

습식분쇄기

방수시트 · 개질아스팔트용 Mill

TREM



저희 트렘무역상사는

High-quality

세계적인 업체의 고품질의 제품만을 엄선하여 국내에 공급합니다.

Customer satisfaction

다양한 해외 업체들로 부터 고객 한분 한분이 만족할 수 있게 고객의 요구에 맞춰 제품을 공급합니다.

Diverse customer base

국내외 중소기업뿐 아니라 대기업의 고객층을 확보하고 있습니다.

global leader

국내 기업의 수출 활동에 도움이 되기 위해 적극적으로 앞장서서 세계 시장 개척을 추진하고 있습니다.

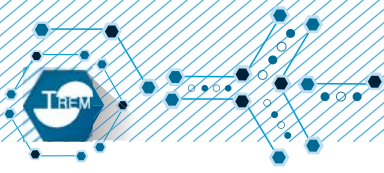
국내 산업 발전에 도움이 될 수 있는 기업으로 성장할 수 있도록 더욱 노력하겠습니다.
많은 관심과 응원 부탁드립니다.





- 04 I. The TRIGONAL[®] – Machine – 작동 원리
- 05 II. 적용 분야
- 06 III. 구조의 특성
- 08 IV. Technical Data
- 09 V. 관련산업 분야
- 11 VI. 설치사례
- 15 Production of Polymer Modified Bitumen
- 19 Siefer Trigonal[®] – Maschinen

○ www.trem.co.kr



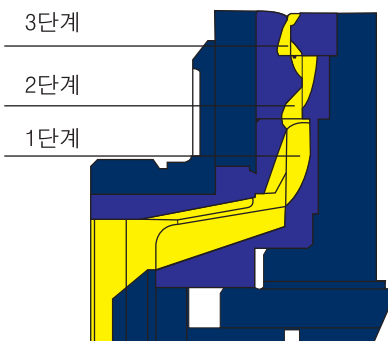
I. The TRIGONAL[®] - Machine - 작동 원리

SIEFER사가 개발, 공급하는 TRIGONAL[®] - machine, 고성능 습식 분쇄 및 펄프 검용기

TRIGONAL[®] - machine은 연속 생산방식으로 작동하며 고주파의 운동 원리에 따라 작동을 한다. 처리할 재료를 고정자와 회전자의 축방향으로 투입하고 원심력으로 분쇄한다.

고정자와 회전자 사이에서 틈새에 가해지는 절단 응력을 이용하여 분쇄한다. 처리의 강도는 어떠한 고정자와 회전자를 선택하느냐 에 따라 결정된다.

현재, 420종 이상의 부품조합을 이용할 수 있으며, 그 조합의 결정은 투입되는 재료와 원하는 최종제품의 품질에 따라 개별적으로 맞춰진다.



분쇄 부위는 단계적 구조로 구성되어 있으며, 네개의 동축 조작링은 서로 연결되어 있다. 고정자와 회전자는 각기 다른 깊이의 홈이 방사상 구조로 연결되어 있어 상호 교차 개방되는 방식이다. 그 결과 재료는 기울어져 흐르고, 고정자와 회전자의 틈새에 의하여 강제 이송된다.

재료는 고정자와 회전자 시스템 사이에 있는 이들의 측면 사이에서 강하게 압축이 된다. 1/1000초 뒤에 재료는 다음 단계의 더 큰 회전자 링을 만나게 되므로 격실이 열리게 되어, 갑자기 응력을 풀게 된 다음 중심축으로 부터 먼 다음의 격실로 이송하게 된다.

기계안에서 제품의 체재시간은 고정자와 회전자 형상의 배열을 조절하여 제어할 수 있다 . 고정자와 회전자의 회전 속도는 25 ~ 54 m/s이므로 적용방식에 따라 이 과정은 최고 초당 5억회 반복하게 된다.

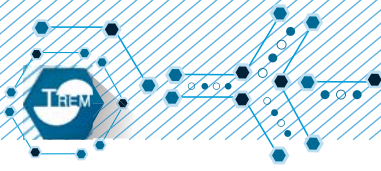


SIEFER TRIGONAL[®] - machines은 다른 방식의 재료처리가 동시에 일어나기 때문에 효율성이 높다.

- 처리되어지고 있는 물질의 분쇄는 수많은 개별 물체의 흐름으로 이루어진다.
- 제품이 통과할 때 흡과 챔버의 단면적의 감소는 조각링이 다음 단계 보다 더 미세한 단계로 넘어가도록 한다.
- 챔버에서의 물질은 다음 단계 보다 큰 링을 만나서 통과하게 되면 가속이 되고, 통과하지 못하면 감속이 된다. 급격한 가압과 감압의 변화로 가속과 감속이 이루어지고 미세한 기공을 형성한다.
- 챔버 내에서의 소용돌이로 인하여 내부 마찰력이 제품에 전달된다.

