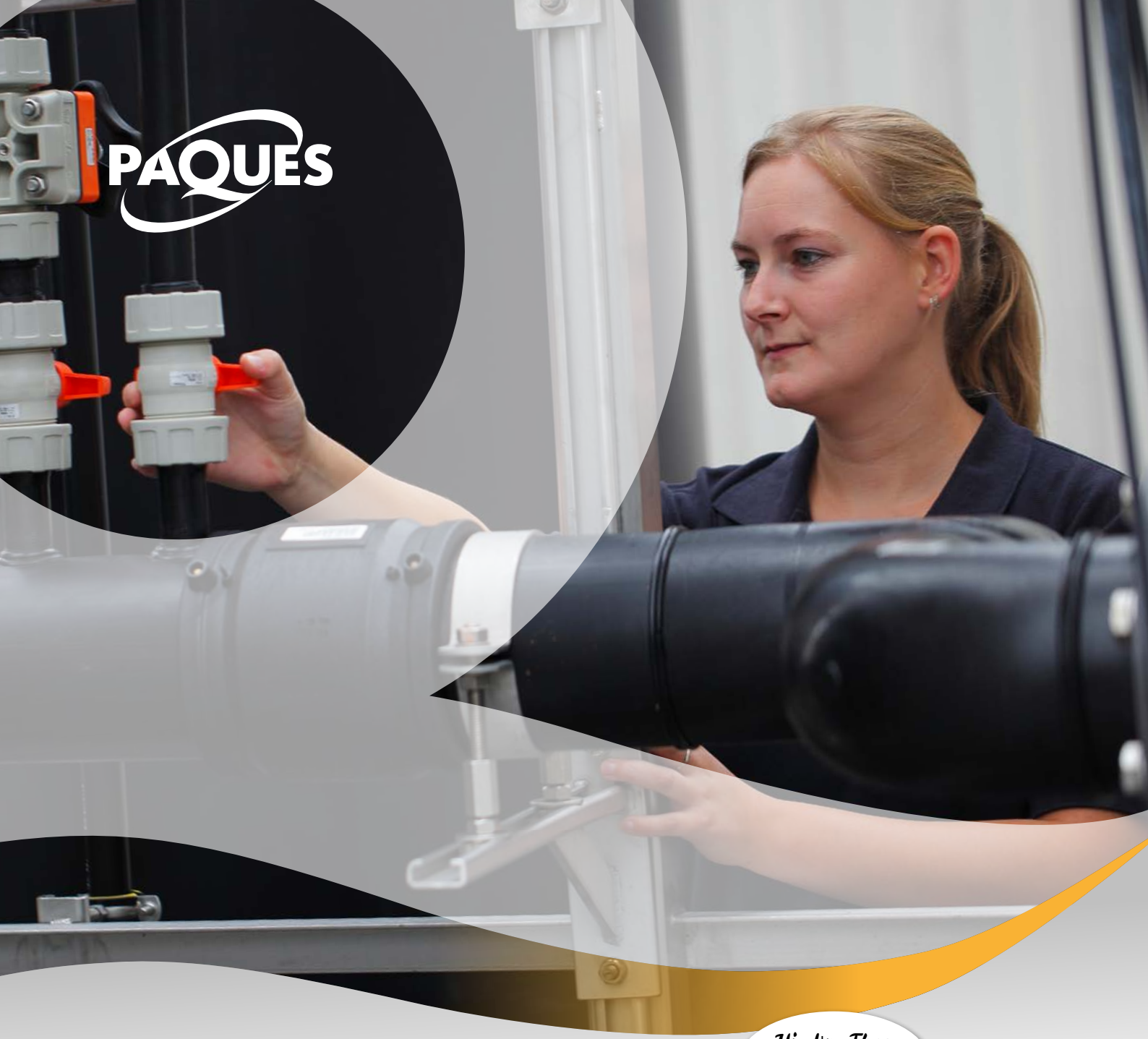
PAQUES



THIOPAQ®

Biogas desulfurization

Deep hydrogen sulfide removal from biogas at high uptime enables industries to meet stringent gas quality requirements.

revitalizing resources

Deep hydrogen sulfide removal

Biogas is an important renewable energy source. However, the gas originating from anaerobic digestion plants, anaerobic wastewater treatment plants and landfills often contains hydrogen sulfide (H_2S). Removal of H_2S is required for reasons of health, safety, environment and corrosion of equipment such as gas engines, boilers and piping.

