling higher organic loading rates)
- Reduced feedstock requirements
- Increase of methane yield between 3–14 %

Farmers and operators acting in unison will see the sum of effects from the single production steps adding to their collective economic success.

## Conclusion

The conservation of feedstocks for biogas generation means maintaining quantity and quality of the biomass harvested or purchased as much as possible. Ideally, the financial value of the original substrate can be preserved in its entirety.

Furthermore, silages must not disrupt the biogas process by containing inhibitors and should deliver highest gas yields per hectare. Thus, proper feedstock conservation and resource efficiency go hand in hand, emphasizing that prevented energy losses are crucial for economically viable biogas production in an increasingly demanding production environment.

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