Biogascleaning

Collection of the Conditioning- and Cleaningmethods

Method	Com-ponent	Characteristic	Advantages	disadvantage	comment
Pressure-water wash	CO_2, H_2S, NH_3	CO_2, H_2S and NH_3 are getting accumulated in water under pressure	- relatively experienced in this method - only sewage, no need of chemical waste disposal - no in situ need of advanced desulphurization	- high consumption of water, relatively high necessity of electricity, - pressure method, - loss of methan, - H_2S-precipitation, precipitation outside the fermenter	Is used when there is a need of natural gas quality
Altenating pressure-adsorption	CO_2, H_2S, H_2O	Adsorption of CO_2, H_2S and H_2O are getting intercepted under pressure in a molecular filter, regeneration of the loaded molecular filter through pressure reduction	- Dry method, therefore no appearance of sewage, reference machines available in Europe	- relatively high necessity of electricity - H_2S-concentration is allowed up to max. 400mg/m³ - - H2S-precipitation outside the fermenter	Is used when there is a need of natural gas quality
Selexol method	CO_2, H_2S, H_2O	Gymes (Glycol Dimethyl Ether) is used to remove H_2S, CO_2, H_2O. Only works satisfying as a high pressure method (3 bar for H_2S, 8 bar for CO_2, H_2O removal)	- Good cleaning conductor - CO_2, H_2S removal and drying in on step possible (only works for H_2S removal)	- resource- and disposalcosts relativly high - little experience - H2S-precipitation outside the fermenter	Is used when there is a need of natural gas quality
Membran method	CO_2, H_2S, H_2O	The component which needs to be removed are getting seperated on a membran in terms of different permeationsrates ; Dry and wet method	- No need of expensive resources	- High necessity of energy and loss of methan make the method expensive - Not established in the biogascleaning - H2S-precipitation outside the fermenter	Is used when there is a need of natural gas quality
Aminwash	CO_2, H_2S	specific Amine can be used to remove sour components	- standard method for natural gas cleaning - a lot of experience	- to expensive fort he biogascleaning, resource- and disposalcosts - H2S-precipitation outside the fermenter	
Gasdrying using gas cooler / condensation	H_2O Siloxane (partly.)	During the cool down of the gasflow accumulates a condensate. The more the temperature falls down the more can the condensate drop out.	- standard method for the gasdyring - a part of the siloxane can be intercept too	- in case of low dewpoints there ist he danger of icing -	Zur H_2S-precipitation unsuitable
Gasdrying using Glykol	H_2O	TEG (Triethylenglykol) detracts the crude biogas water at ambient air temperature and can be regenerated later under waste heat utilisation at higher temperatures	- TEG is relatively solid and can be recycled over a long time period. - Disposal is not problematic	- Heating necessity for regeneration needed - No standardmethod	Zur H_2S-precipitation unsuitable

Integrated biological Desulphu-rization	H_2S	H_2S is getting reduced from sulphur bacterias in the gasroom of the biogasfermenter in an aerobe process to elementary sulphur	- Technical easy method - Low-cost method - desulphurization happens in fermenter - elementary sulphur can be used as fertiliser	- the temperature in the gasroom is especially in the winter to low fort he sulphur bacterias , which is due to a poorly cleaningeffort - danger of corrision in the fermenter and pipe, - delicate and accident-sensetive method- - note the explosionprescription - biogas is getting dilute through airaddtion	Only makes sense up to a H_2S-concentration in biogas of < 1000 ppm
External biological desulphu-rization	H_2S	Downstream biowasher (filling material column), wahingdilution (dishwater) is being carried in counter current to biogas. The dishwater uses solidpure stormwater from the digestion tank/ methanreactor.	- High cleaningeffort - Easy method - Standardmethod	- Biological methods are delicate at concentration fluctuation - For high H_2S-conzentrations are more washer needed - Cleaningeffort is depending on the temperature - Note the explosionprescription - biogas is getting dilute through airaddtion - H2S-precipitation outside the fermenter	Only makes sense up to a H_2S-Konzentra-tion in Biogas of < 4000 ppm
Desulphu-rization with ferric oxide (FerroSorp S)	H_2S	Adsorptionsmethod H_2S is carried over to ferric(hydr)-oxidpellets in ionsulphide. At the regeneration elemantary sulphide is appearing. The cleaningeffort depends on the roomspeed and the used cleaningproduct. There is cartouche- and towersystem	-a lot of experience in this system -Very safe method - Standardmethod for gascleaning	- Regeneration is limited as the sulphide accumulates on the pores and cloggs those. - The needed and long dwell periods need high towers. - high investment costs - High resource and disposalcosts - - H2S-precipitation outside the fermenter	Only makes sense up to a H_2S-concentration in Biogas of < 4000 ppm
NaOH-wash	H_2S	One levled NaOH-wash in counter current THIOPAQ-method (combination of NaOH-wash and microbiological oxidation of hydrosulphide)	- Good cleaning effort - precipitation of H_2S up to 99 % possible - machine effort up to 2500 Nm^3/h possible	- high investment costs - H2S-precipitation outside the fermenter	Compare: alternative-comparison
Active carbon	H_2S, COS, Siloxane (partly)	H_2S is getting oxidised catalyticly to sulphur on impregnated active carbon (often based on iodine). A total desulphurization is theoretically possible, but precision cleaning makes more sense. A COS-distance is only with specific aktive carbon possible	- Good cleaning effort	- High investment costs - High costs for the purchase of active carbon as so for the disposal - H2S-precipitation outside the fermenter	Only makes sense for low H_2S-conzentration in biogas
Iron salt	H_2S	liquid iron salt are getting conducted into the fermenter, where H_2S is getting precipitated.	- Good cleaning effort - For a H_2S-conzentration up to < 2000 ppm safe - Well priced method - Standardmethod - The desulphurization happens internally, hence the blockade process of the methanaccumulation, which is caused by the toxic hydrosulphide is getting effectivly eliminated	- substance is harmful to water - Note accident prescription - The pH-value in the fermenter goes sour - Continuously in action - Increase of salinity	Only makes sense up to a H_2S-conzentra-tion in biogas of < 2000 ppm

			- The fermentation medium contains sulphide and both is disposed agriculturally, where the sulphide opperates as a fertiliser component		
ironoxidhydrat FerroSorp DG	H_2S	- The powder product is used in the fermenter. Forms of delivery: - Goods due to cause - Big Bag or - Silogoods	- Reliable and safe method - hydrosulphidecontent < 100 ppm and lower in clean gas can be reached easily - Safe method, not depending on the emerging hydrosulphideconzentration in fermenter - Not harmful for water or dangerous substance. - The desulphurizatin happens internally, hence the blockade process of the methanaccumulation, which is caused by the toxic hydrosulphide is getting effectivly eliminated. - Micro elements are available for microorganisms. - -The fermentation medium contains sulphide and both is disposed agriculturally, where the sulphide opperates as a fertiliser component - If there is a hydrosulphideconcentration in fermenter of > 2.000 ppm the FerroSorp-costs are mostly caught by the higher production of biogas - No or minimal investment in the dosing technology of the product - Corrosion, which can be caused by hydrosulphide, in all parts which are touched by gas is stopped	- Continuously action of a consumption product (FerroSorp DG)	Compare: alternative-comparison

Key

Component : Substances which are meant to precipitate of the biogas

CO_2 ≠ carbon dioxide
H_2S ≠ hydrosulphide
H_2O ≠ water
NH_4 ≠ ammonium
COS ≠ Carbonyl-Sulphide
Siloxane ≠ organic silicon compound