



**B** BRENNTAG

# Geothermal Energy

Products and services

# Brenntag Energy Services: Unlocking Geothermal Power

Geothermal heat has become one of the most desired forms of energy in today's world.

It is renewable, safe, and readily available across the globe. Whether used as a heat source or transformed into electricity, geothermal energy offers numerous benefits. But geothermal energy is not limited to just heating and electricity. Geothermal water can also be utilized in medical applications and as a source of valuable elements. At Brenntag Energy Services, we understand the immense potential of geothermal energy, and we are here to support you in unlocking its power at every stage of the geothermal energy value chain.

As one of the leading chemical distributors, we are proud to be within the 1 % of distributors scored with an EcoVadis Platinum Sustainability Rating. In 2016, Brenntag became the first chemical distributor to join the Together For Sustainability initiative in the chemical industry. We are committed to sustainability and reducing our carbon footprint. As a member of the RE100 group, which unites the world's largest and most successful companies in their mission to switch to 100 % renewable electricity, Brenntag aims to achieve this goal by 2025.

Our offering for geothermal energy encompasses a wide range of applications:

- Drilling and Cementing operations
- Production of water and heat
- Intensification – Enhanced Geothermal Systems
- Services and monitoring
- Carbon Capture solutions for geothermal installations









# Drilling & Cementing operations

When it comes to drilling operations, including geothermal wells, Brenntag Energy Services is your reliable and respected partner. With our extensive expertise and specialized products, we have gained recognition as a trusted EMEA supplier in the industry. Our commitment to safety, top-quality products, and

proximity to operations sets us apart and makes us the perfect choice for planned deliveries and unexpected situations. We offer a comprehensive range of drilling and cementing products designed to meet the specific requirements of geothermal drilling operations. Our portfolio includes:



## Drilling

Product Category	Function	Natural Feedstock	Low Carbon Footprint	Improved personal and environmental safety	Comments
Viscosifiers	Rheology modification LT, HT	✓		✓	Natural polymers
Fluid Loss	Filtration reducer HT	✓			Natural polymers
Defoamers	Foam prevention	✓	✓	✓	Renewable feedstock
Dispersants	Thinners and flocculants	✓			Natural feedstock
Corrosion Inhibitors	Corrosion protection			✓	Reduced dosage,
Shale Inhibitors	Swelling clay protection		✓		Reduced carbon footprint
Lubricants	Torque and drag reduction	✓		✓	Renewable feedstock
H <sub>2</sub> S Scavengers	H <sub>2</sub> S protection	✓			Renewable feedstock
LCM	Various PSD	✓			Natural minerals, waste, or renewable

## Cementing

Product Category	Function	Natural Feedstock	Low Carbon Footprint	Improved personal and environmental safety	Comments
Retarders	Thickening time control LT, HT	✓		✓	Renewable feedstock
Fluid Loss	Filtration reducer LT, HT	✓			Natural polymer derivatives
Defoamers	Foam prevention	✓	✓	✓	Renewable feedstock
Dispersants	Pumping pressure reduction	✓		✓	Renewable feedstock minimum ground water impact
Extenders/weighting agents	Weight control	✓			Natural minerals, or waste, by-products
Anti gas migration	Cement expansion	✓		✓	Mineral mixture
Spacers	Mud spacing out, cleaning, bond promoting	✓	✓	✓	Renewable feedstock, reduced carbon footprint
LCM	Various PSD	✓		✓	Natural minerals, or renewable source