The THIOPAQ® was developed by Paques in cooperation with universities, research institutes and customers. Fundamental and applied research into biological, physical and mechanical aspects of the system resulted in a cost-effective and reliable system.

Through continuous development Paques is able to provide every customer with a tailor-made gas treatment solution that enables the customer to transport biogas with reduced safety, environmental, and corrosion risks, and to fuel local gas-fired microgrids, or upgrade the gas to biomethane. Additionally, the elemental sulfur produced by the THIOPAQ® can be used as a high-quality fertilizer.

About THIOPAQ®

- Proven technology
  > 30 years operational experience
- > 300 THIOPAQ® references worldwide
- Continuous innovation
- In-house manufacturing and quality control
- Deep H_2S removal
- High uptime and reliable process
- Low total costs of ownership
- No air input in biogas
- Production of high-quality fertilizer

THIOPAQ®

Operation principle

The 'caustic' solution in the THIOPAQ® scrubber is continuously biologically regenerated. In the scrubber, the gas containing H_2S is brought into contact with the wash solution in counter-current. Absorption of H_2S under slightly alkaline conditions (pH 8-9) enables a chemical reaction with hydroxide ions:

$$H_2S_{gas} + OH^- \rightarrow HS^-_{liquid} + H_2O$$

In the bioreactor the sulfide is oxidised into elemental sulfur by autotrophic colorless sulfidogenic bacteria:

$$HS^-_{liquid} + \tfrac{1}{2}\, O_2 \rightarrow S^o + OH^-$$

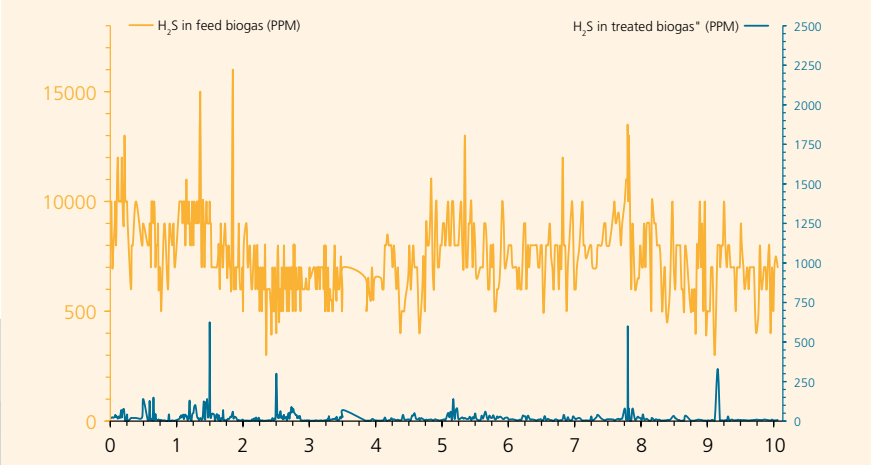
The hydroxide used in the scrubber is regenerated in the bioreactor. Since the wash solution entering the scrubber at the top is sulfide-free, a high concentration difference between the liquid and gas phase makes it possible to obtain a very high H_2S removal efficiency: exceeding 99.5%. Both the small bleed stream (consisting of sodium salts) and the produced sulfur are free of sulfide, so discharge is not a problem.

