Staying ahead with High Shear XXL

Trigonal®-Machines by SIEFER,
a pioneer and partner for efficient solutions
in the wet processing technology.

SIEFER
Trigonal® - Maschinen

Proven for more than 50 years

Wilhelm Siefer GmbH & Co. KG with its brand Trigonal® specialises in the development of mixing and size reduction machines for processing low to high viscosity products such as liquid mixtures or solids in liquid suspension.

Application areas of our rotor-stator technology:

fine comminuting • coarse comminuting • homogenising • dispersing • emulsifying • deflaking • mixing • aerating • accelerating reactions • loosening • neutralising • polymerising • transferring of product • boiling under shear stress • solubilising pulp • defibrating • extracting • recycling • applying heat • reducing viscosity • moistening • de-agglomeration …

Customer oriented consulting and individual solutions

Our machines are used wherever highest product quality and recipe stability are essential.

With a most versatile design of the rotor-stator system, our Trigonal®-Machines have been proved successful for:

- Homogeneous mixing of polyphase liquids
- Crushing, suspending or dissolving of powders in liquids of all kinds as well as
- A variety of other dispersion tasks.

Our machines combine high performance with exemplary ease of use, safety and a long life span. The variety of our delivery program – featuring a number of **different rotor-stator systems, four design sizes as well as numerous other optional variants** – ensures the perfect adaptation to the characteristics of the product to be processed and to all related requirements.

Rotor-Stator Systems

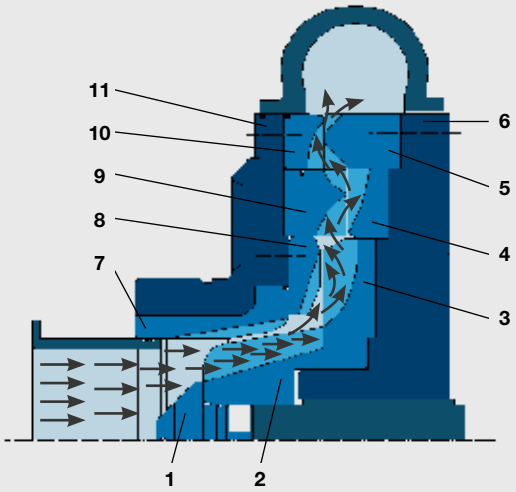
Perfectly suited for the required task: Effective processing of each medium by application of shearing stress in the gap between rotor and stator using very high circumferential speeds (up to 54 m/s).

Always the best adaptation

High flexibility. Well proven. Excellent durability. Up to now, our systems have been used successfully in more than 6,000 processing plants featuring a vast number of modifications. A broad selection of different materials ensures an adaptation with optimised service lives.

For the selection of the suitable rotor-stator system an intensive product evaluation is required: Characteristics such as density, degree of hardness, consistency and composition have to be evaluated. Temperature sensitivity, agglomeration behaviour or surface reactions can also affect on the correct configuration to achieve the desired processing result.

While hard to brittle products can be crushed by impact, pressure and friction, soft and elastic materials can often be reduced only by cutting and shearing effects. If necessary, a patented silhouette arrangement of the tooth flanks allows a unique cutting effect for the size reduction of elastic media.



Cross section of a rotor-stator system

1 Rotor screw
2 Rotor cone
3 Rotor ring 1
4 Rotor ring 2
5 Rotor ring 3
6 Rotor bearer
7 Stator cone
8 Stator ring 1
9 Stator ring 2
10 Stator ring 3
11 Stator bearer

With power and precision – the special functional principle

The core of each of our machines is characterised by its variable structure: Rotor and stator consist of up to four coaxially arranged rotor and stator rings (stages) each. They each have a toothed design and feature radial channels and/or bores. The number of channels as well as their shape, width, depth and alignment varies. Rotor and stator can be arranged either plane-parallelly or step by step.

The resulting vast selection of different rotor-stator systems allows the Trigonal®-Machine to always be optimally adapted to the required task.

