# Adsorbents
# for Biogas Processing

*Renewable Natural Gas*
*Biomethane*
*Landfill Gas*

Molecular Sieve
Activated Alumina
Silica Gel
And More

HengYe®

www.hengyeinc.com

# Hengye Solutions for Biogas

## We Offer You

- molecular sieve, activated alumina, silica gel
- ideal adsorption capacity and product durability
- ISO certified manufacturing, consistent quality

## We Will Provide

- reliable adsorbents with proven success
- technical service , engineering, and sales support
- material analysis and capacity evaluation
- change out, turn around services
- inventory in Houston, TX; Omaha, NE; Shanghai, CN
- Super Sacks and drums available

## Dehydration

- molecular sieve, activated alumina, silica gel
- removes water to 0.1 ppm or less


## H2S, Sulfur Removal

- molecular sieve, activated alumina, specialized adsorbents, and catalysts
- removes H2S and other sour gases such as mercaptans and sulfides

## Siloxane Removal

- molecular sieve, activated alumina, silica gel, and activated carbon
- removes siloxane to protect equipment

# Adsorbents in Biogas Processing

Biogas must be completely dehydrated before it can be used for its various applications. After dehydration, additional molecular sieve units may be used to remove undesirable contaminants such as siloxane, carbon dioxide, sulfurous compounds like $H_2S$, and more.

## Molecular Sieve

Molecular sieves are ideal for upgrading biogas and rely on Pressure Swing Adsorption units to selectively remove contaminents. Type 4A molecular sieve is ideal for dehydration while Type 5A and Type 13X molecular sieve can be used to remove $H_2S$ and siloxane.

## Activated Alumina

Activated alumina is a versatile adsorbent that can be used to upgrade biogas by removing water, $H_2S$, and siloxane.

## Silica Gel

Silica gel can be used to upgrade biogas by removing water and siloxane.

## Activated Carbon

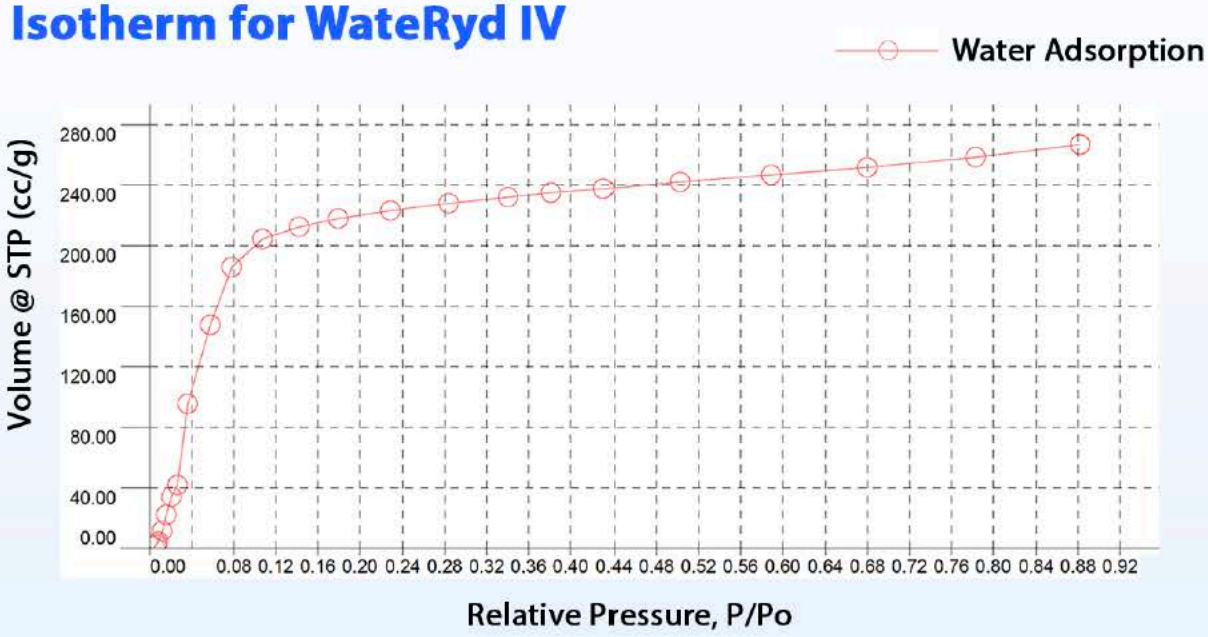
Activated carbon is commonly used to remove siloxane from biomethane streams.