II. 적용분야

Homogenizing	●	균질화
Dispersing	●	분산
Emulsifying	●	유화
Deflaking	●	탈피
Mixing	●	혼합
Gas injection	●	가스 주입
Reaction acceleration	●	반응가속
Dissolving	●	용해
Neutralizing	●	중화



Polymerizing	●	중합
Rearranging	●	재배열
Continuous boiling subject to shearing stress	●	전단응력을 주기위한 지속가열
Disintegrating Mixing	●	분해
Pulp Disintegration	●	펄프분해
Defibrating Dissolving	●	완전분쇄
Extracting	●	추출
Recycling	●	재활용

III. 구조의 특성

● 체계적인 구조설계

여러 기능군들을 교환할 수 있는 독창적인 디자인을 갖고 있다.

- 회전자와 고정자를 조합하면 420종 이상의 시스템을 구현할 수 있다.
- 베어링 시스템은 다른 부품들과 독립되어 있으며, 고도로 정숙한 가동을 위하여 정밀가공과 연속적인 가혹한 운전을 고려하여 설계, 제작하였다.
- Shaft seals
- 직간접 냉각수 탱크
- Single mechanical seal
- Double mechanical seal – relieved
- Double mechanical seal with pumping screw and thermosiphon vessel
- Other shaft seals upon request, e.g., labyrinth or radial seals

● 재 질

- 연마도구
- 부식 저항력이 있는 철강, CrMoCo, 약 58시간 연속 경화, 재연마 가능
- 공구강, 약 64시간 연속 경화, 재연마 가능

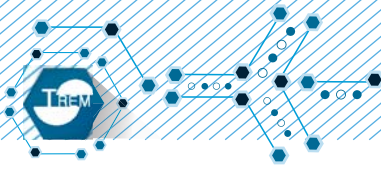
- 크롬 니켈강 1.4571, 1.4539 등, 공차관리에 적합, 재연마 가능
- Hastelloy C, 공차관리에 적합, 재연마 가능
- Tungsten carbide, 재연마 가능
- 샤프트씰링 하우징을 포함하여 생산품과 접촉하는 특수한 기계부품
- Chrome nickel steel 1.4571, 1.4539, Hastelloy C 등
- Heating and cooling channels
- Chrome nickel steel 1.4571, steel
- 안정적 밀봉
- Viton, Buna, EPDM, PTFE, Kalrez or other conventional grades
- 샤프트 밀봉
- 도료 제조업체에서 사용되는 모든 물질

● 구동장치

- motor, 직접 구동방식
- motor, V-belt 구동방식
- frequency controlled motor (RPM 가변방식)

● 선택사양

- 가열자켓 (hot media: steam, oil, water)
- 냉각자켓 (cold media: water, brine, liquid nitrogen)
- SM 180 모델과 SM 290모델(구동력과 속도를 제한적으로 고려)을 수직으로 설치
- 최적의 분포, 균질 및 가스반응을 위하여 제품의 부분 또는 전체를 고정자와 회전자 사이의 간격에 직접 투입



IV. Technical Data

○ 표준모델 ◎ 가능한 모델	모델 (생산용)				Lab machine 모델(실험용)
	SM 180	SM 290	SM-D2	SM-D3	SM 102-28
출력 [m ³ / h]	4 to 28	6 to 120	15 to 150	20 to 250	0,006 to 1
펌프 압력 [bar]*	6	6	8	8	2
전기 출력 [KW]	7,5 to 45	15 to 110	15 to 140	90 to 240	3 to 11
속도 [최대/최소] [1분]	5400/3000	3800/1500	3800/1500	1800/1500	13,200/4000
파워커플링의 트랜스미션	◎	○	○	○	○
파워 V 벨트의 트랜스미션	○	◎	◎	◎	
규격 [높이/폭/길이]	420/420/980	480/500/1000	560/600/1200	650/800/1450	250/230/510
중량 [Kg, 약세사리 제외]	160	240	530	980	45
투입구 연결	65 (2,5")	100 (4")	100 (4")	150 (6")	25 (1")
배출구 연결	65 (2,5")	100 (4")	100 (4")	150 (6")	25 (1")
최대 허용 압력 [bar]+	16	16	16	16	16
최대 허용 온도 [° C]+	200	200	200	200	200
최대 속도 (RPM) +	5400	3600	3600	1900	13,200
가열/냉각	◎	◎	◎	◎	◎
최대 허용 압력 [bar]	6	6	6	6	6
최대 허용 온도 [° C]**	200	200	200	200	200
투입 물질의 최대 크기 [mm]	Ø 30	Ø 50	Ø 50	Ø 100	Ø 5
건조물의 최대 비율 [%]	50	50	85	85	50
최대 소음 [dB(A)]***	65	63	65	65	62
분쇄 간격 조절	mech, Counter	mech, Counter	mech, Counter	mech, Counter	mech, Counter
분쇄 간격 표시	Scale	Scale	Scale	Scale	Scale
재료의 직접투입 [회전자와 고정자 사이]	◎	◎	◎	◎	◎
현장에서 온도 측정	○	○	○	○	○
* : 평균	** : 250 ° C 까지 가능, + : 운전중			*** : 1 m 거리에서의 소음	