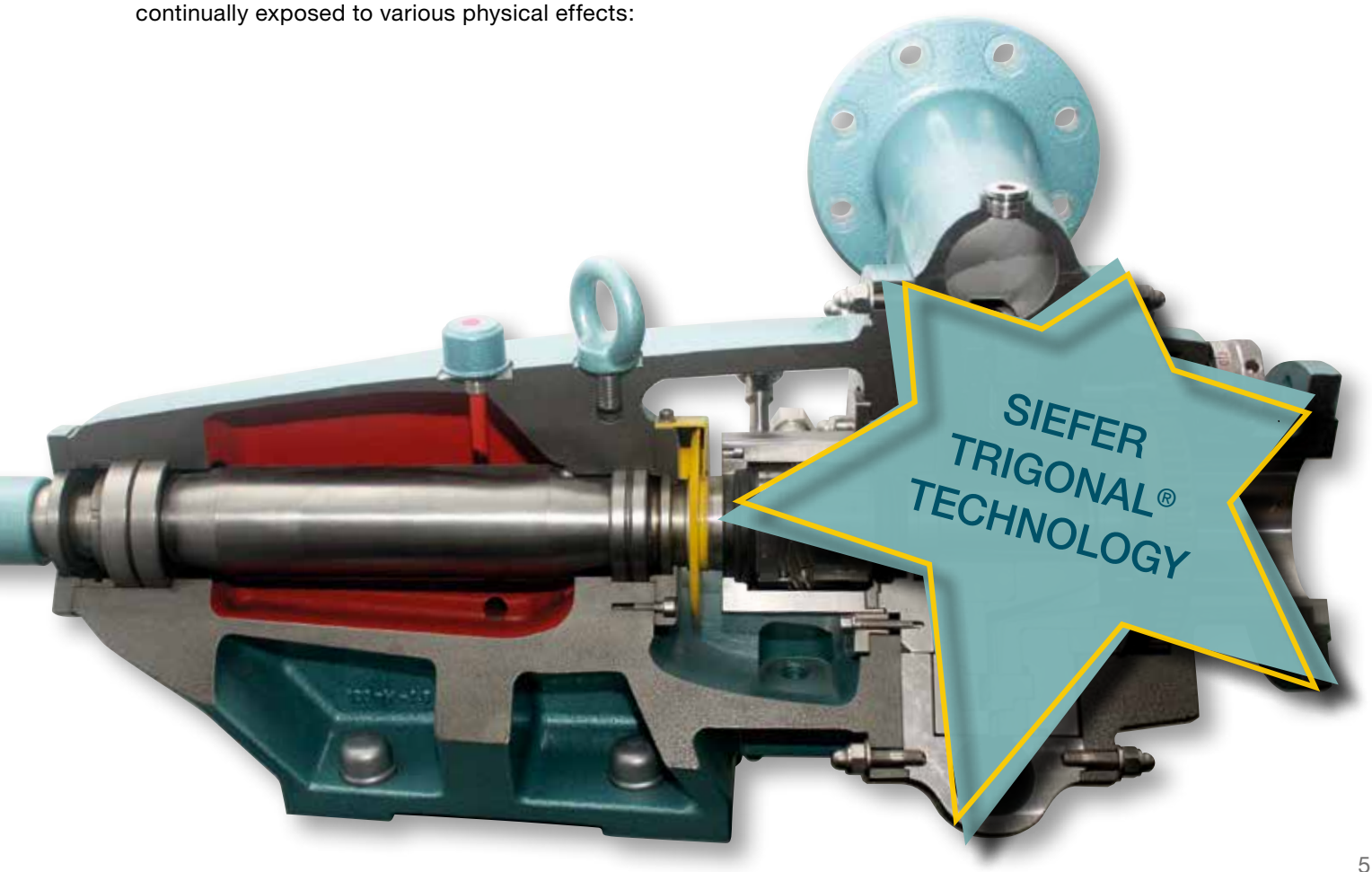
The unique operating principle of our systems

The medium initially enters the centre of the rotor-stator system in an axial direction and is centrifugally accelerated towards the outside (“forced feeding through the gap”). The medium has to pass through up to four stages. During this process the medium is continually exposed to various physical effects:

- Separation of the medium into many separate currents
- Frictional, shearing, cutting and/or impact loads
- Sudden acceleration and deceleration of the medium, which cause shock pressure waves with compression and decompression processes, which then cause micro-activities
- Turbulences transfer their frictional processes onto the medium.

These following effects can be further adjusted by changing the geometry and alignment of the slots (in or against the flow direction), by changing the speed and flow rate, as well as by changing the infinitely adjustable gap size between stator and rotor.

As neither rotor nor stator have a continuous channel, no particle passing through the machine remains unprocessed!



Machines

Four different sizes and a universal range of application: Designed for continuous use, all Trigonal®-Machines excel at a high reliability and a long life span even under harsh conditions – both in single-pass or in circulation processes.

