

PICK 'N' MIX

Thomas Lansdorf, EIRICH, Germany, explores the role of mixers in the production of fertilizer ingredients and solid fertilizers.

A wide range of different mixing systems are used in the chemical industry. Depending on the task in hand or the consistency of the mixing material, mixers, granulators, kneaders or dispersers and stirrers are used. Each of these units is designed to perform a certain task. However, in response to growing industry demand, EIRICH have designed a mixer which is capable not only of mixing, but also of granulating and coating as well as dispersing. These mixers can be used in

applications when other types of unit reach their limits if particularly high product quality is required, or when companies need to manufacture more cost-effectively or when multiple process steps are to be combined in a single unit (e.g. mixing and kneading). For example, the processing times for kneading and dispersing processes can be shortened from several hours to a few minutes. In this article the properties of this combined mixer are explained, and several examples of its use in the fertilizer industry are described.



On standard systems – regardless of whether mixers, granulators, kneaders or stirrers – the material being mixed is moved by the mixing tools. The tools run close to the wall or floor of the mixing container so that the entire content can be

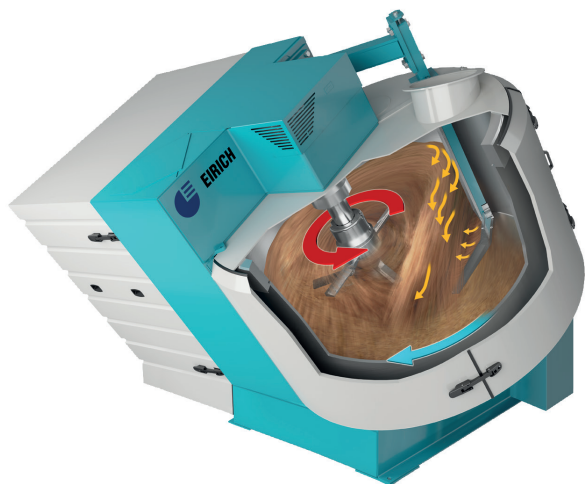


Figure 1. Mixing principle.



Figure 2. EIRICH mixer.



Figure 3. Fertilizer plant.

picked up and moved around. This results in slow tool speeds, and a low energy input into the mixture, resulting in long preparation times.

With a mixer manufactured by the company, it is no longer the mixing tools that move the mixing material – instead, a rotating container takes care of the transport (Figure 1). The mixing tool, which is referred to as the rotor, is then only required to mix. This results in a number of advantageous properties.

At sizes from 1 l up to 3000 l, only a single moving mixing tool is required, with more tools required on larger mixers. It is characteristic of this mixing system that the rotor only needs two small bottom cleaning blades to keep the bottom of the mixing pan free of sediment. The energy input (via friction) into the bottom is therefore very low. The mixing tool can run approximately 30 m/s faster, which makes it possible to operate the machine in Froude number ranges >50 . The power input into the mixture can be specifically adapted to the mixing material and to the tool for the task in hand. As a result, the mixer is able to mix, granulate, coat, knead and disperse, depending on how it is operated.

Other features of this system include:

- During a single rotation of the mixing pan, 100% agitation of the material takes place; the mixer therefore mixes without any demixing.
- Various consistencies can be processed in the same mixer.
- Liquids can be easily added to the mix, usually without the use of nozzles.
- Upscaling is comparatively straightforward.

For the customer, this means that various kinds and consistencies of materials can be processed quickly and to a high quality. As the mixer distributes the mix to this standard, it is often possible to reduce the levels of binding agents and additives that are added to the mix, thus the system faces significantly less wear (which is why the mixer is a popular choice among manufacturers of grinding tools). This also results in significantly higher availability – on continuous mixers used in the conditioning of fine iron ore for pelletising, it is possible to run the machine in continuous 24/7 operation for months on end without any interruption, creating significant annual savings.

Production of fertilizer ingredients and solid fertilizers

Calcium dihydrogen phosphate

Calcium carbonate reacts with phosphoric acid in the company's mixer. The reaction product is then granulated, without any need to transfer it to a different container. Systems are running with an RV15 size mixer (750 l) in Slovenia, and an RV24 size mixer (3000 l) in Bulgaria (Figure 2) and in Peru. Projects that require an RV24 size mixer are at the planning stage in Brazil and South Africa.

Superphosphate or double superphosphate

Disintegration of phosphate ores with sulfuric acid (superphosphate) and with phosphoric acid (double superphosphate) is possible in the mixer. The processes of disintegration and granulation are carried out in a single machine, without needing to transfer the material. This results in significantly shorter processing times.

