



We design, engineer and install specialized fertilizer solidification and handling systems. Our systems are end-to-end, benefitting from our long experience of working in partnership with the chemical industry.

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— ROTOFORM — PASTILLATION — — FOR — — SULPHUR — — BENTONITE —



AGRICULTURAL DEMAND FOR SULPHUR

Sulphur for crops, the 4th nutrient after NPK

Integrated nutrient management ensures that the right fertilizers are applied in the right dose to maximize crop production: a deficiency of any single nutrient will have an adverse impact on growth.

While the importance of nitrogen, phosphates and potassium is widely recognized, sulphur also has an essential role to play. It is needed for chlorophyll formation, aids the activities of certain enzymes and vitamins, and aids efficient nitrogen stabilisation.

And recognition of sulphur's importance comes at a time when many of the world's soils are suffering from a sulphur deficiency, one caused by a combination of three factors:

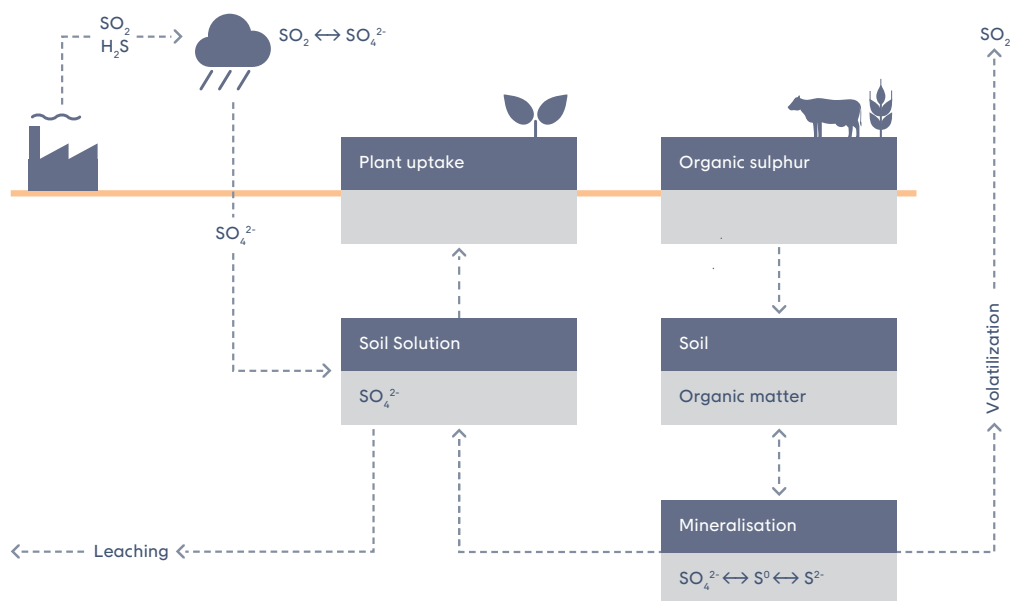
- Continuing use of high-analysis fertilizers at the expense of sulphur-based products, for reasons of economy.
- Increasing crop yields resulting in the removal of greater amounts of sulphur from the soil.
- Reduced volumes of 'free' sulphur emissions from industrial plants (due to tougher environmental legislation worldwide).

Sulphur cycle

As well as being an essential nutrient in its own right, the presence of sulphur actively complements the efficacy of nitrogen. Fertilizers containing both N and S have been shown to increase crop yields by more than 50%. In addition, sulphur has proved extremely useful for lowering soil pH levels in a high alkaline soil.

For all these reasons, global demand for sulphur for agricultural applications is growing rapidly.

The sulphur cycle



Sulphur bentonite – a solution to the challenge of delivering sulphur to the soil



Elemental sulphur, although available in large quantities, is not suitable for use as a nutrient, mainly because it is not soluble in water and therefore takes a long time to be plant available.

One solution to this challenge is to combine elemental sulphur with 10% bentonite, a type of clay that increases its volume when it comes into contact with water.

The use of elemental sulphur in this degradable granular form has proven highly efficient as the pastille form is easily distributed, either mechanically or by hand, enabling high application rates per hectare.

When a sulphur bentonite pastille comes into contact with soil moisture, the bentonite begins to swell, breaking the pastille apart into dust size particles, thus allowing oxidation into sulphate form by microbes in the soil to take place.