	Production machine				Laboratory machine
***Trigonal*®-Maschines**	**SM 180**	**SM 290**	**SM-D2**	**SM-D3**	**SM 102-28**
Throughput based on water [m³/h]	4 - 28	6 - 120	15 - 150	20 - 250	0,006 - 1
Discharge pressure [bar]*	6	6	8	8	2
Drive power [kW]	7,5 - 45	15 - 110	15 - 160	90 - 250	3 - 11
Dimensions without equipment [L/W/H in mm]	965/420/420	1000/500/500	1200/600/700	1450/800/835	510/230/250
Weight without equipment [kg]	190	265	525	960	45
Connections at suction and discharge side DIN/ANSI	65 (2½)"	100 (4")	100 (4")	150 (6")	25 (1")
Speed min/max [rpm]	3.000 / 5.400	1.500 / 3.600	1.500 / 3.600	1.500 / 2.300	4.000 / 13.200
Max. feed size solid/dry matter [mm]	ø 30	ø 50	ø 50	ø 100	ø 5

*average value

Individual features

Among others:

- Heating/cooling jacket (suffix “HK”)
- Large selection of materials for product contacted parts
- Power transmission via coupling or V-belt
- Discharge connection in various directions
- Large selection of available shaft seals – whether single stuffing box or complex double mechanical seal
- Flange design either DIN or ANSI standard
- Binary entrance for merging different partial flows
- ATEX version

Performance and equipment perfectly adapted to your needs

One operating principle, many names:

"Rotor–stator machine, wet size reduction machine, mill, centrifugal mill, colloid mill, cutting mill, toothed-disc granulator, toothed-disk mill, disc mill, macerator, dynamic mixer, siefer-trigonal homogeniser, grinding mixer, agitator, dispergator, de-agglomerator, delumper, refiner, homogeniser, emulgator, deflaker …"

Our Trigonal®-Machines are characterized by their flexible adaptability to different media, tasks and applications taking into account procedural, technical, economical as well as safety aspects.

The machines are available in four sizes:
SM 180, SM 290, SM-D2, SM-D3. Furthermore, our customers can use the laboratory machine SM 102-283 for research and product development.

Convincing advantages

- Highest quality standards
- Selection from a variety of rotor-stator systems
- For single-pass or multiple-pass process
- Modular design for easy modification of individual component groups
- High throughput with excellent size reduction results
- Continuous and controllable process in a closed system
- Infinitely variable mechanical adjustment of the gap between rotor and stator
- Direct starting without gap adjustment possible
- Low-wear and easy to maintain
- Low cleaning requirements
- Pump effect usually eleminates the need for a discharge pump
- Selective replacement and repair of individual rotor-stator rings possible
- Regrindable rotor-stator system

SM 180

SIEFER Trigonal®-Machine,
TYPES SM 180 and
SM 180/HK (heating/cooling jacket)

Fields of application:
Agricultural chemistry, biotechnology, bitumen, chemistry, paints and coatings, pet food, cosmetics & pharmaceutics, food and paper industry

(with heating/cooling jacket)

Technical data:	SM 180	SM 180/HK
Throughput based on water [m³/h]	4 – 28	4 - 28
Discharge pressure [bar]	6	6
Drive power [kW]	7,5 – 45	7,5 - 45
Connections at suction and discharge side DIN/ANSI standard	65 (2½")	65 (2½")
Speed min/max [rpm]	3.000 – 4.500	3.000 – 4.500
Max. feed size solid/dry matter [mm]	Ø 30	Ø 30
Dimensions L/W/H [mm]	965 x 420 x 420	965 x 420 x 420
Weight [kg] (without equipment)	190	235

Features SM 180:

- Large selection of materials for product contacted parts
- Power transmission via coupling or V-belt
- Discharge connection in various directions
- Large selection of available shaft seals in cartridge design
- Flange connections either DIN or ANSI standard
- Binary entrance for merging different partial flows
- ATEX version
- Excellent accessibility to and replaceability of the cutting tool
- Tool system can be exchanged and REGROUND very quickly
- Very high availability, service life and durability of the machine

SM 290

SIEFER Trigonal®-Machine,
TYPES SM 290 and
SM 290/HK (heating/cooling jacket)

Fields of application:
Agricultural chemistry, biotechnology, bitumen, chemistry, paints and coatings, pet food, cosmetics & pharmaceutics, food, paper & recycling industry