V. 관련 산업 분야

◆ Asphalt and bitumen industry 아스팔트와 역청 산업

- Polymer bitumen 중합체 역청
- Elastomer bitumen 일레스토머 역청
- Bitumen emulsions 역청 에멀션
- Recycling system for recovery of residualbituminous materials 잔여 역청 재활용 시스템

◆ Chemical industry 화학공업

- Adhesives 접착제
- Pastes, polishes, glazes 풀, 광택제, 유약
- Paints 페인트
- Latex paints 라텍스 페인트
- Lubricating greases 윤활 그리스
- Colors for office chemistry 화학 안료
- Liquid fertilizers 액체비료
- Pesticides, herbicides, fungicides 살충제, 제초제, 살균제

◆ Meat and fish industry 육류와 수산물 가공 산업

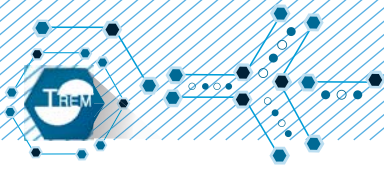
- Meat pastes 분쇄육
- Fish pastes 어묵

◆ Animal food industry 동물 사료 산업

- Obtaining protein and fat from by-products of slaughtering 도축 부산물의 단백질, 지방 추출
- Animal and food mixtures 동물·음식물 혼합
- Meat with bone 뼈있는 육류 가공
- Poultry slaughter wastes 가금류 폐기물
- Gelatins (wastes, skins, cartilage) 젤라틴(폐기물, 껍질, 연골)

◆ Cosmetics industry 화장품 산업

- Lotions, creams, gels 로션, 크림, 젤
- Washing emulsions 세척용 유화제
- Lipstick masses 립스틱 공정
- Sun protection preparations 자외선 차단제
- Toothpastes 치약
- Detergents 세제



● Paper industry 제지 산업

- Pre-, fine- and ultrafine deflaking 전처리-, 미세-, 초미세 분쇄
- Deflaking of trash and rejected material 불량품과 쓰레기의 분쇄
- Coating emulsions made of wax, tall oil resin, enamel 왁스, 털유 레진, 에나멜로 생산된 코팅에멀전
- Recycling system for recovery of residual bituminous materials 잔여 역청 재활용 시스템
- Ferrous oxide 산화철 • Pasteboard, cardboard 판지 (마분지) • Wood 목재
- Kaolin 카오린 • Pulp 펄프 • Rejected cellular material 섬유질 불량품 • Waste paper 폐종이
- Cotton (short + long fibers) 면(단섬유, 장섬유) • Brush-on colors 채색용 색상

● Fruit and vegetable industry 과일과 야채 산업

- Nectars 넥타 • Cloudy and pure fruit juices 과일 주스 • Vegetable juices 야채 주스
- Fruit concentrates 과일 농축

● Delicacies, baby food and ready-to-serve meals 음식, 이유식과 즉석식

- Sauces, Dressings 소스, 드레싱 • Ketchup, Mayonnaise, Mustard 케첩, 마요네즈, 겨자

● Mineral oil industry 광유 산업

- Oil and grease products 유제품 • Oil processing 유가공
- Oil modification 변성유 • Oil emulsifying 오일 에멀전화

● Pharmaceutical industry 의약 산업

- Salves 연고 • Paints 페인트
- Pharmaceutical cosmetics 제약 화장품
- Suppository masses 좌약 질량

● Candy industry 제과 산업

- Syrups 시럽 • Cocoa 코코아 • Chocolate masses 초콜릿

VI. 설치사례

1. 아스팔트 재생공정

- Compact Hot Recycling System

루핑, 아스팔트 싱글업체의 생산과정에서 나온 부산물과 불량품을 회수하여 재활용하기 위한 새로운 소형 다기능 고온 재활용 시스템

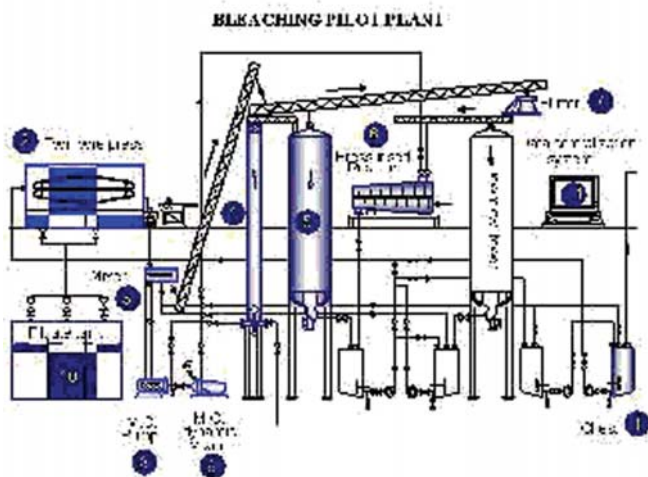
- Compact Hot Recycling System(CHR)

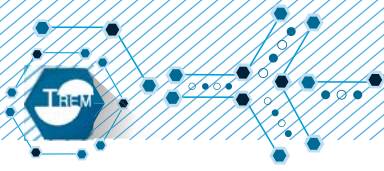
고형의 역청 부산물이 생산공정으로 투입되려면 펌핑할 수 있는 액상의 상태로 변환하여야만 재활용할 수 있다. 이 때문에 역청 부산물은 공급장치를 타고 파쇄기로 이송하여 1차 분쇄를 한다.