Sulphur and sulphur bentonite in contact with water

| | Sulphur | Sulphur bentonite |
|------------------------------|---|--|
| Addition of H ₂ O |  |  |
| After 20 min |  |  |
| After 1 hour |  |  |
| After 2.5 hours |  |  |

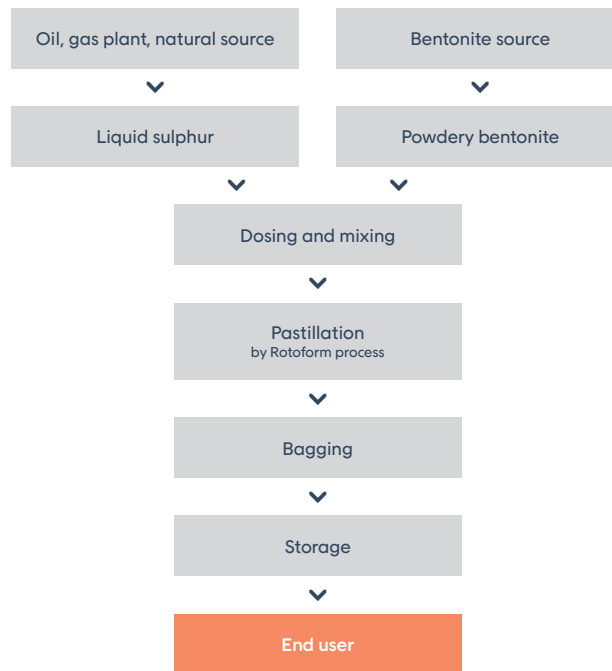
Complete end-to-end solutions from mixing to bagging

We are a market leader in the design, engineering and installation of specialized fertilizer solidification and handling systems, and have more than half a century's experience of working in partnership with the chemical industry.

As such, we are able to deliver complete, end-to-end systems for the production of sulphur bentonite, including:

- Raw materials handling.
- Mixing of liquid sulphur and bentonite.
- Pastillation with Rotoform and steel belt cooler.
- Intermediate storage in hoppers.
- Weighing and bagging.

Sulphur bentonite pastillation and handling





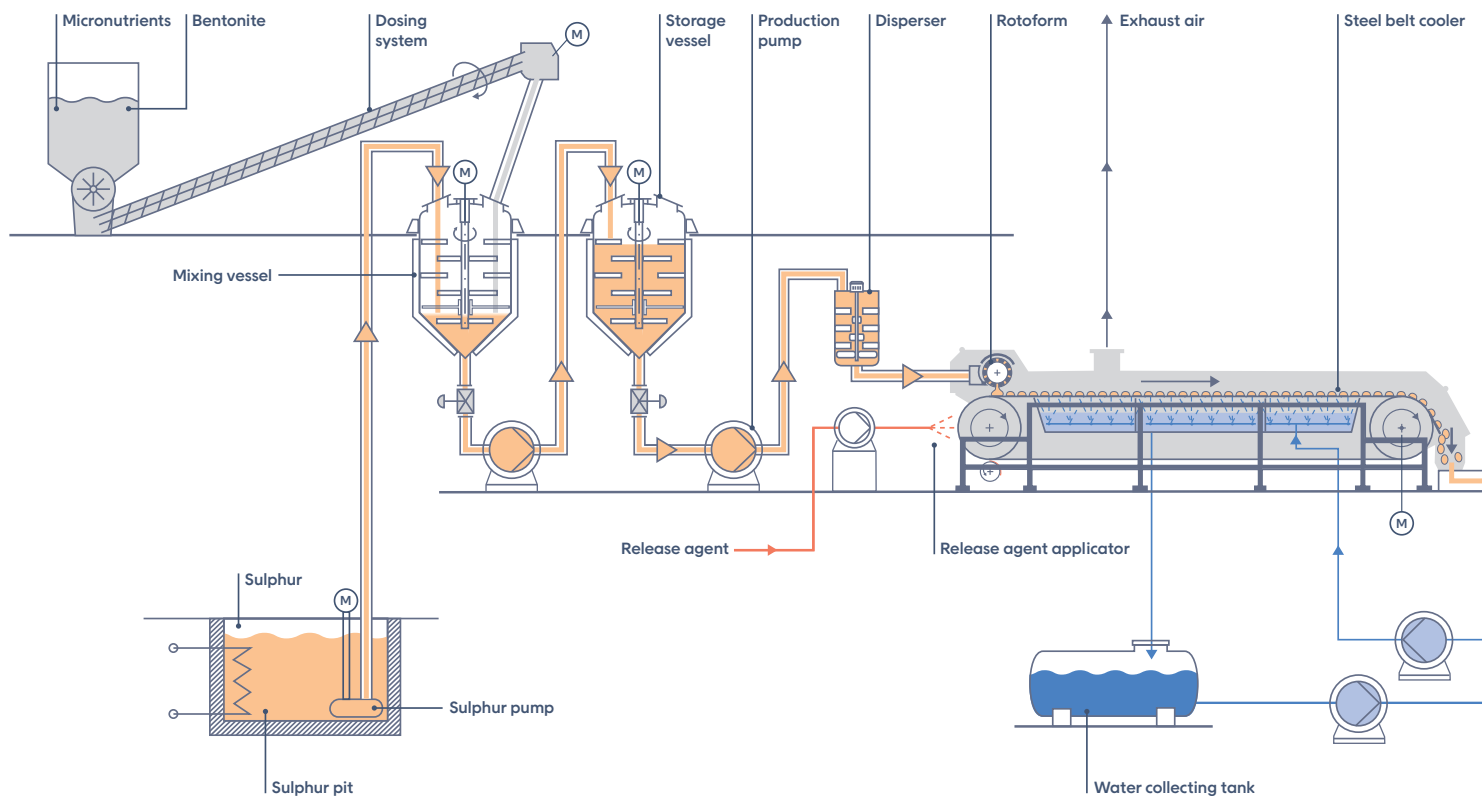
As a world leader in the design, engineering and installation of chemical solidification and handling systems, we can provide complete end-to-end systems for the mixing, solidification and downstream handling of sulphur bentonite.