# Product Highlights



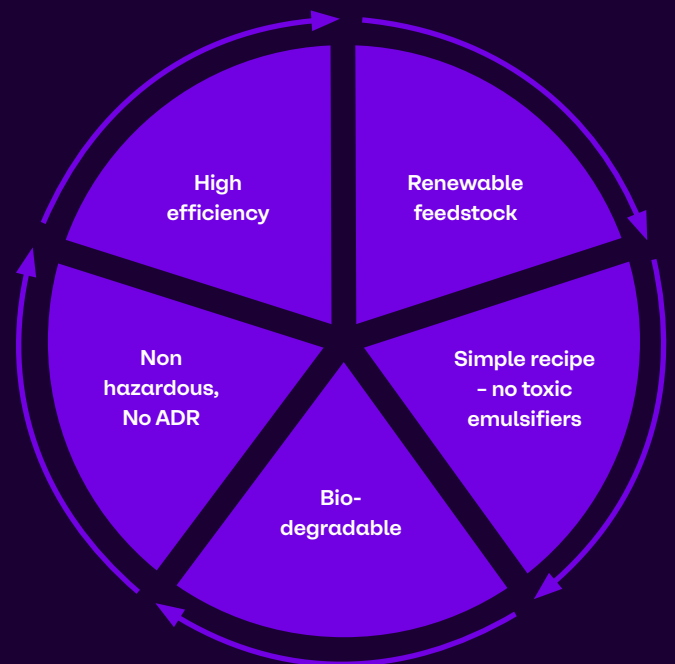
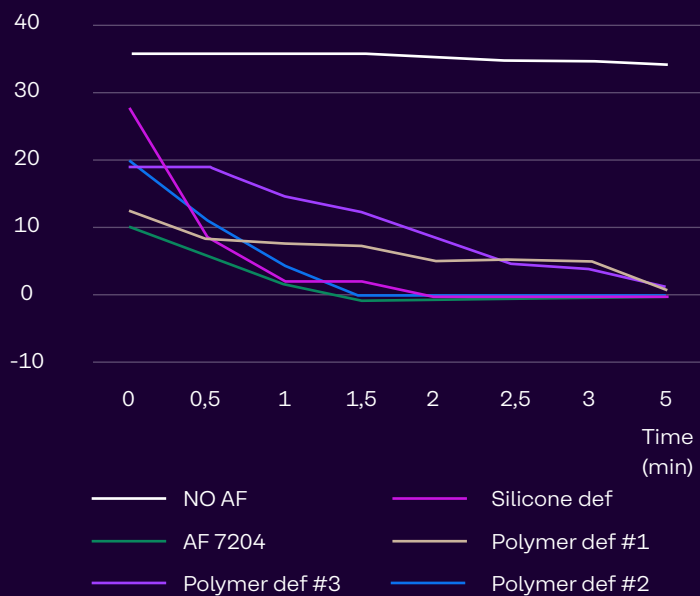
## AF 7204 defoamer

Introducing AF 7204, a breakthrough in the world of defoamers – highly efficient and eco-friendly! Composed of natural, plant-based polymers, it offers a high level of biodegradability, making it an excellent choice for environmentally conscious applications.

### Key Features and Benefits:

- 1. Safety for People and the Environment:** AF 7204 is designed with utmost safety in mind. It is completely safe for personal handling and poses no harm to the environment. This not only ensures a secure working environment but also simplifies the handling and transportation process, eliminating the need for ADR compliance.
- 2. Sustainable Composition:** Our defoamer is formulated with natural, plant-based polymers. These renewable ingredients not only exhibit excellent defoaming properties but also boast a high level of biodegradability.
- 3. Streamlined Production Process:** AF 7204 simplifies the production process with its simplified recipe. Unlike many defoamers that require emulsifiers, which often rely on fossil-based additives, our product eliminates the need for such components. This not only enhances its eco-friendliness but also reduces energy demands during production.
- 4. Enhanced Efficiency:** When compared to commonly used defoamers in the market, such as silicone and alcohol/polymer/surfactant-based alternatives found in various drilling fluids, AF 7204 stands out as a highly efficient solution. It effectively prevents foam formation when added to fluid compositions, or it can be utilized to collapse existing foam, ensuring smooth and efficient operations.

### Defoaming efficiency



# Production additives

Geothermal water production poses a unique set of challenges. From high temperatures to mineral content and the presence of H<sub>2</sub>S, it requires specialized solutions to ensure smooth operations. At Brenntag Energy Services, we have extensive experience in protecting production installations and assisting our customers every step of the way.

**Tailored Solutions for Individual Conditions:**

We understand that every geothermal installation is unique, with its own set of conditions. That’s why we offer tailored solutions to address specific challenges. Our team of experts is equipped with the knowledge and expertise to assist you with sampling and in-house tests in our state-of-the-art R&D centre.

**Wide Range of Specialized Production Additives:**

Our product portfolio includes a wide range of highly specialized production additives specifically designed for use in geothermal installations producing water and heat. Whether you have closed or heating media systems, we have the solutions you need including corrosion inhibitors, scale inhibitors and H<sub>2</sub>S scavengers.