파쇄된 역청 물질과 고체는 수직 공급장치 스크루를 통하여 특수 교반기가 달린 믹서에 전달된다. 믹서는 SIEFER TRIGONAL[®] - machines 에서 잘게 분쇄되고 균질하게 되도록 교반을 한다. 재료는 원하는 입자크기에 이를 때 까지 SIEFER TRIGONAL[®] - machines을 반복해서 통과하여 처리를 한다. 처리된 물질이 루핑 생산 공정으로 이송되면 모든 공정이 마무리된다.

2. 제지산업 표백공정

- Bleaching Pilot Plant



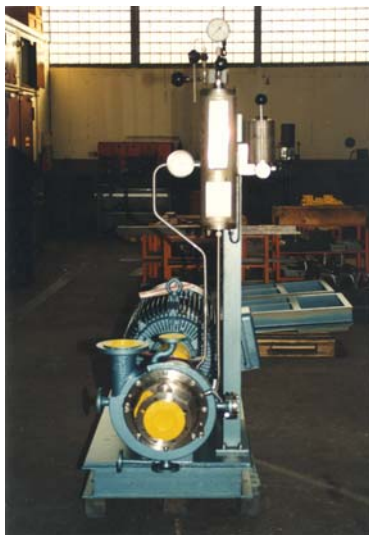
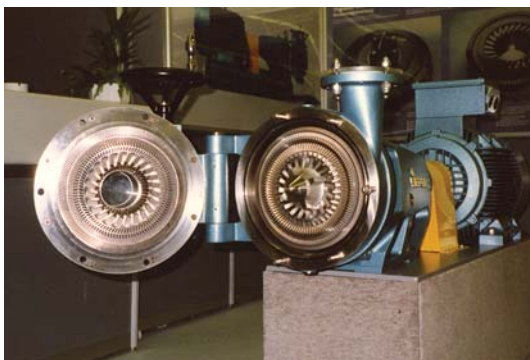


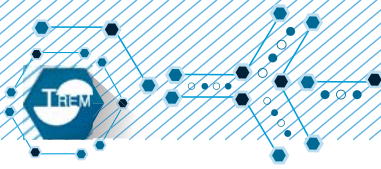
공정해설

1. Chest : Capacity 4 m³
2. Twin Wire press
3. Mixer (Single shaft)
4. Upflow tower : Capacity 0.3 m³
5. Downflow tower : Capacity 1.8 m³
6. Reactor : Double shaft mixing, varying speed (20 to 130 rpm) maximum pressure 6 bar, capacity 1.7 m³
7. Fluffe "CONDUX", varying speed 1450 to 3000 rpm
8. Medium consistency pump (Maximum 12%)
9. High shear mixer "SIEFER" Trigonal 3000 rpm
10. Effluent tank : 10 m³
11. Data centralization system (pH, T°, C, Pbar, [O₃], gaz flow, pulp flow....)

3. 실제 설치 사진







Production of Polymer Modified Bitumen (PmB)

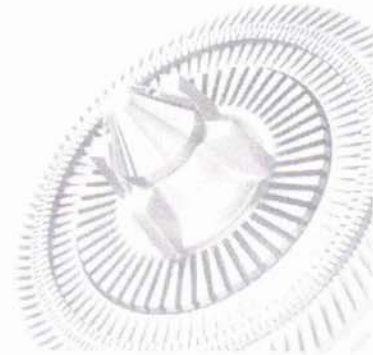
Since establishment in 1947, Siefer develops and manufactures Trigonal® - Machines and Equipment for wet processing.

Trigonal® - Machines operate on the flow method, functioning in accordance with the principle of cinematic high frequency technology. The product to be processed enters the center of a rotor-stator-system axially and is centrifugally accelerated. The effect on the product is the result of

- shearing stress,
- friction and
- resiliencies in the gap between rotor and stator.

The intensity of processing is decisively affected by the

- selected rotor-stator-design,
- the gap breadth and
- the flow rate.



The existing diversity of different rotor-stator-systems (currently more than 430) makes it possible to equip Trigonal® - Machines universal, depending on task and intended purpose. Because of processed product or demand modification, a change of rotor and stator can be made supplementary. Even single components of a rotor-stator-system can be varied.

To find the ideal set-up for our customers application, Siefer is in possession of a pilot plant equipped with all types of Trigonal® - Machines. By making tests with original processed products, statements about performance and quality can be made.