(with heating/cooling jacket)

Technical data:	SM 290	SM 290/HK
Throughput based on water [m³/h]	6 – 120	6 - 120
Discharge pressure [bar]	6	6
Drive power [kW]	15 – 110	15 - 110
Connections at suction and discharge side DIN/ANSI standard	100 (4")	100 (4")
Speed min/max [rpm]	1.500 – 3.600	1.500 – 3.600
Max. feed size solid/dry matter [mm]	Ø 50	Ø 50
Dimensions L/W/H [mm]	1.000 x 500 x 500	1.000 x 580 x 580
Weight [kg] (without equipment)	265	275

Features SM 290:

- Large selection of materials for product contacted parts
- Power transmission via coupling or V-belt
- Discharge connection in various directions
- Large selection of available shaft seals in cartridge design
- Flange connections either DIN or ANSI standard
- Binary entrance for merging different partial flows
- ATEX version
- Excellent accessibility to and replaceability of the cutting tool
- Tool system can be exchanged and REGROUND very quickly
- Very high availability, service life and durability of the machine

SM-D2

SIEFER Trigonal®-Machine,
TYPES SM-D2 and
SM-D2/HK (heating/cooling jacket)

Fields of application:
Biotechnology, bitumen,
chemistry, paints and coatings,
pet food and recycling industry

(with heating/cooling jacket)

Technical data:	SM–D2	SM–D2/HK
Throughput based on water [m³/h]	15 – 150	15 - 150
Discharge pressure [bar]	8	8
Drive power [kW]	15 – 160	15 - 160
Connections at suction and discharge side DIN/ANSI standard	100 (4¨)	100 (4¨)
Speed min/max [rpm]	1.500 – 3.600	1.500 – 3.600
Max. feed size solid/dry matter [mm]	Ø 50	Ø 50
Dimensions L/W/H [mm]	1.200 x 600 x 700	1.200 x 600 x 700
Weight [kg] (without equipment)	525	540

Features SM-D2:

- Large selection of materials for product contacted parts
- Power transmission via coupling or V-belt
- Discharge connection in various directions
- Large selection of available shaft seals in cartridge design
- Flange connections either DIN or ANSI standard
- Binary entrance for merging different partial flows
- ATEX version
- Excellent accessibility to and replaceability of the cutting tool
- Tool system can be exchanged and REGROUND very quickly
- Very high availability, service life and durability of the machine

SM-D3

SIEFER Trigonal®-Machine,
TYPES SM-D3 and
SM-D3/HK (heating/cooling jacket)

Fields of application:
Biotechnology, bitumen,
chemistry, pet food,
paper and recycling industry

(with heating/cooling jacket)