Maximising productivity through continuous mixing and pastillation

The technology behind sulphur bentonite pastillation is based on our proven Rotoform processing system, of which more than 2 000 units have been supplied worldwide, including 700+ used for the solidification of sulphur.

By linking the Rotoform solidification process to upstream dosing and mixing plant, we can deliver a fully automated continuous process for the production of sulphur bentonite fertilizer.

As the diagram below shows, plant productivity is maximised by using two mixing vessels: one mixing while the other feeds the Rotoform system.



Mixing sulphur with bentonite and micronutrients to form a liquid/solid suspension

Only two basic component materials are required: sulphur and bentonite. Sulphur is normally received from desulphurisation plants in oil refineries and gas fields with a standard minimum purity level of 99.9 %.

Bentonite, a special form of clay, is available worldwide in large quantities and can be either sodium or calcium based; the former is more widely used for this application.

It also needs to be dry (max. 11% moisture), free from impurities or other solid particles, and sieved to a predetermined level of fineness. Other important factors in the selection of bentonite include its pH-value and swelling index, both of which can vary depending on grade.

The first step of the process is the mixing of powdered bentonite and liquid sulphur (the latter at a temperature of between 125 °C – 140 °C).

In order to avoid having to remelt solid sulphur, the ideal solution is to transfer sulphur in its liquid form (i.e. as it comes from the desulphurisation plant) directly to the storage pit of the plant, either by tanker or via a pipe system. It will therefore be advantageous if sulphur bentonite production facilities are situated close to a liquid sulphur source.

If this is not possible, then storage and remelting facilities also have to be provided. The sulphur will also have to be filtered to ensure that it is completely free of solid particles before it enters the vessel to be mixed with the bentonite powder. The bentonite is added manually or, for greater capacity, by continuous feeding.

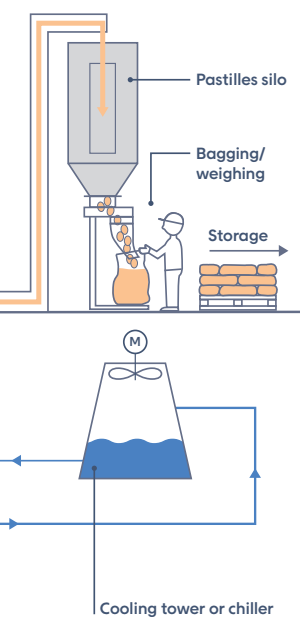
Mixing of the two components is performed in agitated vessels. The abrasive nature of bentonite means that special care has to be taken when selecting the materials for pumps, pipes, mixers, valves, etc.

