

# Process Equipment for the fertilizer industry

Solidification and Cooling Systems







## Solidification & Cooling Systems for the fertilizer industry

The Berndorf Band Group has stood for quality and innovation in the fields of engineering and manufacturing since 1843. We continue to be active in the fertilizer industry and have successfully installed Solidification and Cooling Systems for the processing of sulphur and sulphur-based fertilizers worldwide.

Our expertise extends far beyond the solidification process for sulphur bentonite applications. Berndorf Band Group is your reliable partner for additional upstream and downstream processes including liquid sulphur handling, bentonite and micronutrient mixing, filtering, and downstream material handling and bagging systems.

## Sulphur bentonite solutions

Berndorf Band Group covers equipment for the entire production process - from receipt of molten sulphur, dry powder bentonite clay and micronutrients to solidification including pastilles handling storage, bagging and/or truck/rail loading.

## Engineering and consulting services

The Berndorf Band Group offers a wide range of engineering and consulting services. A team of experts is available to support you in all areas including plant layout design, equipment specifications, and process or technology improvement.



## General introduction: sulphur bentonite

Sulphur is referred to as the fourth major nutrient in agriculture. Sulphur, along with NPK, is an essential component of plant nutrients. It contributes to an increased crop yield by direct plant nutrient value, increased efficiency of other essential plant nutrients and indirect plant value as a soil amendment.

The elemental sulphur characteristics are non-metallic chemical elements, a yellow crystalline solid, insoluble in water, odorless and 99.5% pure.

The bentonite in sulphur bentonite is typically a clay composed of minerals which exhibit a significant amount of plasticity, cohesion, swelling, and shrinkage. These bentonite characteristics enhance the delivery of elemental sulphur and other micronutrients to the plant.

Micronutrients including zinc, boron, copper, manganese, iron, magnesium, and others can be added to meet your specific plant nutrition needs. The addition of micronutrients provides a cost-effective method to maintain proper soil levels.



### Why sulphur bentonite?

Pure elemental sulphur or “soil sulphur” has significantly larger particle sizes and a much slower oxidation rate as compared to sulphur pastilles containing bentonite clay. It requires months to a year or longer for the oxidation process to occur. Bentonite clay upon exposure to water has the capacity to swell up to 15 times its dry volume. Sulphur bentonite contains about 10-15 % clay. When the pastilles are field applied, the clay in the sulphur pastilles absorb soil moisture and swells resulting in the sulphur pastilles fracturing into very small particles.

Sulphur bentonite is “designed” to quickly degrade, disperse, and convert the sulphur to sulphate faster than other form of essential sulphur. These particle sizes can range from 60 to 1,000 microns. Smaller sulphur particles provide greater surface area for bacteria to feed on the sulphur and oxidize it to sulphate.

As particle size decreases, there is a dramatic increase in surface area allowing more bacteria to feed and convert the elemental sulphur to plant available sulphate to enhance plant growth.

Berndorf Band Group Process Equipment offers complete support for the addition of bentonite clay to the sulphur matrix with desired micronutrients to create a mixed homogenized product. Each pastille contains uniform amount of sulphur, clay, and/or micronutrients that can meet customers’ needs.



## Process solidification for the sulphur bentonite industry

For an optimal pastillation process, the molten sulphur product must be continuously fed at 130 °C to 140 °C | 266 °F to 284 °F and metered by a sulphur supply pump directly to a jacketed duplex filter before entering the mixing tank. We recommend placing a jacketed duplex filter with wire mesh baskets in the product feed line before the depositor. The filter will ensure optimal performance of the **BernDrop® AD200** depositor.

When adding the bentonite powder to the liquid sulphur, we suggest using a bulk bag unloader with screw conveyor to meter the powder into the mixing vessel. Once the bentonite has been mixed thoroughly, the mixture is moved to a batch tank before being pumped to the designated Cooling Conveyor.

Afterwards the filtered molten product is transferred to the **BernDrop® AD200** unit at the specified pressure by means of a jacketed pipeline complete with all necessary instrumentation and valves heated by hot steam (or oil). This ensures the product remains in molten form throughout the process.

Each Berndorf Process Equipment System consists of a Steel Belt Cooler equipped with a **BernDrop® AD200** pastillation head which provides uniform size drops deposited on the running steel belt. The rotational speed of the shell is synchronized with the belt speed so that the drops fall on the moving Steel Belt to ensure the pastilles are regular and well-shaped. Solidification of the pastilles formed on the Steel Belt occurs due to heat transfer caused by cooling water being sprayed on the underside of the Steel Belt. This is a dry process, the cooling water never encounters the sulphur product.