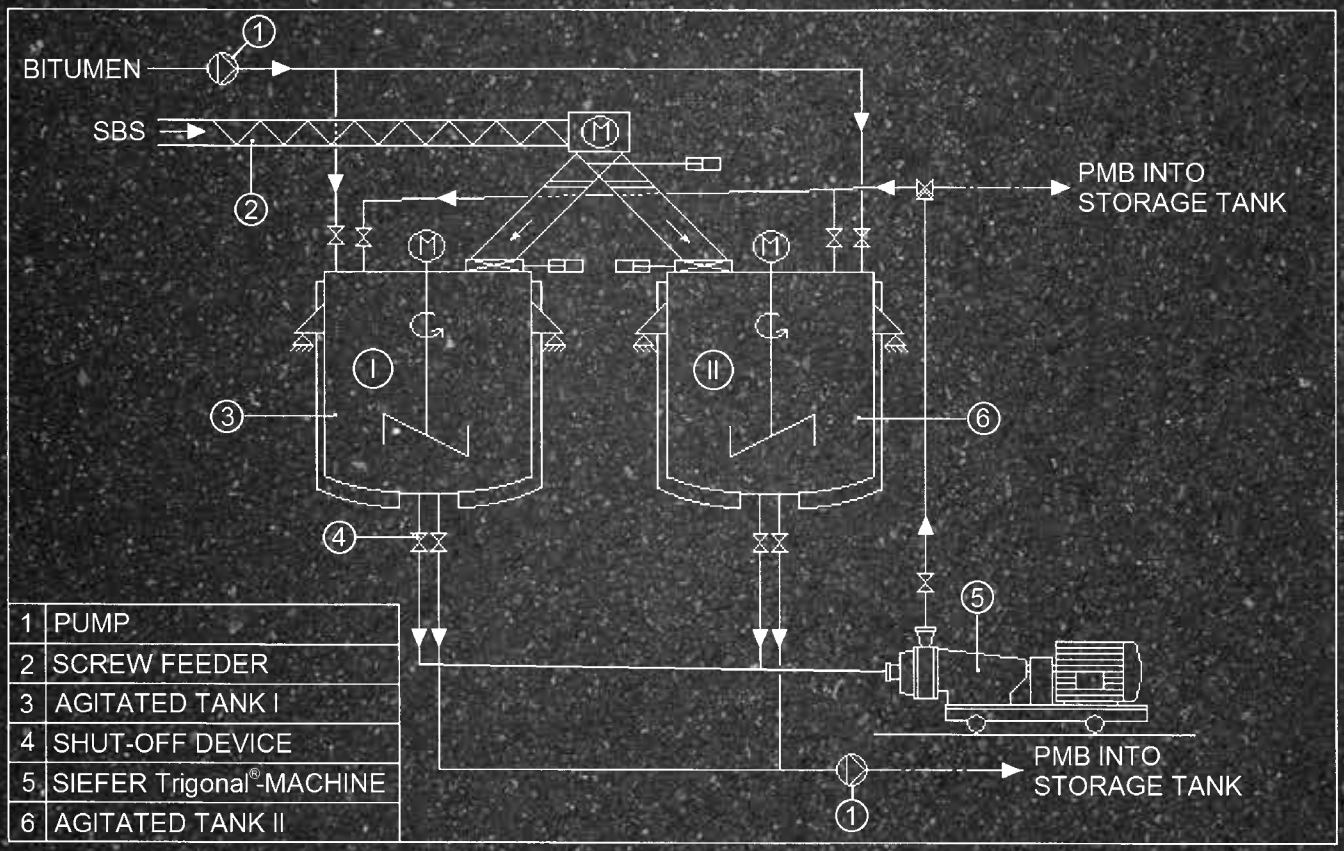
Technical data:	SM–D3	SM–D3/HK
Throughput based on water [m³/h]	20 – 250	20 - 250
Discharge pressure [bar]	8	8
Drive power [kW]	90 – 250	90 - 250
Connections at suction and discharge side DIN/ANSI standard	150 (6¨)	150 (6¨)
Speed min/max [rpm]	1.500 – 2.300	1.500 – 2.300
Max. feed size solid/dry matter [mm]	Ø 100	Ø 100
Dimensions L/W/H [mm]	1.450 x 800 x 835	1.450 x 900 x 835
Weight [kg] (without equipment)	960	980

Features SM-D3:

- Large selection of materials for product contacted parts
- Power transmission via coupling or V-belt
- Discharge connection in various directions
- Large selection of available shaft seals in cartridge design
- Flange connections either DIN or ANSI standard
- Binary entrance for merging different partial flows
- ATEX version
- Excellent accessibility to and replaceability of the cutting tool
- Tool system can be exchanged and REGROUND very quickly
- Very high availability, service life and durability of the machine







The core of each plant for the production of polymer modified bitumen (PmB): Our Trigonal®-Machines specifically tailored to the individual requirements of our customers. Thanks to their extremely high shear forces and turbulent flow, their unique rotor-stator-system ensures that the polymers are mechanically mixed into the bitumen and are evenly distributed. At the same time the considerable size reduction of the individual particles guarantee a smooth mixing process.

Bitumen and Bitumen Emulsion

Modular design principle: Our range of services for the processing of bitumen has been setting new quality standards worldwide for many decades and covers all our customer's needs – from the design of a single machine up to the turnkey plant in cooperation with our partner for plant design & construction.

Our specific passion and competence

For SIEFER the processing of bitumen – especially for road construction the manufacturing of roof sheetings and building protection materials as well as for the recycling of bituminous waste have been of particular significance to us for a long time. Impressive evidence: More than 2,800 Trigonal®-Machines for the modification of bitumen as well as for the manufacturing of traditional and modified bitumen emulsions are up and running!

However, our range of services covers far more than the design and construction of an individual machine: Based upon our long time experience and the versatility of the projects realized for our customers in the bitumen-processing industry, we have become a highly renowned partner in the planning and production of new machines as well as in the optimisation of existing process technologies both on a national as well as on an international level.