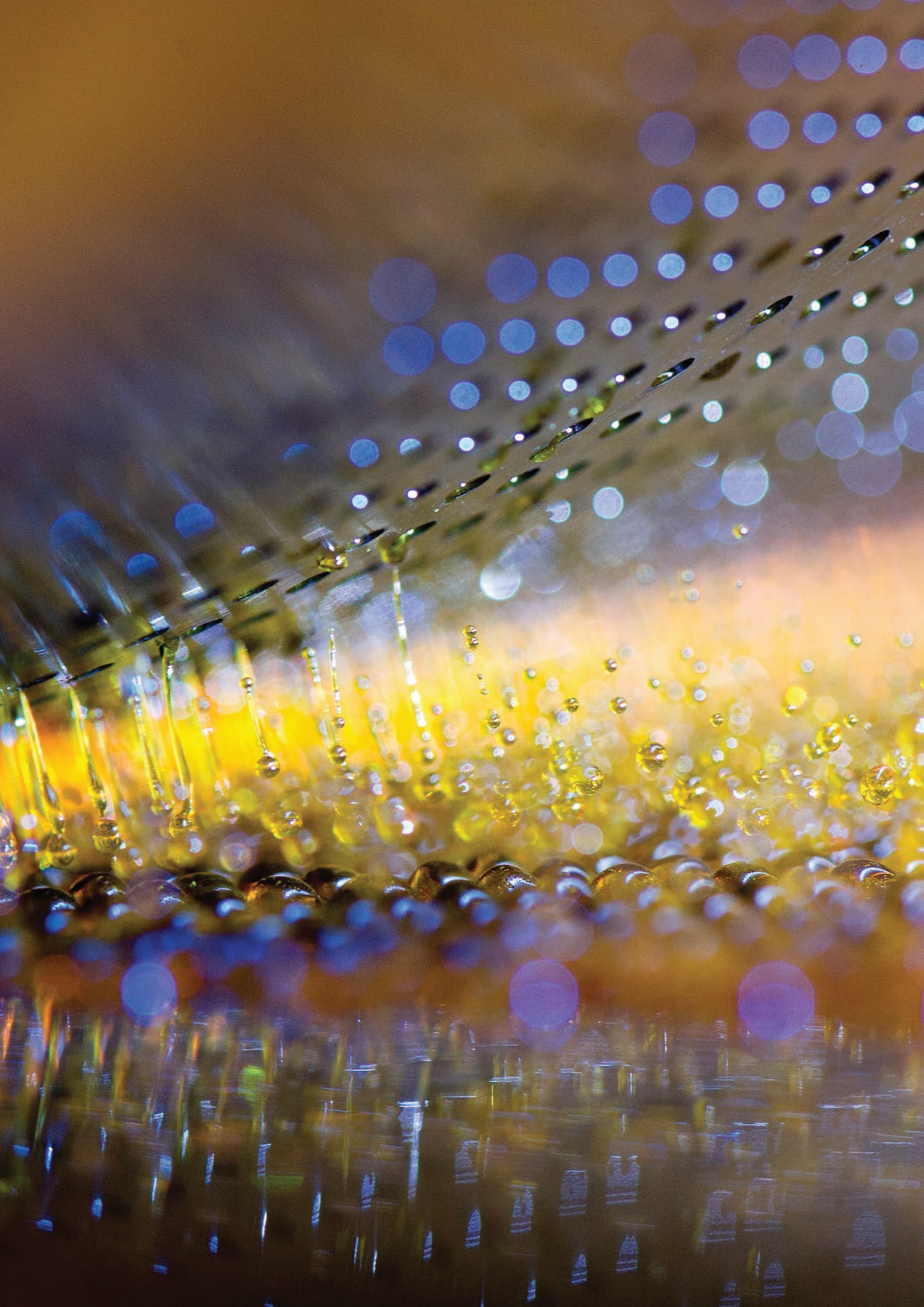
The use of a dispersing unit ensures even dispersion of the solid bentonite in the liquid sulphur and avoids agglomeration of the mix before entering the Rotoform unit.

Creating additional value with micronutrients

The versatility of this process also enables the addition of micronutrients such as zinc, copper, iron or manganese. These and other micronutrients have an important role to play in plant metabolism and growth, acting as catalysts in different metabolic reactions.

The ability to combine such micronutrients with sulphur bentonite opens the door to the production of added value fertilizer products.





Clean, efficient pastillation based on Rotoform technology and steel belt cooler

The sulphur bentonite suspension is then fed to the Rotoform unit, a heated cylindrical stator and perforated rotating shell that turns concentrically to deposit the melt in the form of drops across the whole operating width of the steel belt cooler.

The circumferential speed of the rotating shell is synchronised with the speed of the belt to ensure that drops are deposited without deformation.

Water is sprayed against the underside of the solid steel belt and, as the product moves along the system on the steel belt, the resulting transfer of heat converts the liquid droplets into solid pastilles.

This indirect approach ensures that there is no risk of contamination in either direction: the quality of the sulphur bentonite is maintained as there is no contact with the cooling media, while the water is collected in tanks and can be reused within the system without any need for purification.