Solid fertilizers

Two general methods are possible with the mixer: firstly, build-up granulation from powdery ingredients and, secondly, the production of granulates from a moist or wet agglomerate under addition of dry substances. Plants are often designed so that both production routes are possible.

Build-up agglomeration runs in a batch process, with a batch time of approximately 5 minutes. The raw materials (of which there can be more than 20 in some cases) are loaded in batches into the mixer. After a short period of dry mixing, fluid is added. The granulating fluid can be either water or a salt solution, in which case there is no need for the salts to be ground down to granulation fineness. It is also possible to add process slurries or filter cakes from wet grinding or recycling processes. The materials are added in an area in which the material is immediately drawn in and distributed in the mixing material in seconds. If the granulate also needs to be coated, solid material is added toward the end of the granulation process. If the recipe demands the introduction of superheated steam, this is possible, as localised overheating is reliably avoided by the immediate admixing.

The granulate size and size distribution can be controlled within wide limits by varying the speed of the mixing tool and the rotating mixing pan. This makes the systems versatile, allowing many different products to be manufactured in a single unit. Furthermore, changes to the type and consistency of raw materials do not necessitate changes to the plant.

A German fertilizer manufacturer placed an order with EIRICH in 2014 to build a new production plant for nitrogen, phosphorus and potassium (NPK) fertilizers with 8 mixers (Figure 3). A large number of mixers and plants have been supplied to the industry in recent years, including to Australia, the UK, Poland, Russia, Sweden, Switzerland (Figure 4) and Turkey.

In cases where there are special demands in terms of the roundness of the grains and in terms of the grain spectrum, the granulate is produced in a combination mixer/disk pelletiser. The mixer then produces a micro-granulate, which is fed onto the disk. The task here is identical to the preparation of fine ores. In this case, the mixers operate with a usable volume of up to 12 m³, with throughput rates of up to 1500 tph.

Cooling, heating and drying in the mixer

In some applications the temperature of the mixing material needs to be adjusted, either by cooling or heating. Various methods are available for this. Depending on the industry, cooling can be performed either by injecting carbon dioxide snow or liquid nitrogen through a nozzle; the cooling media are immediately drawn into the material flow, with no localised freezing, and the temperature can be adjusted to almost within 1 kelvin (K).

Similarly, there is no localised overheating when superheated steam is used for heating. The mixing material can also be heated by heating the mixing pan (e.g. via porous burners). As 100% of the mixing material is fully turned over within just a single rotation of the pan, this delivers a fast and uniform heating effect (Figure 5). With the aid of inductive heating, it is even possible to reach mixing temperatures as high as 250°C.

Many industries also take advantage of the mixer's ability to dry materials. For some applications, convection drying plants



Figure 4. Fertilizer plant.

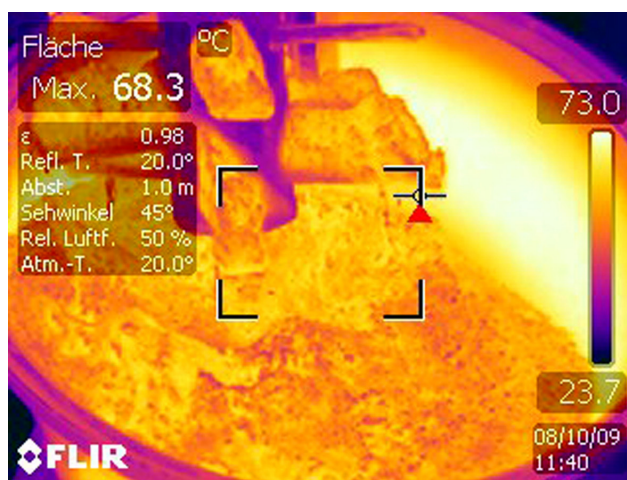


Figure 5. Temperature distribution.

with hot gas have been implemented. This is advantageous if transfer/decanting processes are to be minimised during the production of pesticides/plant protection agents. By introducing hot gas into the mixing pan, the moisture is driven out and separated in a downstream condenser; closed-loop circulation is possible. This technology is also used for drying and simultaneous granulation of filter cakes.

Outlook

Finding ways to make manufacturing processes cheaper is a constant challenge for every manufacturer. What might have been cost-effective yesterday may cease to be tomorrow. By using the right mixing and preparation technology, in many cases it is possible to optimise processes. **WF**