Polymer modified bitumen (PmB)

Finished product	Throughput	Machine type
in multiple-pass	in a passage	
1 t/h	5 t/h	SM 180/HK
5 t/h	15 t/h	SM 290/HK
7 t/h	18 t/h	SM-D2/HK
12 t/h	30 t/h	SM-D3/HK

Configurations as stationary or mobile unit, for circulation or single-pass process

Bitumen emulsions

Throughput	Throughput	Machine type
traditional	modified	
6 t/h	4 t/h	SM 180/HK
12 t/h	10 t/h	SM 290/HK
40 t/h	30 t/h	SM-D2/HK

Configurations for batch or inline process, for traditional and modified bitumen emulsions

Industry

From agricultural chemistry to pulp processing: We offer comprehensive competence and a long-time experience – for innovative process engineering solutions and economic and efficient production of products for many industrial sectors.

Perfectly adapted and economic solutions

High flexibility. Well approved. Excellent durability. Up to now, our systems have been used successfully in more than 6,000 processing plants featuring a vast number of modifications. A broad selection of different materials ensures an adaptation with optimised service lives.

For the selection of the suitable rotor-stator system an intensive product evaluation is required: Characteristics such as density, degree of hardness, consistency and composition have to be evaluated. Temperature sensitivity, agglomeration behaviour or surface reactions can also affect on the correct configuration to achieve the desired processing result.

While hard to brittle products can be crushed by impact, pressure and friction, soft and elastic materials can often be reduced only by cutting and shearing effects. If necessary, a specifically adapted silhouette arrangement of the tooth flanks allows a unique cutting effect for the size reduction of elastic media.

Each task is different ...

Our wide range of professional experience covers many branches of industry involving the most varied tasks and applications. And all the time new ones are added. With innovative products as well as with the related in-house developed production processes we have grown, have provided both benefits and technological progress for our customers and have all intentions to keep doing so in the future.

The intensive exchange with renowned companies from all sorts of industrial sectors allows us to continuously optimise our products adapting them to the state-of-the-art requirements.

Typical applications in our customers‘ branches of industry





Agricultural chemistry

Moistening and dispersing of plant protection granulates in water • Production of liquid fertilizers • Crushing of active agents and additives in an aqueous suspension • Deagglomeration of fungicides • Production of crop protection agents ...

Biotechnology

Mechanical fiberising of grass into different fractions for the extraction of cell contents and proteins • Processing of sea weed • Starch extraction from wheat semolina and wheat bran • Size reduction and homogenisation of coal in oil for coal gasification ...

Bitumen

Production of PmB • Production of traditional and polymer-modified bitumen emulsions • Deagglomeration of carbonised particles before the coating pan • Production of building protection materials • Production of anti-corrosive materials and agents ...

Chemistry

Dissolving of additives in liquids • Reducing the viscosity of a dispersion-adhesive • Production of hot glues • Grinding of plastic granulates • Breaking of crystals in liquids • Size reduction of fibrous plastics in a solvent-water-suspension ...

Paints and Coatings

Size reduction and dispersing of titanium-dioxide pigments • Dispersing of soot in water • Size reduction of pigments with resin particles in water • Deagglomeration of blue pigments in water and glycol • Processing of soluble pigments ...

Pet food

Production of sauces from carcasses • Processing of meat emulsions • Emulsification of meat mixes and cereals in water • Size reduction, mixing, homogenising and coagulating of minced meat for wet and dry pet food ...

Cosmetics and pharmaceutics

Emulsification of ethereal oil-water suspensions • Dispersing of calcium carbonate with simultaneous deagglomeration • Production of birth control pill extracts • Processing of seaweed ...

Food

Production of dressings, sauces and pastes • Processing of jam starch • Production of soybean milk • Size reduction of syobeans in water • Production of spice blends • Production of fruit juices ...

Paper

Deflaking of pulp • Preparation of coating compounds • Deflaking of paper scrap • Dispersing of titanium-dioxide with sodium-chloride and resin in water • Deflaking of bleached cotton linters • Fiberising of various raw materials ...

Recycling

Processing of bituminous roof sheetings • Recovery of laminated plastics • Recycling of various sludges • Size reduction of bitumen-laminated carpet residues • Grinding of pre-comminuted big bags in hot medium • Recycling of automotive rubber tyres in bitumen ...

Consultation and Service

100 % focussed on the customer: Our all-in service offers everything you need to achieve maximum productivity and to minimise operating costs – Technical support, Maintenance and Repair as well as Training and Spare parts supply.