Each **BernDrop® AD200** is provided with a safety covered hood with doors for inspection and maintenance. In addition to the **BernDrop®** hood, the first cooling zone within the Cooling System is enclosed as well to provide for efficient fume and warm air removal. Sulphur vapors and dust, which are produced by sulphur solidification, are evacuated by an exhaust ventilation system that conveys the air outside the building or working area.

To avoid drops sticking to the Steel Belt, a thin layer of release agent is applied to the running Steel Belt at the feeding terminal before the product is deposited on the Steel Belt. The release agent is prepared and kept mixed in a release agent mixing tank.

Solid sulphur bentonite characteristics	
Shape	Hemispherical
Size	2 - 6 mm
Moisture conten (H <sub>2</sub> O)	Less than 0.5 %
Bulk density	> 1,040 kg/m <sup>3</sup> loose
Angle of repose	In the range of 28° - 30°
Friability performance test	Less than 2 % fines



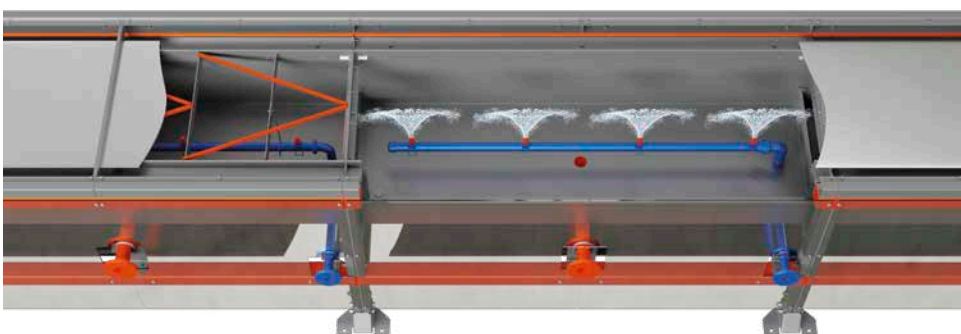


## Cooling Systems

Berndorf Cooling Systems offer a state-of-the-art indirect cooling process, effectively removing product heat and optimizing product solidification. The cooling water is collected in an integrated stainless steel reservoir which can be re-circulated using a pumping system.

The Belt System is kept at the ideal process temperature by means of a well-thought-out Cooling System. Extra cooling zones can be adapted to enable a controllable cooling process. Thanks to the sophisticated construction of the total installation, highly qualified chemical or pharmaceutical products can be produced economically to your exact specifications.

All of our Cooling Systems are equipped with a large orifice, quick disconnect and spray nozzles that spray cooling water in a full square spray pattern designed for maximum cooling efficiency and maintenance-free operation.



## Steel Belts for the sulphur bentonite industry - physical and mechanical properties. Typical values.

Material			NICRO 12.1	NICRO 94
Type			CrNi 17 7	CrNiMoN 22 5 3
Similar material		DIN AISI	1.4310 301	1.4462 -
Tensile strength	at 20 °C at 68 °F	N/mm <sup>2</sup> psi	1,150 166,800	1,400 203,100
0.2 %-offset yield strength	at 20 °C at 68 °F	N/mm <sup>2</sup> psi	950 137,800	1,050 152,300
Hardness		Rockwell HRC Vickers HV 10	37.0 360	36.0 350
Elongation 50 mm   1.97 in		%	18	9.5
Welding factor			0.70	0.65
Fatigue strength under reversed bending stress*	at 20 °C at 68 °F	N/mm <sup>2</sup> psi	480 69,600	450 65,300
Modulus of elasticity	at 20 °C	N/mm <sup>2</sup>	200,000	200,000
	at 200 °C	N/mm <sup>2</sup>	180,000	184,000
	at 68 °F	ksi	29,000	29,000
	at 392 °F	ksi	26,100	26,700
Density		kg/dm <sup>3</sup>	7.90	7.80
		lb/in <sup>3</sup>	0.29	0.28
Mean coefficient of thermal expansion	20-100 °C	10 <sup>-6</sup> m/m°C	16.0	13.3
	20-200 °C	10 <sup>-6</sup> m/m°C	17.0	13.8
	20-300 °C	10 <sup>-6</sup> m/m°C	-	14.2
	20-400 °C	10 <sup>-6</sup> m/m°C	-	-
	68-212 °F	10 <sup>-6</sup> in/in°F	8.9	7.4
	68-392 °F	10 <sup>-6</sup> in/in°F	9.4	7.7
	68-572 °F	10 <sup>-6</sup> in/in°F	-	7.9
68-752 °F	10 <sup>-6</sup> in/in°F	-	-	
Specific heat		J/g°C	0.50	0.50
		BTU/lb°F	0.12	0.12
Thermal conductivity	at 20 °C	W/m°C	15	15
	at 68 °F	BTU/hr ft°F	8.7	8.7
Specific electric resistance	at 20 °C	Ω mm <sup>2</sup> /m	0.73	0.80
	at 68 °F	μΩ in	28.74	31.50
Min. permissible operating temperature		°C	-196	-50
		°F	-321	-58
Max. permissible operating temperature		°C	250	250
		°F	482	482
Tensile strength at max. permissible operating temperature		N/mm <sup>2</sup>	940	1,130
		psi	136,300	163,900
0.2 %-offset yield strength at max. permissible operating temperature		N/mm <sup>2</sup>	770	990
		psi	111,700	143,600