Over decades Siefer has strengthened its substantial position in the international market because Siefer Trigonal® - Machines and Equipment stand for the ultimate in quality, both in processing of the customer's product and in machine performance.

Indispensable are Trigonal® - Machines in the Bitumen Industry. Since almost 30 years Siefer has been offering a wide range of solutions for the production of Polymer Modified Bitumen and Bitumen Emulsions. Its dedication to excellence has resulted in

**more than 2.900 Trigonal® - Machines for Polymer Modified Bitumen
as well as for (Unmodified and Modified) Bitumen Emulsions**

that have been put into service all over the world.



For reaching the best quality of **modified bitumen** – in consideration of the chemical reaction of bitumen and thermoplastic rubber – the blending process should consist of three stages:

- 1) dispersion,
- 2) disintegration and
- 3) final swelling and incorporation.

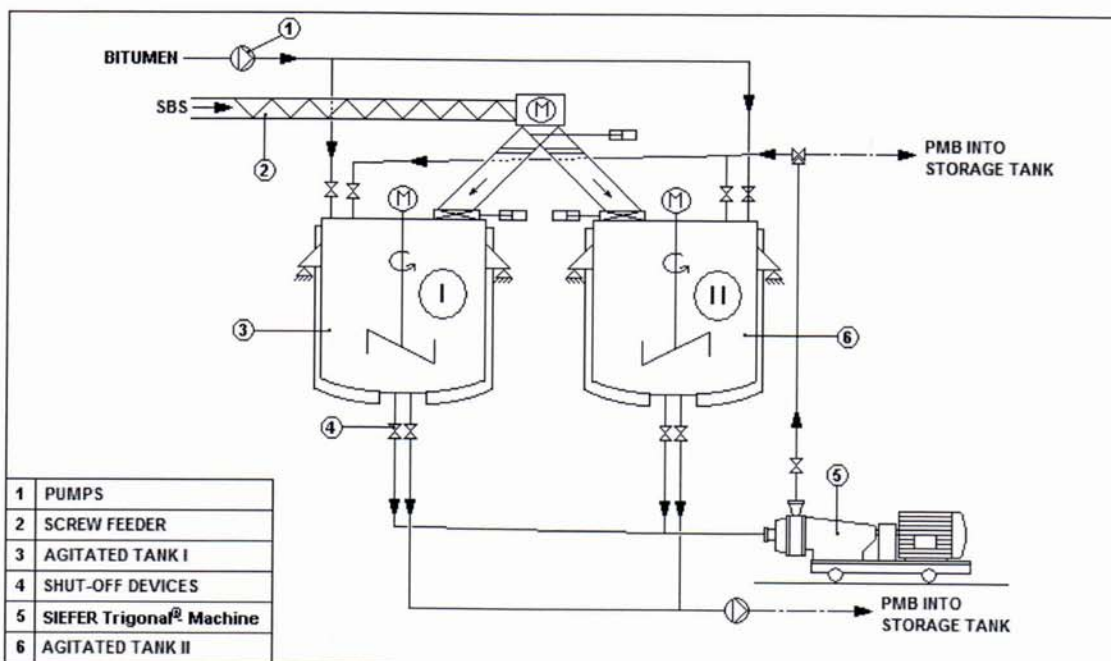
In the first stage the hot bitumen is pumped at the required temperature (usually around 185 °C) into an agitated tank. The thermoplastic rubber is added and stirred for an equal distribution. Following, the mix flows to the Trigonal® - Machine by gravity.

The mix is passed through the Trigonal® - Machine to physically reduce the thermoplastic rubber particles in size by mechanical shear, accompanied by a significant input of heat energy. This provides rapid and efficient disintegration of the thermoplastic rubber particles in the bitumen.

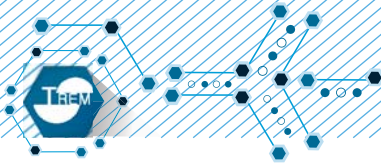
The final swelling and incorporation of the thermoplastic rubber with the bitumen is carried out under low shear stirring in a storage tank, maintaining the blend at about 185 °C. The required time for this process depends on the efficiency of the previous stages and on the nature of the bitumen.

The blending-process referring to a circulation-mixing-process

The world’s most commonly used process for blending bitumen and thermoplastic rubber is the circulation-mixing-process because it is the most effective system providing a great flexibility in choice of materials and operation.