# Molecular Sieve, Type 4A

## WateRyd IV - Type 4A Molecular Sieve

Our molecular sieve is able to dehydrate biogas streams to less than 0.1 ppm water, making biogas suitable for compression or liquefaction.

## Isotherm for WateRyd IV



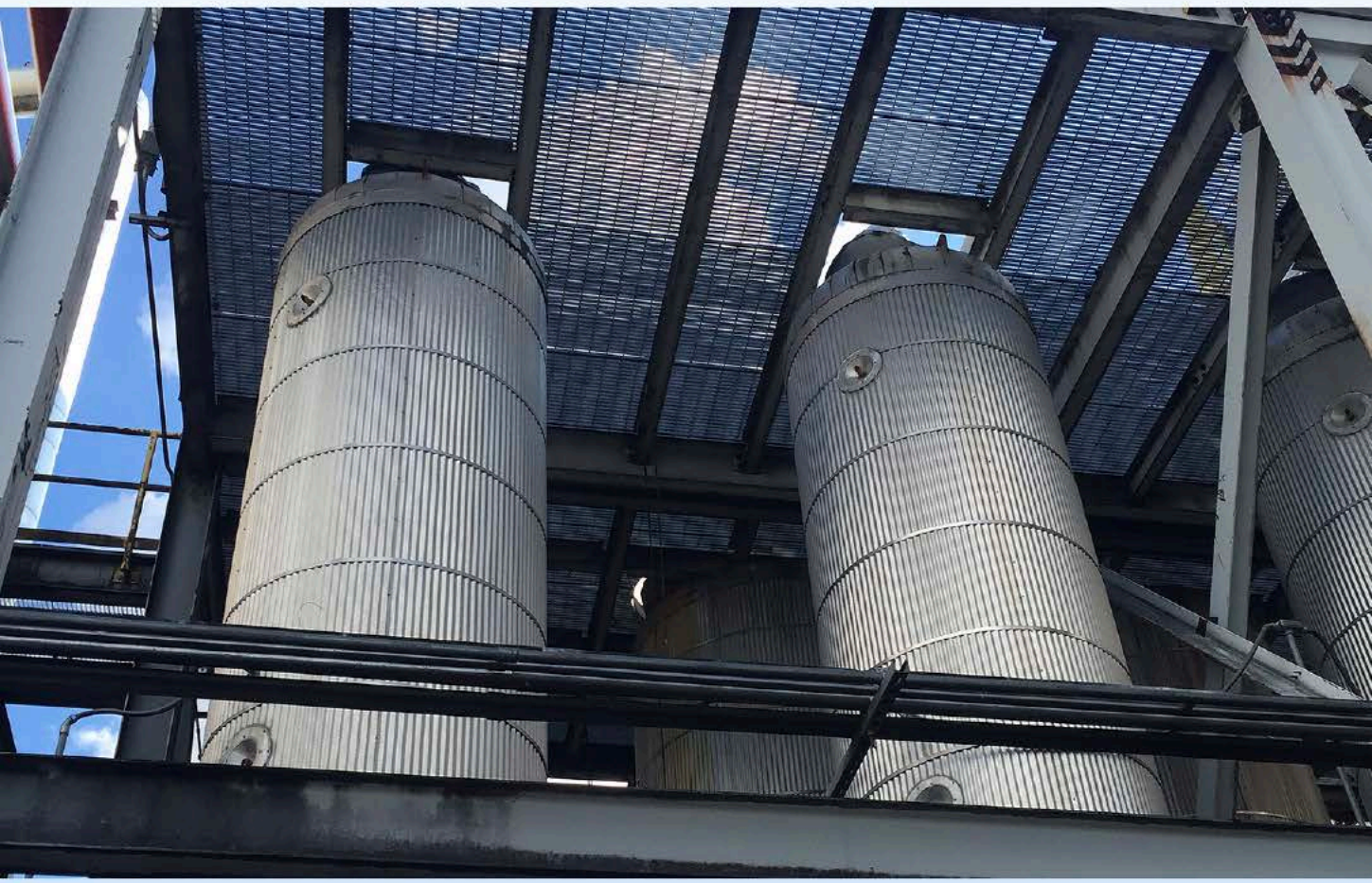

The moisture isotherm above shows water capacity at various operating pressures for Hengye's WateRyd IV, a 4A molecular sieve for Biogas Dehydration Units.

## Specifications

| WateRyd IV | | Beads | | Pellets | |
|---|---|---|---|---|---|
| Property | Unit | 4x8 Mesh | 8x12 Mesh | 1/8 Inch | 1/16 Inch |
| Diameter | mm | 2.5 - 5.0 | 1.6 - 2.5 | 3.0 - 3.3 | 1.5 - 1.8 |
| Bulk Density | $lb/ft^3$ | 43.7 - 47.4 | 46.8 - 50.6 | 40.6 - 44.3 | 41.2 - 44.9 |
| Crush Strength | lbf | ≥20 | ≥10 | ≥18 | ≥9 |
| Static $H_2O$ Adsorption | wt% | ≥21.5 | ≥21.5 | ≥21.5 | ≥21.5 |
| Attrition | wt% | ≤0.1 | ≤0.1 | ≤0.4 | ≤0.4 |
| Moisture Content | wt% | ≤1.5 | ≤1.5 | ≤1.5 | ≤1.5 |