Pastilles are taken off the cooler with a discharge knife and pass via a chute to a collecting belt for further handling. Release agent is applied to the steel belt as a thin film by means of a spray system, eliminating the possibility of damage to the pastilles during discharge. An automatic dosing system ensures that sufficient quantity of the release agent solution is always sprayed onto the steel belt.

The Rotoform system is equipped with an effective exhaust system with a tight exhaust hood; an air exhaust and throttle flap is positioned above each line. A radial fan ventilates each plant. The pastilles are transferred to the downstream packaging system.

Sulphur bentonite suspension fed onto the steel belt from Rotoform.

Advantages of the IPCO Rotoform for sulphur bentonite:

Process

- Solidification – well defined cooling time.
- Heat transfer – indirect, no contact between product and cooling medium.
- Flexibility – rapid changeover to partial operation without changes in quality; modular design means each unit can be operated individually; ability to blend other micronutrients.
- Environment – process is environmentally friendly: dust, H₂S and SO₂ content are all within internationally accepted limits.

Product

- Globally accepted as a premium quality product.
- Uniform size of pastilles.
- Consistent quality.
- Stable properties over time.
- Free flowing product that blends easily with other fertilizers.
- Low friability and good impact abrasion resistance (low visual dust generation).

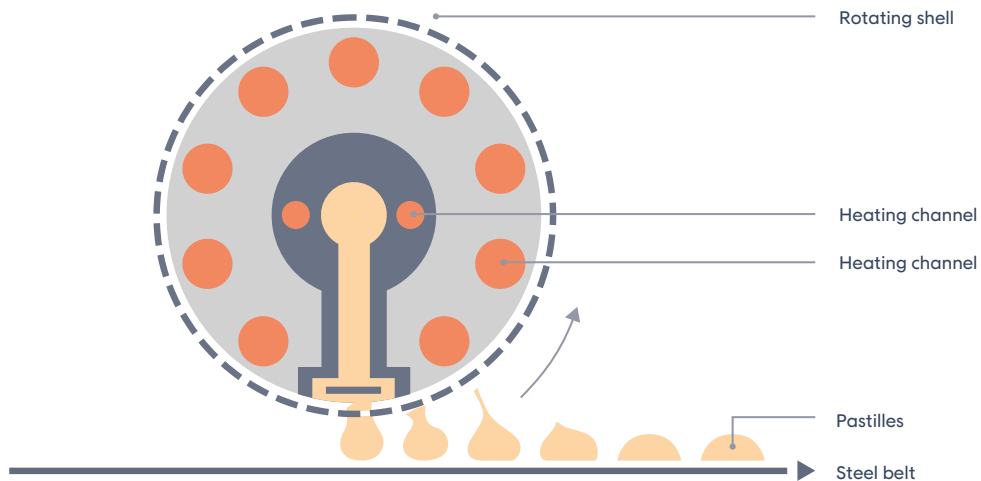
Operation & maintenance

- Fully-automatic operation (except start-up which is manual for safety reasons).
- Easy maintenance and operation.
- Essential components accessible from the floor without auxiliary equipment.
- Few, light and easily mountable spare parts.
- Quick start-up of plant for reduced downtime.
- Use of disperser instead of filter ensures high machine availability.

Utilities

- Low energy consumption (power and steam).
- Low water consumption due to recooling system.

Rotoform process



Efficient, safe handling of sulphur bentonite pastilles

Pastilles offer a range of inherent advantages, but an effective granulation system – particularly one used for the pastillation of sulphur bentonite – also needs to satisfy a number of key technical issues.

We have the know-how and experience needed to design, manufacture and commission complete handling installations, tailor-made to the requirements of each client.

This includes:

- Systems for the transportation of pastilles, i.e. conveyor belts, inclined conveyors and bucket elevators.
- Hoppers including filling and discharging devices.
- Weighing and bagging systems for different types of bags (25, 50, 500, 1 000 kg).
- Control systems.

Global after sales support to protect your investment

Our continuing investment in a global service infrastructure enables us to deliver service when and where it's needed, through local technicians backed up by a dedicated engineering team.

We can also provide in-depth skills training for your in-house teams, ensuring optimum system productivity, a high quality end product and maximum return on investment.

In short we will provide a complete package of support services to ensure that your IPCO system achieves maximum productivity at all times:

- Global capability.
- Trained, equipped and qualified engineers.
- Full system optimisation.
- Fast, cost effective commissioning.
- Transfer of know-how to in-house personnel.
- Tested under production conditions.
- Full technical service.





HUR — BENTONITE —
— ROTOFORM —
ASTILLATION —
— SULPHUR —