Preserving value and function

SIEFER is your reliable partner at your side during the entire product lifecycle of your Trigonal®-Machine.

We offer a full range of services for the entire life span of your Trigonal®-Machine to help you to maximise productivity and to minimise operating costs.

“Technology that benefits our customers”:
At SIEFER, this is defined not only by technical features and high quality expectations. Equally important are after-sales offers and a first-class support. Our consulting service is competent and comprehensive. What we focus on are the processes at hand, an integrated system approach and above all economic efficiency. That's why we support our customers with a comprehensive range of services – from process consulting via start up to maintenance and provision of spare parts.

Our aim is to provide exactly the service you need.
We advise – you decide!

Service catalogue

Our services at a glance:

- Technical support
- Maintenance and repair
- Training of operating and maintenance staff
- Spare parts supply

A team of experienced technicians and engineers is available at any time to answer your questions all around our products and their integration into your processes and plants.

In our well-equipped R&D laboratory, we carry out tests and experiments together with our customers helping them to develop and test new products.

Original spare parts - fast delivery included

To be on the safe side! By using original SIEFER spare parts you choose technical safety and econnomic efficiency.

Your benefits:

- Components are matched to your specific machine 100%
- Full manufacturer's warranty
- Benefiting from ongoing product developments
- Spare parts often available from stock

Downtime is expensive! SIEFER deals with each spare part request right away – either by phone or by email – and makes sure the delievery is made as quickly as possible. Upon customer request express delivery is available worldwide.

As we have all important parts and components for our current as well as for our older products on stock, we are able to guarantee an optimum spare part supply for the entire life-cycle of your machine. Comprehensive consulting with replacement part recommendation and offers complete our service.

About us

Tradition, flexibility, and innovation: Independent value-oriented actions with a high in-house production depth and local production allow us to fully live up to our quality expectations with regards to social responsibility at any time.


Success based on experience and know-how

Well known for durable products: Our technical know-how and our excellent craftsmanship grant the long-term operational and functional safety of our products. Best proof: A couple of our machines have already been up and running reliably for more than 40 years!

Apart from this for many decades SIEFER has been a synonym for:

- Leading edge thanks to individual technical solutions
- Innovation-driven focus on core competencies combind with a cooperative consulting approach
- Uncompromisingly entrepreneurial and commercially correct acting together with a high social responsibility

Competences concentrated at one place

Even in times of outsourcing, lean production and production site relocations to foreign countries, we believe in the benefits of being independent from external suppliers and are relying on our wide production know-how right at our German location. To fully implement our quality standards, our products are designed and manufactured completely in-house.
In specialised areas beyond our core competencies, we closely cooperate with carefully selected and proven partners. This way we ensure our personal proximity to the customer for each and every task and answer for responsibility – today, tomorrow and in the future.

Our principle – your benefit

Looking ahead we shall maintain our independence for the consistent implementation of all principles and thus self-determine our operative and strategic targets – such as social responsibility, protection of jobs, and a stable company value in the long term.

What is true for our head office in Germany, of course also influences on our international business.

By consistently using the Internet, we are constantly improving our service and consultation quality making our cooperation with the customers more independent of time and distance. Via the Net you may call a detailed inquiry form to describe your task at hand or your request in a more detailed way to us. This way we are able to respond to your issue directly.

Please do not miss to visit SIEFER on their homepage to learn more about the latest news and information regarding our values, performances and services.
www.siefer-trigonal.com

We are there for you

Trigonal®-Machines make Wilhelm Siefer GmbH & Co. KG one of the worldwide leading companies for dispersing, homogenising, mixing and size reduction technologies looking back on decades of professional experience.

„High Shear XXL“: Our versatile machines are used for those tasks and applications where conventional systems meet their limits.

We are the proven partners of many industrial sectors on both national and international level – no matter whether perfectly matched individual machines or more complex projects – in cooperation with selected partners.

Get to know us and challenge us! We will find the solution for any kind of task in the wet processing technology sector.

Wilhelm Siefer GmbH & Co. KG
Bahnhofstr. 114
42551 Velbert – Germany
Tel.: +49.2051.9575-0
Fax: +49.2051.9575-16
Email: office@siefer-trigonal.de

www.siefer-trigonal.de • www.siefer-trigonal.com

Managing Directors: Manfred Siefer, Gerd Birkenkamp, Britta Göbel-Schäffer
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