The newsletter for biogas production – by Schaumann BioEnergy

BioEnergy News

Fighting foam

Causes of foam formation, its manifestations and control strategies in AD practice

By now, a large number of process disruptions in biogas plants can be controlled effectively or be prevented altogether. The spontaneous and excessive formation of foam however, is still unpredictable in many cases and frequently very hard to control.
Almost 10 % of biogas plants are affected by serious foaming incidents in irregular intervals. An important distinction to make is between foam formation and the so-called "bread dough effect" (see box below).

Causes for foam formation

One requirement for foam formation is the presence of surface active substances which stabilise the foam scaffold. These substances can enter the digester either via the feedstocks or they are produced as metabolites during degradation or process imbalances.
In full-scale plants, foam formation is further influenced by a number of other factors, such as gas formation rate, temperature, viscosity, alkalinity and mixing (see fig. 1).

When looking at a total of 330 biogas plants with foam issues, it turned out that in ca. 70 % of plants the cause for foaming were the feedstocks. Process disruptions induced 15 % of foaming cases while another 15 % were triggered by physical parameters, e.g. abrupt degassing after feeding of silage effluent or stirring of "dead zones" in the digester.

Feedstocks as triggers

In 80 % of plants showing foam formation slurry is part of the feedstock mix. Other feedstocks often associated with foam generation are sugar beet, cereals, poultry litter and wastes (e.g. food waste). Some of these can trigger immediate foam formation (e.g. sugar beet) whereas others may promote foam formation long-term (e.g. cereals and poultry litter).

Excursus: "bread dough effect" in AD plants

The "bread dough effect" in biogas digesters affects the entire liquid column in that it expands in its entirety because biogas becomes trapped within. This expansion originates from the interaction between viscosity, water content and the degree of mixing of the digester content. The main risk lies in the fact that the filling level can rise by up to several metres within a short span of time. The consequences can range from blockage of gas extraction pipelines and pressure units to the violent rupture of digester roofs and walls, respectively (see fig). Only constant mixing can provide short-term relief, particularly in the upper section of the digester, to promote gas extraction.
To eliminate the problem, viscosity in the digester needs to be decreased by either changing feedstock composition or by applying enzyme module BC.ZYM VK3 designed to target mucilage-based viscosity problems.

Fig.: Spilt digester content after expansion ("bread dough effect")

Fig. 1: Causes for foam formation in AD plants (n= 326)

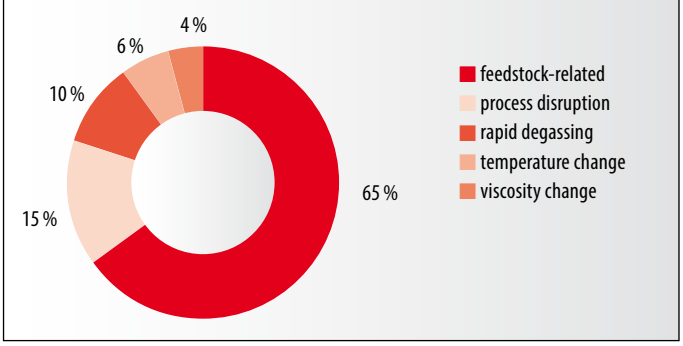

Fig. 2: Foam types and foam-like phenomenons

- Surfactant-stabilised foams
- Protein-stabilised foams
- Fat-stabilised foams
- Floating or bulking sludge
- "bread dough effect"

Foam formation as a result of process disruptions

Process disruptions are one of the most distinct reasons for increased foam generation. This can be due to stress-related production of foam-activating metabolites (e.g. long-chain fatty acids) or the excretion of surfactant-like substances, so-called "bio-surfactants". Typically, process disruptions are triggered by overfeeding, temperature and feedstock changes, trace element deficiency or inhibitors.

Fighting foam: strategies

A large proportion of foam types in biogas plants respond well to treatment with antifoam from the BC.SPcon range. Parallel to antifoam application, however, it is advisable to get to the root of the problem in order to develop long-term strategies for preventing foam formation in the first place if possible.

Emergency measures:

- Lower filling level in digester to prevent blockage by foam of gaspipe system
- Bring height-adjustable agitators into top position to stir in foam
- Reduce foam-inducing feedstocks by storing them or redirect into post digester
- Use of vegetable oil: after initial positive effect, dosage has to be increased over time to retain effectiveness
- At low nitrogen and TIC-values, e.g. due to high amount of sugar beet in the feed ration, application of urea or sodium bicarbonate can show positive effects against foam formation

When faced with long-term foam incidents, a variation of the digester's physical or rheological properties can reduce foam formation by e.g. changing temperature or viscosity. And yet, in some cases mechanical solutions are the only option left. The most common one in anaerobic waste digestion is the installation of fan nozzles in the digester headspace to mechanically disintegrate the foam passing underneath and to apply antifoam like BC.SPcon AF directly onto the foam if necessary.

If you have any more queries, please contact us via email or phone.

Fig. 3: Foam control strategies

Emergency measures	• Lower filling level • Reduce feeding • Stir in foam • Send sample for analysis
Application of additives	• Antifoam • Vegetable oils • Buffering substances
Prevention of foam-inducing feedstocks	• Reduce foam-inducing feedstocks • Redirect into post digester • Change feeding intervals
Fighting process disruptions	• In case of trace element deficiency: application of bespoke micronutrient mixture • In case of inhibitors: reduce inhibitor, additives, reseed if necessary • In case of overfeeding: feeding pause
Changes in physico-chemical conditions	• Viscosity change • Temperature change • Alkalinity change
Optimising mixing	• Decrease intervals between stirring • Vary agitator settings • Increase feeding intervals
Mechanical measures	• Installation of fan nozzles • Installation of overflow system • Installation of near-surface agitators

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