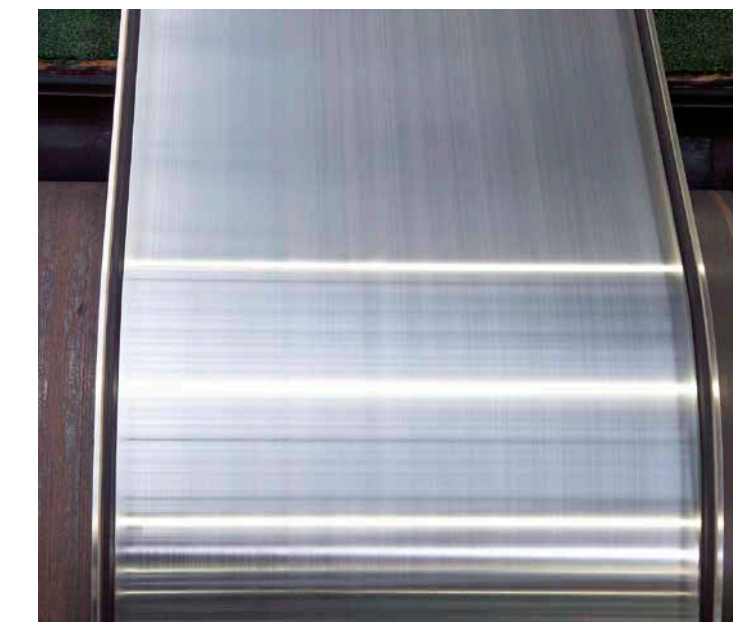
\*50 % of the test specimens withstand 2,000,000 load cycles. If not otherwise specified, the values given apply at room temperature. Subject to change due to technological progress. Errors and omissions excepted. Special materials available upon request.

## Vee-ropes & Product Retaining Strips

Berndorf Band Group guarantees perfect adhesion of Vee-ropes and Product Retaining Strips.

Vee-rope-material	Operating temperatures
Nitrile rubber	-20 °C to +100 °C   -4 °F to +212 °F
Natural rubber	-60 °C to +60 °C   -76 °F to +140 °F
Stainless steel spiral vee-rope	up to the max. permissible operating temperature of the respective belt material

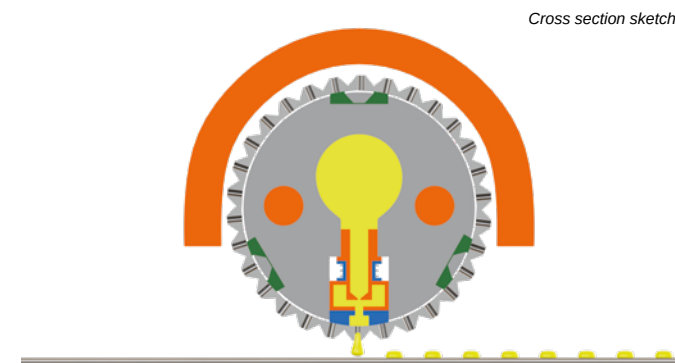
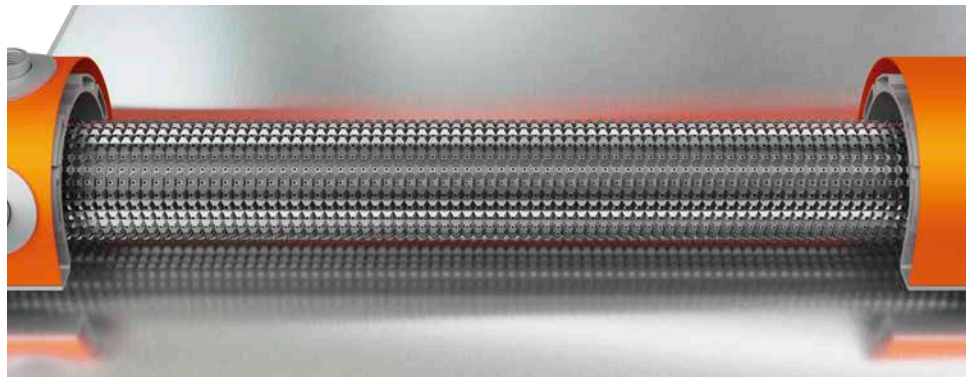
Retaining Strip-material	Operating temperatures
Nitrile rubber	-20 °C to +100 °C   -4 °F to +212 °F
Natural rubber	-60 °C to +60 °C   -76 °F to +140 °F
Silicone rubber	-80 °C to +300 °C   -112 °F to +572 °F