Layout 1: circulation-mixing-process (double-tank-circulation-system)



The operation involves two agitated tanks (double-tank-circulation-system), as shown in Layout 1. If the tanks are considered as (I) and (II), the sequence of operations is as follows:

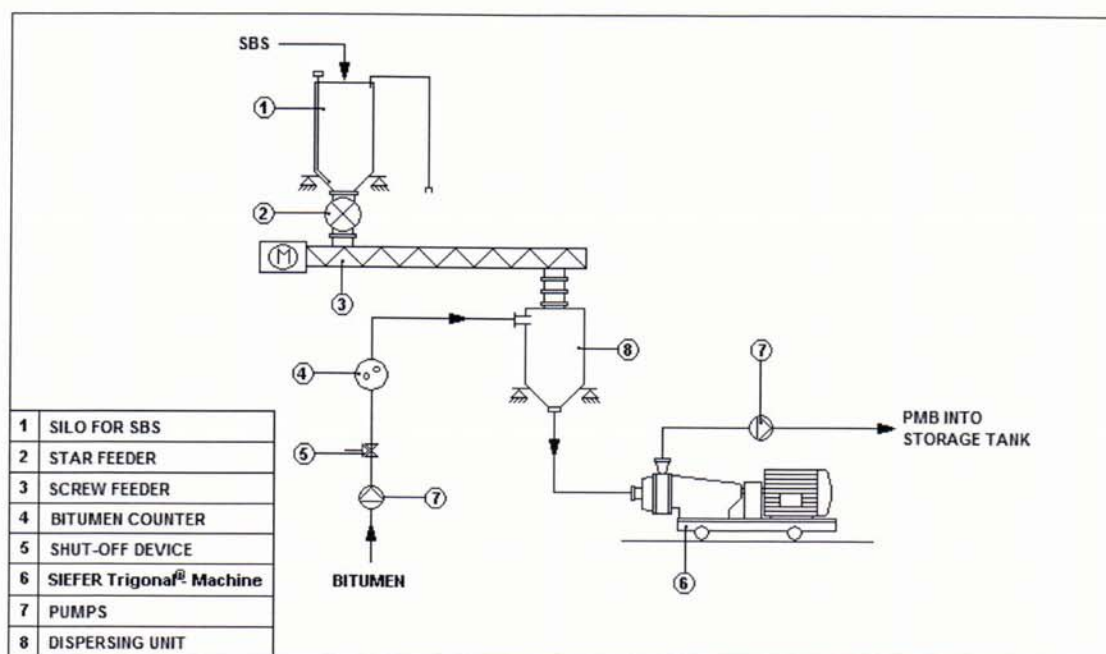
(I) is loaded with hot bitumen and the measured thermoplastic rubber is added. When the thermoplastic rubber is pre-blended with the bitumen, the content of (I) is transferred through the Trigonal[®] - Machine into (II). A special circulation-pass-reduction-tool insures a quick milling of the thermoplastic rubber. When all of the material is discharged into (II), the flow pattern is altered and the circulation through (II) and the Trigonal[®] - Machine takes place.

Meanwhile, (I) is refilled with bitumen and thermoplastic rubber. While the homogenized blend of (II) is being pumped into a storage tank by the Trigonal[®] - Machine or a pump for final swelling and incorporation, the Trigonal[®] - Machine starts to circulate with content of (I). If (II) is empty, the product in (I) is pumped into (II) by the Trigonal[®] - Machine or a pump and the process continues with refilling of (I).

A single-tank-circulation-system with the blend simply circulating through the Trigonal[®] - Machine is also possible. This system can be designed to have the second tank added at a later date if additional production is needed.

The blending-process referring to a single-pass-mixing-process

Due to high flow rates – to point out are applications for the road industry –Trigonal[®] - Machines are also used for single-pass-mixing-processes. In Layout 2 the principle configuration is described.



Layout 2: single-pass-mixing-process



Upon accurate measuring of the thermoplastic rubber and the bitumen, the first contact takes place in a dispersing unit, just in front of the Trigonal[®] - Machine. In a swirl - caused by the geometry of the dispersing unit and the suction pressure of the Trigonal[®] - Machine - the thermoplastic rubber and the bitumen are evenly distributed.

By using a special single-pass-reduction-tool for the Trigonal[®] - Machine, the thermoplastic rubber particles are physically reduced in size by mechanical shear and at the same time blended with the bitumen when passing the Trigonal[®] - Machine once.

For final swelling and incorporation of the thermoplastic rubber with the bitumen, the mix is pumped into a storage tank.

Conclusion

Compared to the single-pass-mixing-process the main advantage of the circulation-mixing-process is the possibility to affect on the quality of the final product by

- modifying the mixing ratio before passing through the Trigonal[®] - Machine and
- varying the circulation time for passing through the Trigonal[®] - Machine for quality reasons or just for the input of heat energy.

To guarantee the reproducibility with the single-pass-mixing-process, it has to be ensured that

- the temperature of the bitumen has always to be the same and
- the quantity value is not changed, e. g. by different geometries of the thermoplastic rubber.

An additional dosing of thermoplastic rubber or bitumen after passing the Trigonal[®] - Machine is not possible with the single-pass-mixing-process.

Of course - dependent on your requirements - Siefer can equip you with all the mentioned machines and equipment or even design an exclusive system for your requirements.

For further details please do not hesitate to contact us.



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).

