The newsletter for biogas production – by Schaumann BioEnergy

BioEnergy News

Optimised desulphurization with iron-based products

Ever since reports about corrosion damages on concrete heads and roofs of digesters became more frequent, the use of ferrous products for desulphurization has increased significantly. Iron products offer an efficient way of preventing said corrosion-induced damages.

Air injection into the digester headspace still represents the most cost-efficient way of desulphurization. However, excessive air input not only leads to dilution of biogas with atmospheric nitrogen (N_2), but it provides sulphur-oxidising bacteria with more oxygen than is required for the oxidisation of hydrogen sulphide (H_2S) to elementary sulphur. As a consequence, bacteria use the excess oxygen to oxidise sulphur to sulphate (SO_4^{2-}), leading to the formation of sulphuric acid which in turn causes corrosion damages on digester concrete heads or the timber construction supporting the membrane roofs. Additionally, if sulphuric acid drips into the digester content or sulphur incrustations come loose, the sulphur will in parts be reduced back to H_2S, leading to a renewed increase of H_2S in the biogas.

Application of iron products

Ferrous products are able to bind hydrogen sulphide in the form of hard to dissolve iron sulphide. In this way, sulphur remains in the digestate and is spread on the fields as highly bioavailable fertilizer. In terms of speed, the faster iron-additives react in the digester, the smaller the ineffective proportion of it reaching the final storage unit. Therefore, high availability in combination with fast distribution of the product within the digester are crucial factors for reaching optimal efficiency. That is why application strategies banking on “delayed, sustainable effects” do not lead to the desired results.

Optimised desulphurization

To attain the optimal desulphurization result, it is generally recommended to extract biogas from the post digester/final storage unit to maximize its retention time within the plant. Air injection into downstream tanks should be minimized and combined with application of iron products in the main digester. In plants without air injection, desulphurization ought to be by iron products entirely.

Range of application for BC.ATOX Scon and BC.ATOX liquid

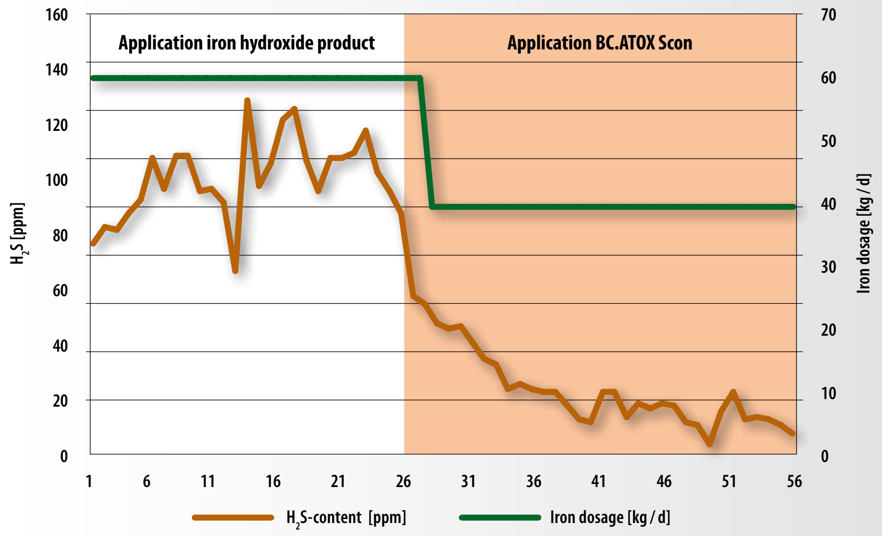
As a constant supplement to air injection
- ➜ Prevents sulphuric acid formation in the digester headspace

As a supplement to trace element concentrates
- ➜ Balances microbial iron supply

After gales or maintenance works on digester roofs
- ➜ Prevents sulphuric acid formation from sulphur incrustations when dropped into the digester

During commissioning of plants
- ➜ Until a bacterial flora has formed in the digester headspace

Fig. 1: Development of H_2S-value in biogas and amount of iron application during conversion from a commercial iron hydroxide product (Fe-content > 45 %) to BC.ATOX Scon (526kW, input: maize silage, whole crop silage, slurry)



BC. ATOX Scon binds hydrogen sulphide as hard to dissolve iron sulphide

Which ferrous product is the right one?

Under the designation iron hydroxide and iron(III)oxyhydrate hide a group of trivalent iron compounds (e.g. $FeO(OH)_2$, $Fe(OH)_3$), which can be distinguished between by their water content and degree of crystallization. Usually, iron hydroxides are used featuring iron contents between 35 and 40 % and obtained from waste water treatment. Higher iron contents always indicate a high degree of less reactive iron oxides (see fig. 1). However, much more essential for their effectiveness than the actual iron content is the iron oxides' age and the degree of crystallization that comes with it. A high degree of amorphous, recently precipitated iron compounds ensures the fastest and most complete reaction with H_2S whereas higher degrees of crystallization and higher oxide concentrations display lower reactivity.
BC.ATOX Scon consists of recently precipitated, amorphous iron(III)hydroxide and displays maximal reactivity. On top of that, additional solubilizers included in the product improve availability and distribution within the digester.

Iron salt solutions

Usually, liquid iron chlorides are readily available in the digester. Product differences lie primarily in their iron chloride concentration and the amount of contamination (esp. heavy metals). Downsides are their high potential for concrete and stainless steel corrosion as well as the health and safety risk of chemical burns. Because iron chlorides are classified as hazardous materials and pose aquatic and environmental hazards they are subject to increased storage regulations.
BC.ATOX liquid contains liquid iron salts of the highest purity on the basis of 30 % iron(II) chloride solution. Apart from hydrogen sulphide, it also very effectively reduces ammonia in the biogas.

Harald Lindorfer, PhD
Schaumann BioEnergy GmbH

Recommendations for desulphurization

Plant type 1:	Plant type 2:	Plant type 3:
Plants without timber roof construction and with acid-resistant concrete head	Plants with timber roof construction or concrete heads susceptible to corrosion; gas-to-grid units	All other plants
• Desulphurization mainly by air injection • Gas extraction from post digester or storage unit if possible • Additional iron application as required	• Desulphurization entirely with iron-based product, e.g. BC.ATOX Scon • No air injection	• Iron application into main digester, e.g. BC.ATOX Scon • Gas extraction from post digester or storage unit • Reduced air injection, esp. in downstream tanks

Additional downstream desulphurization if required

170602_GB