## BernDrop® AD200 - the solution for sulphur bentonite solidification

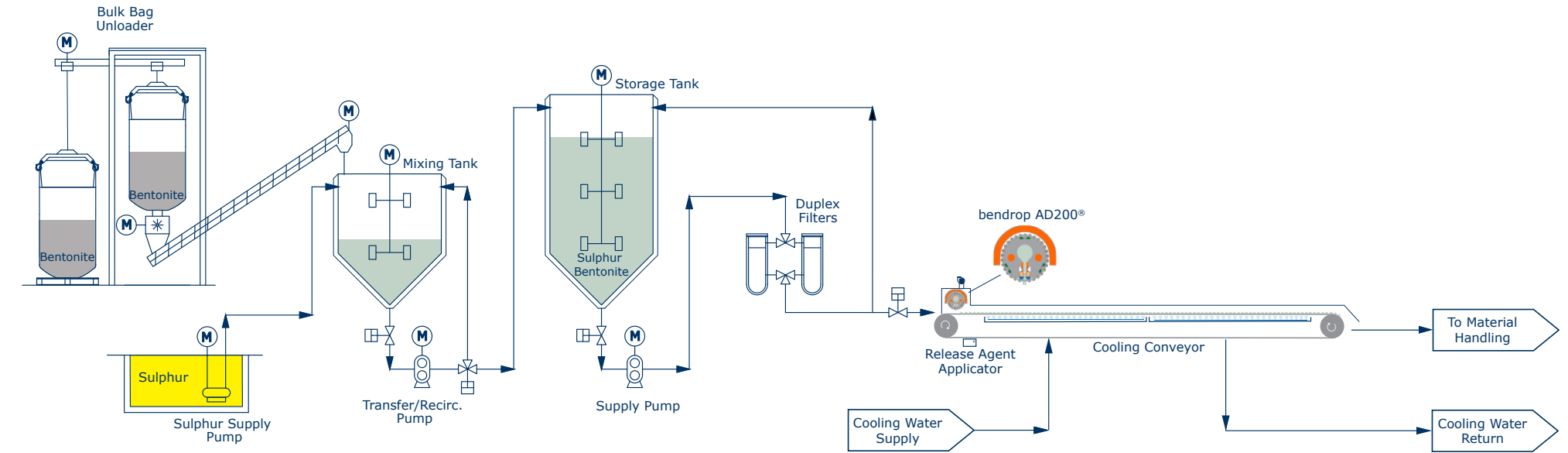
The **BernDrop® AD200** is the world's preferred Feeding Device for the solidification of sulphur and sulphur derivatives. Due to the rotating, special shaped shell design, it can achieve production at higher speeds than the competition. As a result, the **BernDrop® AD200** eliminates the possibility of product deposits on the outer surface of the shell. Any product which remains on the shell surface is forced to the peak to join the next drop.

In addition, this increased surface area causes forced convection, which pre-cools the product and slightly increases viscosity. The result is more capacity and less work for the operator and maintenance staff. The shell design enables a production of sulphur and sulphur derivative pastilles without refeed bar and external seals. Consequently, the **BernDrop® AD200** has the advantage of lower operating costs.



- » Raised shell for optimal pastille quality
- » High production rates
- » Low operating costs
- » Easy accessibility for service and maintenance


## Process scheme for the production of sulphur bentonite pastilles





The application areas for Steel Belts and Belt Systems of Berndorf Band Group are as broad and individual as your requirements. Give us the opportunity to discuss your goals in a personal meeting. Together we will find the right solution for your requirements.

## Our worldwide sales and service network available on [www.berndorfband-group.com](http://www.berndorfband-group.com)

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