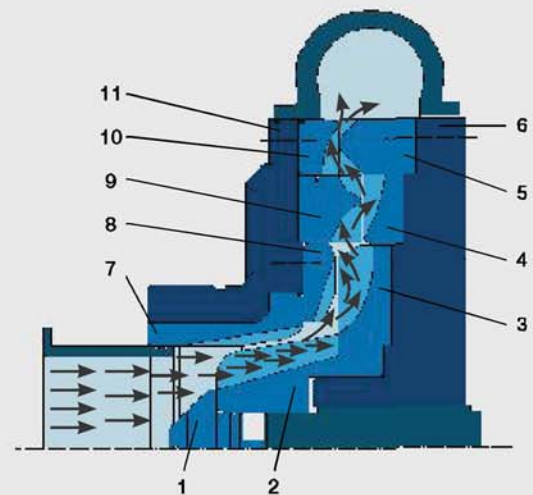


Always the best adaptation

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.

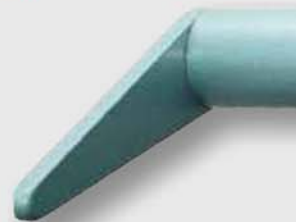
For the selection of the suitable rotor-stator system an intensive product evaluation is required: Characteristics such as density, degree of hardness, consistency and composition have to be evaluated. Temperature sensitivity, agglomeration behaviour or surface reactions can also affect on the correct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

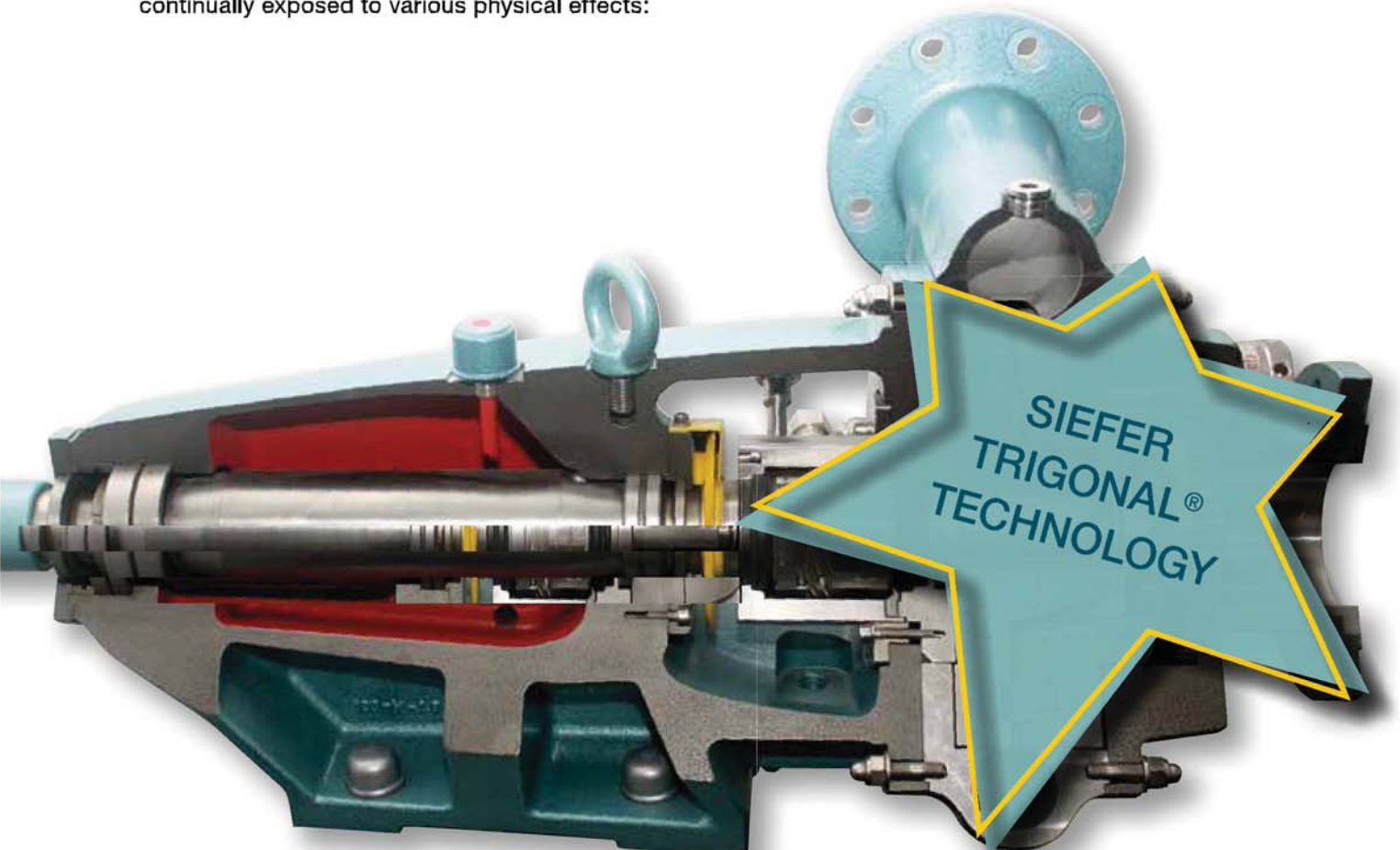
The unique operating principle of our systems

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.