# Dehydrating Biogas

Our high-grade adsorbents are specially designed to remove water and create a product that is suitable for compression, liquefaction, use as fuel, and more. Removing water from biogas streams to less than 0.1ppm is vital to prevent freezing and flow blockage within process equipment and pipelines. Additional molecular sieve units or layered bed layouts may also be utilized to remove other contaminants such as sulfurous compounds like hydrogen sulfide ($H_2S$), siloxane, and more.



# Inside a Dehydration Unit

The image below shows a single dehydration unit at three different stages in the dehydration cycle.

**Start of Cycle:**

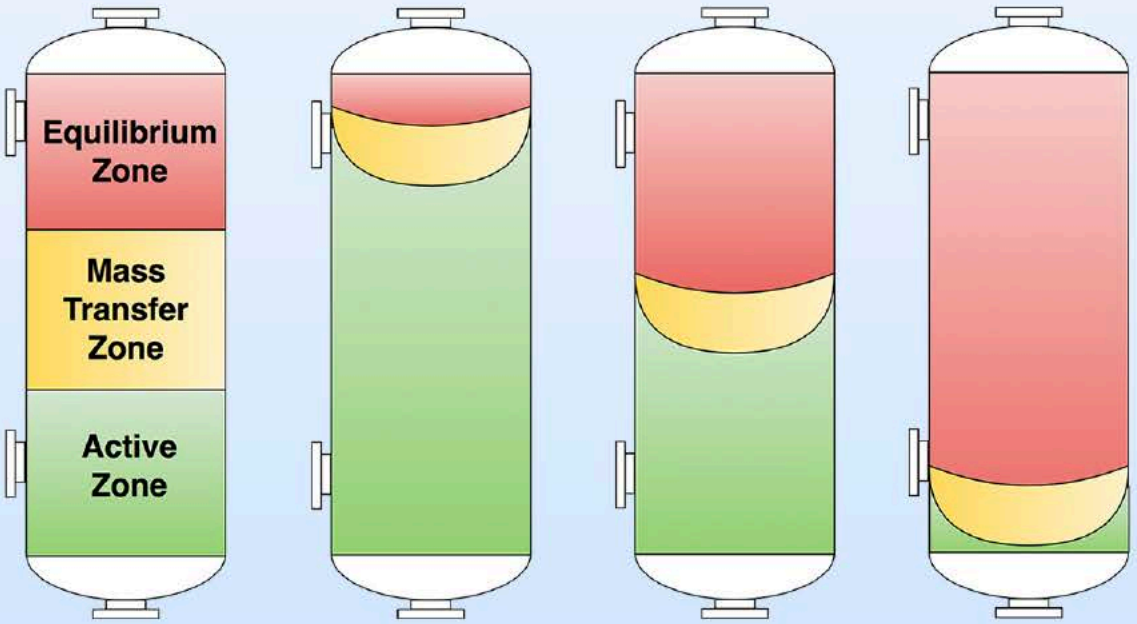
- the majority of the bed is an Active Zone, where sieve is dry from regeneration and ready to adsorb water
- the Mass Transfer Zone (MTZ), where sieve is actively adsorbing water, is beginning to move down the bed