**Maximize Efficiency and Prevent System Failure:**

By utilizing our superior quality products, you can achieve significant benefits. Reduce maintenance costs, optimize process performance, and prevent system failure.

Product Category	Function	Natural Feedstock	Low Carbon Footprint	Improved personal and environmental safety	Comments
Corrosion inhibitor	Corrosion protection in closed/heating media systems		✓	✓	Sodium nitrite based
Scale inhibitors	Scale prevention, principally calcium carbonate, calcium sulfate and/or barium/strontium sulfate scales	✓	✓	✓	Polymer based
H <sub>2</sub> S Scavenger	Hydrogen sulfide neutralization		✓	✓	Zinc bis based
Heat transfer fluids, coolants	Heat exchange		✓	✓	inhibited glycol mixtures



# Product Highlights



Scale formation is a significant issue in geothermal water treatment, leading to various technical problems that can hinder production and cause equipment damage. Brenntag Energy Services understands the importance of combating scale deposition, and we have developed a cutting-edge solution to address this challenge.

Our advanced scale inhibitor, TN-06380, is specifically designed to combat mineral scale formation in geothermal systems. It is based on a polymeric active substance that outperforms commercially available phosphoric acid counterparts when it comes to preventing the deposition of barium and calcium scales.

## Key Benefits of TN-06380:

1. Superior Scale Prevention
2. Non-Toxic and Environmentally Friendly
3. Enhanced Performance

### Barium scale inhibition

#### TN-06380 vs phosphoric acid based products



### Calcium scale inhibition

#### TN-06380 vs phosphoric acid based product





# Intensification – Enhanced Geothermal Systems

At Brenntag, we recognize the significance of green and environmentally friendly solutions. That’s why our products for geothermal well acidizing are designed with a strong emphasis on sustainability. We prioritize effective treatments while ensuring the wellbeing of the environment.

With a commitment to environmental responsibility, we provide products that are formulated to minimize their impact on the surrounding ecosystem.

Our comprehensive portfolio of environmentally friendly additives meets strict quality standards, allowing you to achieve optimal results while adhering to sustainable practices.

Whenever you require acid corrosion inhibitors, acid diverting agents, or other specialized additives, Brenntag has you covered. Our team of experts is dedicated to providing you with the right chemicals and additives for your specific geothermal well acidizing requirements.

Product Category	Function	Natural Feedstock	Low Carbon Footprint	Improved personal and environmental safety	Comments
Corrosion Inhibitor	Corrosion protect LT, HT	✓		✓	Cationic, organic compounds
Iron Control	Precipitation control	✓		✓	Chelating agent
Scale Inhibitor	Precipitation control		✓		Polymer compound
Clay Inhibitor	Clay Protection Temporary and Permanent		✓		Amino base/salt base/polymer based
Surfactants	Reducing IFT, flowback, VES	✓	✓	✓	Organic compounds
Matrix Acidizing System	Ready to use acid systems	✓	✓	✓	Modified acids
Scale Dissolver	Cleaning agent	✓	✓	✓	Chelating



# Product Highlights



Introducing Brenntag's innovative line of safe and effective products for production intensification in geothermal wells. When water production is in decline, the BrenntaStim series is the perfect choice for

acidizing jobs. This advanced system offers numerous advantages over regular products and has already demonstrated its effectiveness in various European projects.

## Liquid Index

<b>BrenntagStim MA3C</b>	Based on synthetic acid and characterized by halogen free product with very low metal corrosiveness. Extremely effective at dissolving deposits and inorganic deposits
<b>BrenntagStim MA6C</b>	Based on stabilized HCL acid with various additives and intended to be mainly used for matrix stimulation and acid fracturing
<b>BrenntagStim MA7C</b>	Based on a mixture of acids and alcohols and intended to be a middle ground between versions MA6C and MA3C, can be applied as removal of downhole formation, scale, cement or mineral deposits.
<b>BrenntagSol Ba</b>	Innovative, high performance dissolver for challenging sulfate and sulfide scales including strontium, barium and calcium sulfate. Other uses include: heat exchangers, industrial boilers, scrubbers and dehydration units, water cooling systems and distribution piping.
<b>StimStone MHFS</b>	Modified hydrofluoric acid (HF) that is neutralized until activated by the addition of an activator in-situ. Safe for environment and human handling.