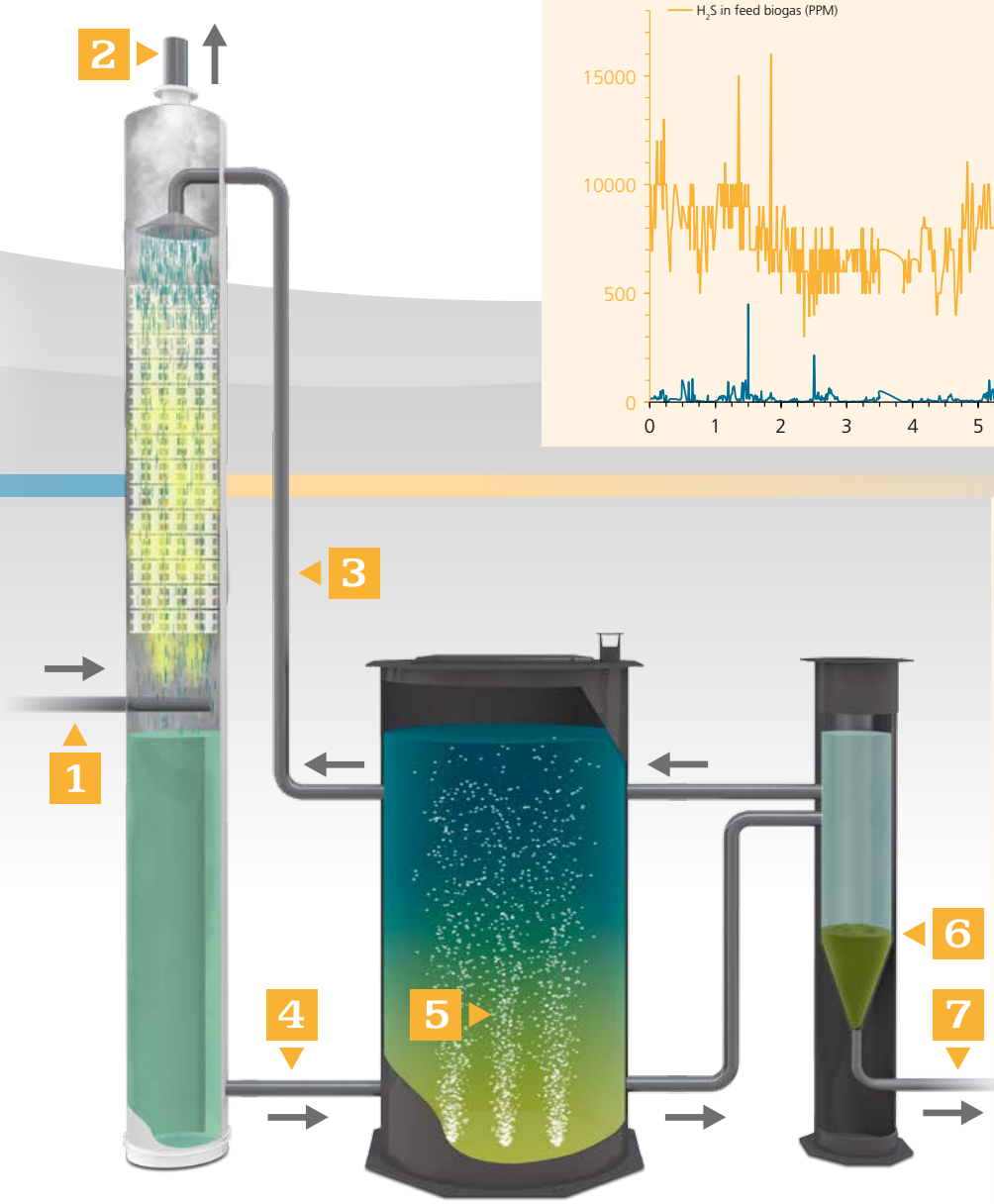
Application

The THIOPAQ® scrubber can be applied to a wide range of biogas streams containing H_2S and can be combined with all biological anaerobic systems. After treatment in the THIOPAQ® scrubber, the biogas can be used in a gas engine or boiler or can be transported and used to fuel a local gas-fired microgrid. Upgrading to biomethane, which can be brought into the gas distribution network or used as fuel for vehicles is another possibility.

- Gas flows from 50 to 2,500 Nm³/h
- Sulfur load up to 600 kg S/day
- Custom-made design for higher gas flows. References for > 10,000 Nm³/h and sulfur loads > 5 tons S/day

THIOPAQ®: influent independent, stable performance





THIOPAQ®: how it works

1. H_2S-rich gas in
2. Purified gas out
3. Alkaline wash solution, (absorbs H_2S from the gas)
4. Sulfide-rich solution from scrubber into bioreactor
5. Air for sulfur oxidation reaction (sulfide to elemental sulfur)
6. Sulfur separated
7. Elemental sulfur

Paques: leading in biological wastewater and gas treatment

For more than 40 years, Paques has been the world's leading company in the field of development and construction of cost-effective purification systems for water, wastewater and gases, based on innovative biotechnology. With over 3,000 reference installations worldwide, Paques has helped companies and municipalities succeed at to one of the major challenges of today: to reduce their water and carbon footprints and reclaim valuable resources.

The biogas produced by wastewater treatment plants can be used as green energy in boilers or gas engines. Beyond our headquarters in The Netherlands, Paques has subsidiaries and/or production locations in Russia, China, Brazil, Argentina, Colombia, India, Malaysia, Thailand, Vietnam, the United States and Canada. In many other countries, Paques is represented by licensed partners. This ensures our local presence and the best service for our clients worldwide.

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