**Middle of Cycle:**

- the MTZ has moved about halfway down the bed
- the top of the bed is the Equilibrium Zone, where water has fully saturated the sieve beads
- the Active Zone, below the MTZ, is still completely dry

**End of Cycle:**

- water will soon break through, bed will regenerate





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# Mass Transfer Zone

The image above shows three different vessels, each with different Mass Transfer Zone (MTZ) heights, which plays an important role in overall bed capacity.

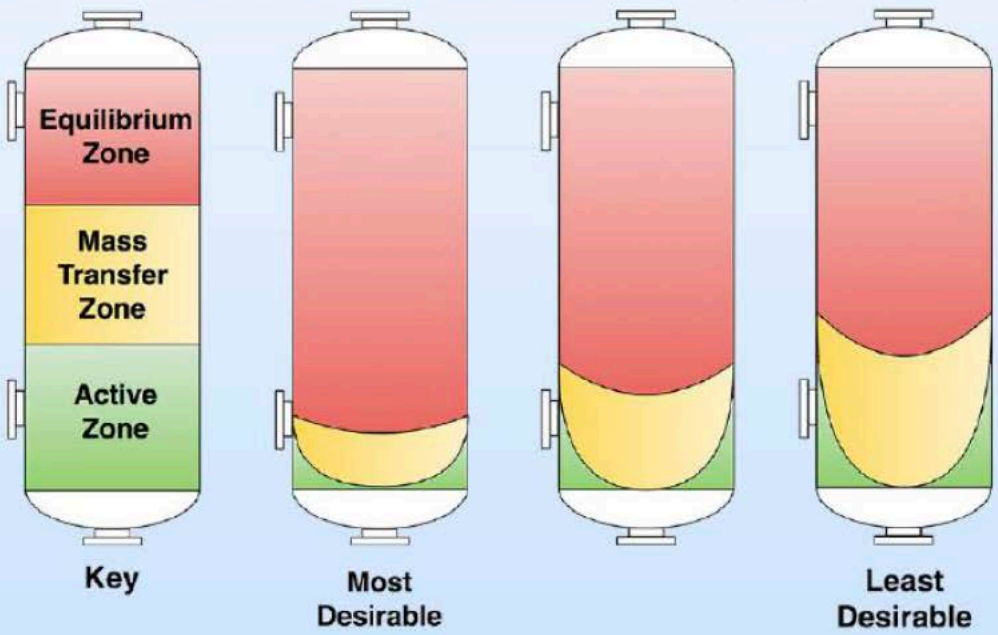
**The Most Desirable bed:**

- shortest MTZ and the largest Equilibrium Zone
- this bed has adsorbed more water in one cycle than the other two beds

**The Least Desirable bed:**

- tallest MTZ and smallest Equilibrium Zone
- this bed has adsorbed the least amount of water

Various factors affect the height of the Mass Transfer Zone including operating conditions and molecular sieve quality. Our molecular sieves offer both durability and favorable Mass Transfer adsorption properties.