### Advantages of BrenntaStim:

- 1. Innovation:** Our product line is based on chelate complexes, a novel approach that has not been previously used in stimulation processes.
- 2. Low Corrosion Potential:** BrenntaStim has an exceptionally low corrosion potential
- 3. Environmental Friendliness:** it contains no halogens and contributes to non-chloride acid systems, making it environmentally friendly and compliant.
- 4. Safety and User-Friendliness:** Our products are designed with a strong focus on Health, Safety, and Environment (HSE) profiles.
- 5. Effectiveness:** The effectiveness of BrenntaStim has been confirmed by the positive experiences of our clients.
- 6. Thermal Stability:** BrenntaStim exhibits impressive thermal stability, withstanding temperatures of up to 220 °C.

### Benefits of BrenntaStim:

- 1. Cost Reduction:** The non-corrosive nature of BrenntaStim ensures the safety of steel elements in the extraction pipe, eliminating the need for costly replacements. This leads to reduced well maintenance costs.
- 2. Comprehensive Package:** Our products are available in a complete package which simplifies logistics and results in transportation savings.
- 3. Prevention of Settling Precipitation:** BrenntaStim facilitates the formation of iron chelate complexes, preventing or slowing down the precipitation of harmful settlings during treatment operations. This helps maintain optimal production and avoids extensive well maintenance.
- 4. Halogen-Free Technology:** The use of halogen-free technology in BrenntaStim eliminates the need for transportation permits and licenses. This simplifies logistical processes and ensures compliance with regulatory requirements.
- 5. Extensive Passage Systems:** BrenntaStim has the ability to create extensive systems of passages, enabling the acid treatment liquid to penetrate deeply and uniformly throughout the reservoir interval. This maximizes the effectiveness of the acid treatment.







# Test Core #1

Pore space **before** BrenntaStim technology: X-ray microtomography **porosity 0.51 %**, (res. 30  $\mu\text{m}$ )

2D - cross section XZ

3D - matrix structure

3D - pore structure

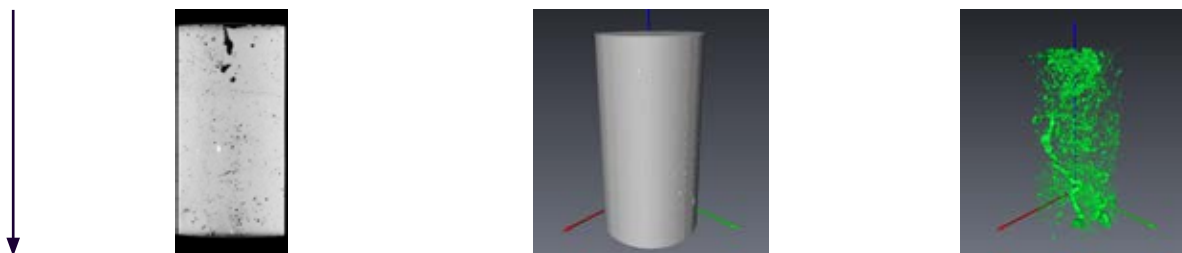


Pore space **after** BrenntaStim technology - X-ray microtomography **porosity 1.33 %**, (res. 30  $\mu\text{m}$ )

2D - cross section XZ

3D - matrix structure

3D - pore structure



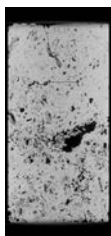
Cores models are Gulf Dolomite (test core #1) and Saddle Dolomite (test core#2) representing different permeability and composition. For the GD core the permeability ranges from 1.3-2.4 mD, while for the SD core, it ranges from 4.2-6.3 mD. The purpose of the flow tests was to obtain parameters for the interpretation of the effectiveness of the acid treatment.

One, critical parameter for the acidizing effectiveness, is the pore volume necessary for the fluid to break through the core (Pdp). A smaller value indicates that less acid will be consumed in the zone near the well and more will be transported deeper into the formation.