<i>Trigonal</i> ®-Machines	Production machine				Laboratory machine
	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





SIEFER
TRIGONAL

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 eliminates 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 & pharmaceuticals,
food and paper industry



(with heating/cooling jacket)

Technical data:	SM 180	SM 180/HK
Throughput based on water [m ³ /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 & pharmaceuticals,
food, paper & recycling industry



(with heating/cooling jacket)

Technical data:	SM 290	SM 290/HK
Throughput based on water [m ³ /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

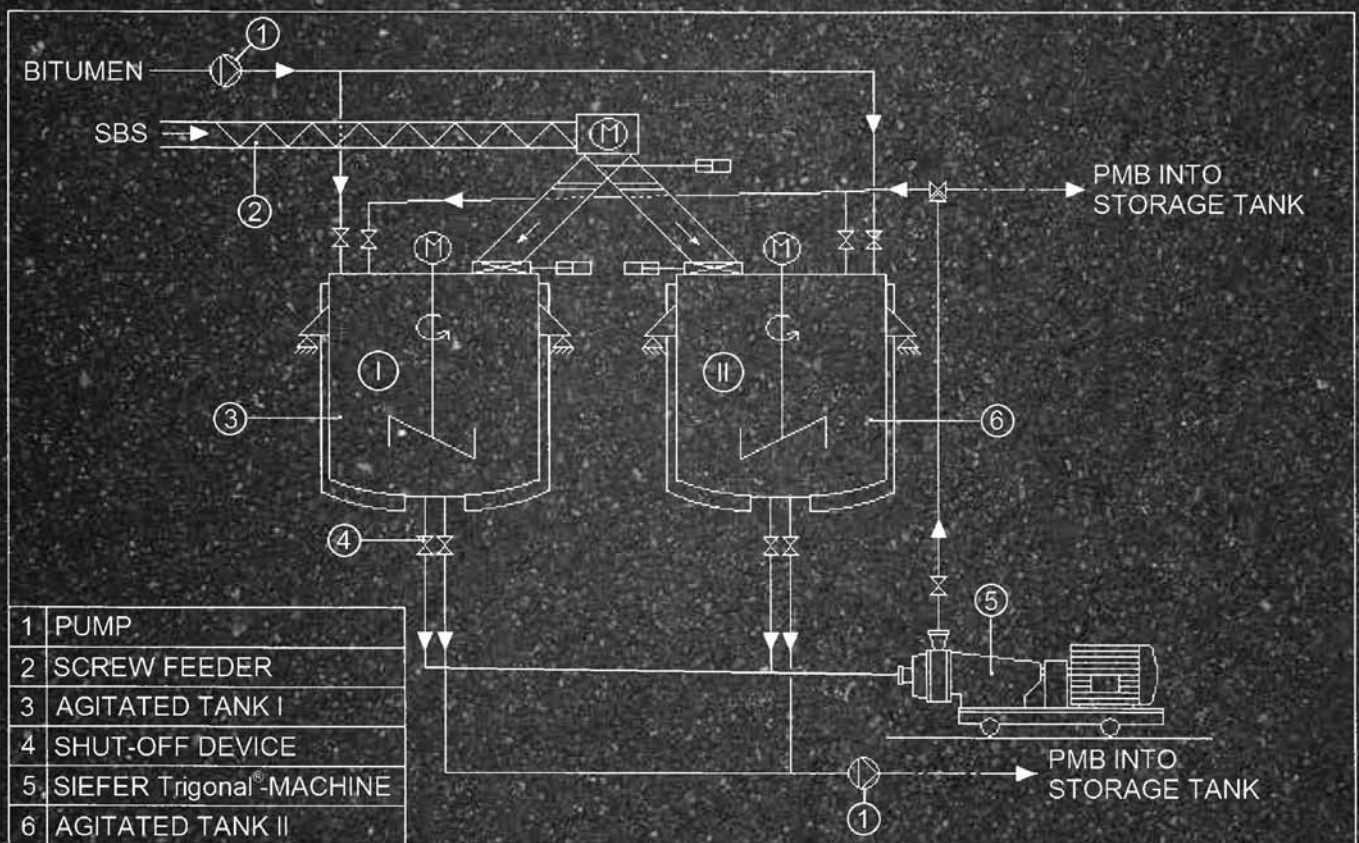


(with heating/cooling jacket)

Technical data:	SM-D3	SM-D3/HK
Throughput based on water [m ³ /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 pharmaceuticals

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 soybeans 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 economic 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 delivery 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 combined 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
Registered in the Commercial Register of the District Court Wuppertal · Reg. No. HRA 20773


SIEFER
Trigonal® - Maschinen

www.trem.co.kr

TREM

 **트렘貿易商社**
Trem Trading Co

서울시 금천구 가산동 481-10번지 벽산디지털밸리 II 812호
TEL. 02-2113-2351(代) FAX. 02-2113-2355
E-mail. trem@trem.co.kr www.trem.co.kr