# Biogas Sweetening

To create high value products that are clean burning, sulfurous compounds must be removed from natural gas streams through a process known as sweetening.

## Why Use Adsorbents?

Not all sulfurous compounds in a natural gas stream will be removed by the amine unit. Molecular sieve technology is utilized to remove the remaining acid gas, which allows the gas stream to meet odorant specifications while increasing overall value.

## Adsorbents for Sulfur Removal

SulfuRyd products include molecular sieves and activated aluminas that are used to sweeten natural gas streams. These adsorbents remove acid gases and sulfurous compounds to create a product that meets pipeline, sales, and environmental specification.

- high adsorption capacity for removing sulfur compounds to levels below analytical detection
- attrition resistant, will withstand the vigorous conditions of operating temperatures and pressures

Some SulfuRyd products can be reused through many cycles and will release sulfur during regeneration. This sulfur can be further recovered such as in sulfur recovery units (SRUs). We offer a variety of Claus catalysts including alumina and titanium oxide.

# Siloxane Removal

Removing siloxane is an important step in cleaning methane gases for use as fuel since siloxane is a form of crystalline silica that will essentially turn into glass when burned or combusted.

## Why Use Adsorbents?

The collection of combusted siloxanes inside of engine components can cause the buildup of heat, water, and other contaminants that can cause corrosion, leading to problems in the engine.

Adsorbents will remove these contaminents to help improve maintenence and prevent engine breakdowns, which increase maintenance costs and can lead to total engine failure.

## Adsorbents for Siloxane Removal

Hengye Inc. offers a suite of products that are suitable for removing siloxane from methane streams, collected from landfill gas. Molecular sieve, silica gel, and activated carbon are common, reusable adsorbent filters, that can be used to upgrade biomethane by removing siloxanes and other contaminants and help decrease downtime and equipment maintenance costs.

# About Hengye Inc.

## Support Services

- remote and on-site support available
- dehydration unit optimization and operation analysis
- systems training and activities support
- material application education and product selection
- analyze remaining working life of products
- breakthrough testing, product performance analysis
- sample testing and spent material evaluation
- product and performance warranties can be granted
- ISO 9001:2015 certified, quality management
- ISO 14001:2015 certified, environmental management

## Everything You Need to Fill an Adsorption Unit

- molecular sieve, dehydration grade
- sulfur adsorbents, guard material
- ceramic and high alumina support material, screens
- design engineering and bed loading calculations
- change-out, turnkey contracting options
- loading, commissioning instruction and assistance

# A Global Manufacturer

In 2014, Hengye Inc. was established in Houston, Texas to meet the growing, dynamic adsorption requirements of the American biogas market. Our team provides a full range of services, including product suggestions, design work and existing bed sizing, technical support, process optimization, turn around services, and more.

Feed streams are unique and the superior design of Hengye products can meet the industry specifications required to maximize the value of product streams. Our engineers and technical advisors will provide the data and education to support and bring confidence to those who use Hengye products.

## WaterRyd Series

We considered the conditions for dehydration units to operate at peak performance and designed a molecular sieve with ideal physical and chemical properties to optimize productivity.

## We Support You

- monitor efficiency, optimize productivity
- product advice and solutions, industry tips
- quick order processing, responsive communication
- hands on site and remote technical support
- start-up assistance and full change out servicing
- operations training and product care education

HENGYE®

## Connect with us...

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Hengye has been manufacturing quality adsorbents for over twenty-five years. Our molecular sieves and adsorbents are ideal for dehydration and purification processes by offering consistency, durability, optimized selectivity for contaminants over hydrocarbons, and increased capacity per cycle to provide a high purity end product. Our goal in creating these specialized adsorbents is to help biogas plants flourish and increase output without needing to expand current operations. These products are built to withstand typical operation conditions when properly maintained and aim to provide a positive return-on-investment.