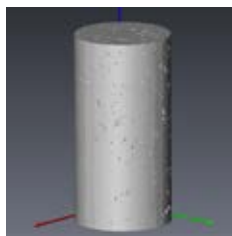
## Test Core #2

Pore space **before** BrenntaStim technology: X-ray microtomography **porosity 5,41 %**, (res. 30  $\mu\text{m}$ )

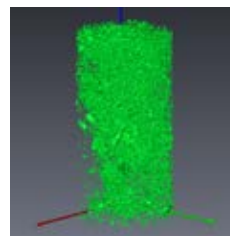
2D - cross section XZ



3D - matrix structure

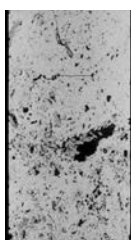


3D - pore structure

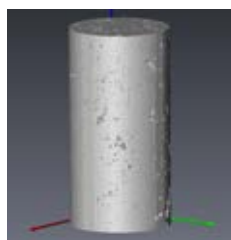


Pore space **after** BrenntaStim technology - X-ray microtomography **porosity 7,46 %**, (res. 30  $\mu\text{m}$ )

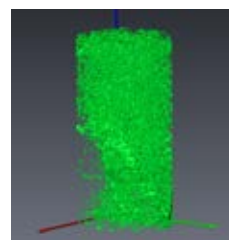
2D - cross section XZ



3D - matrix structure



3D - pore structure



With BrenntaStim MA7C/MA6C system, the SI index for nitrogen for Test core #1 is 4.45, and the marked value of Pdp is 3.06. This indicates a slow reaction of the acidizing fluid with the core. This effect is attributed to the significant increase in core porosity after acid treatment (161 %) and the formation of four new helminth holes. Test core #2 (with higher permeability), the breakthrough of the acid occurred fastest among all the experiments carried out -

after 0.45 volumes of the porous core. As a result, the porosity increased by about 38 % after acidizing, creating clear connections with tubules in the porous structure.

The tested variants of acidizing fluid have the potential to create desirable structures of vermicular holes in the deposit conditions, which is beneficial for stimulation

# Samples before and after the corrosion test

with an acidic liquid – BrenntaStim technology [pressure 20 MP, temperature 130 C, time 6h]

## Material CT



Brenntag Energy Services offers BrenntaStim MA7C and MA6C fluids with exceptional corrosion protection rates of 99.5 % for L-80 steel and 98.7 % for CT samples.

This long-lasting protection reduces the need for additional corrosion inhibitors, resulting in cost savings and lower treatment expenses.

## Material L-80



# Services and monitoring

With extensive experience in diverse projects, including refineries, biogas, and bioethanol plants, Brenntag Energy Services now expands its expertise to geothermal surface infrastructure. Our comprehensive offerings cater to worksites, providing specialized products, dedicated equipment, and certified personnel with a proven track record working on projects for renowned companies like SHELL, BP, MOL, EQUINOR, and NESTE.

## Our offer includes:

- Maintenance operations with heavy equipment
- Replacement of cooling mediums e.g. glycol
- Cleaning of tanks, pipelines
- Chemical injection rate control, troubleshooting
- Personnel 24/7 availability
- Back up equipment: pumps, filters, flowmeters, compressors and other
- Experienced staff with appropriate HSE training
- Monitoring and measurements in partnership with EMERSON
- Corrosion/erosion/scale monitoring
- Continuous Liquid analysis e.g. analytical measurements of water quality
- Flow measurement and control
- Level measurement





# Carbon Capture systems for geothermal installations

Geothermal energy is a versatile and eco-friendly resource, offering direct heat applications and low-carbon electricity generation in power plants. Brenntag Energy Services, in partnership with NeoCarbon, goes a step further by making geothermal installations even more sustainable. Our offer includes:

## **Carbon Capture Technology**

Brenntag leverages the waste heat and green energy from geothermal plants to facilitate reliable and measurable carbon removal. NeoCarbon's advanced capture unit can achieve capacities comparable to the largest Direct Air Capture plants globally, ranging from 50 to 1000 tons.

## **Sustainable Utilization of Captured CO2**

The captured CO2 can be utilized in various ways. It can be directed to nearby agriculture plants for fertilization or used in e-fuel production. Additionally, it can be permanently sequestered to generate emission reduction or Carbon Removal Credits.

## **Novel Reactor Technology**

NeoCarbon's cutting-edge reactor technology utilizes existing cooling towers or air cooler condensers available at geothermal plants. This approach delivers high-purity CO2 that is ready for sequestration, ensuring market-leading energy efficiency and cost-effectiveness.

## **Tailored Sorbents for Industrial Applications**

Brenntag and Neocarbon cooperation results in comprehensive offer for industrial applications including solid and liquid sorbents tailored to individual installations.



# Contact

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