



# MIX TO GRANULES

**Thomas Lansdorf, EIRICH, Germany,** explains the importance of mixing granulators in producing high quality and cost-efficient fertilizer.

**D**emand for fertilizer and soil conditioner grows and grows, while the standards expected by industrial and private customers in terms of quality and processing properties are increasing in equal measure. The challenge is to produce solid fertilizers that combine high quality with low cost. Quality mixing and granulating technology can help make this possible.

## **Advantages of build-up agglomeration**

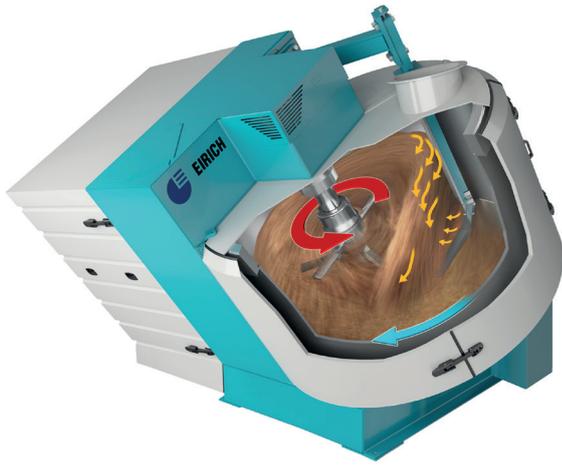
Both press agglomeration with use of compactors and following crushers, screens and spheronising units and build-up agglomeration are available as methods for the production of granules. Press agglomeration generally does not deliver fine-grained, round granules when the additional step of spheronising is missing. Both processes follow on from a dry mixing process that plays a decisive role in the homogeneity of the product. With press agglomeration, demixing in or after the mixer cannot be ruled out, particularly if raw materials with different grain sizes are used. If the product is sold in small packages, the consumer will not necessarily receive the product with exactly the same composition in all granules as the one stated on the packaging. This is why mixing and granulating in a single unit process, which is possible with build-up agglomeration, is advantageous.

## **Mixing and granulating in one unit**

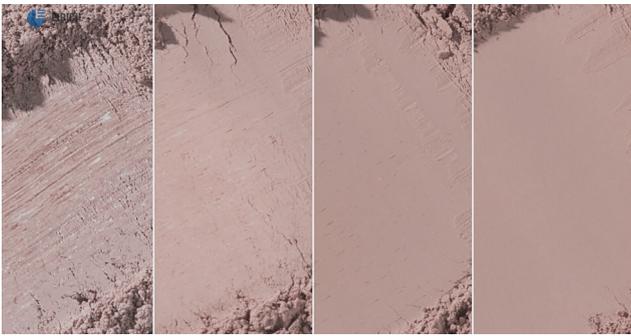
For build-up agglomeration, the raw materials are initially ground as composition or individually (e.g. to a fineness of less than 200  $\mu\text{m}$ ), and then mixed and granulated. In many cases, a large number of components with different properties and quantities are used. First of all, a homogeneous mixture needs to be produced, before the granulating process is then initiated by adding moisture. Here, the EIRICH mixer has proved itself to be advantageous. The mixer is not only capable of producing a high quality mix in a short space of time, but it can also granulate with excellent yields on desired sizes. Quantities of small components down into the ppm range can be homogeneously admixed as solids or liquids (e.g. colours). In addition, with this unit it is also possible to manufacture granulates with a narrow range of grain sizes.

## **The operating principle**

Whereas in other mixers, such as plowshare mixers or pug mills, the mixing tools move the mix and thus perform the mixing task, on the



**Figure 1.** The EIRICH mixer can also granulate, coat, knead and disperse.



**Figure 2.** Stages to perfect homogeneity.



**Figure 3.** Nearly unlimited granule design.

EIRICH mixer, the transport and mixing are two separate processes. A rotating pan transports the mix and feeds it to the mixing tool. This results in a number of advantages. One advantage is that these mixers can both mix as well as granulate, coat, knead and disperse. This means that various consistencies – from dry to stiff/plastic – can be processed in the same machine.

The last development stage of the mixer has a so-called patented z-type rotor as the mixing and granulating tool, which only requires two small bottom cleaning blades to keep the bottom of the mixing pan free of cakings. The energy input (via friction) into the bottom is therefore very low. Among other things, this enables much higher tool speeds (with correspondingly higher power input into the mixture), and also makes it possible to mix abrasive substances.

For fertilizer manufacturers, this technology offers many different advantages, as raw materials with any consistency can be used. Depending on the task, the rotor can run at speeds of more than 30 m/sec. This makes it possible to generate high shear forces and distribute liquids quickly. The high power input also makes it unnecessary to use high speed (and high wear) choppers. These are normally required on plowshare mixers to disintegrate agglomerates and to exercise at least a degree of control over the spread of grain sizes during granulating.

During preparation, varying speeds are possible if required – so this can be referred to as a hybrid process. This is a major difference to the plowshare mixer, which can only be operated as a centrifugal mixer in a narrow speed range. In addition, the tool speed here depends on the diameter of the mixer, on the material being mixed and the fill amount. By contrast, on the EIRICH mixer the tool speed is independent of the size of the mixer and the fill amount. This is also the reason why it is so easy to upscale this solution from a small laboratory mixer to a large production mixer. A linear transfer of laboratory results to industrial scale is often possible, particularly since the mixers in the sizes from 1 litre to 3000 litres only have a single rotor tool. By comparison, the plowshare mixer offers clear disadvantages for upscaling. On the one hand, additional mixing paddles are required on the larger mixer, which in turn are subject to uncontrolled friction and wear. On the other hand, according to literature references, the effects of chopper heads are not scalable.

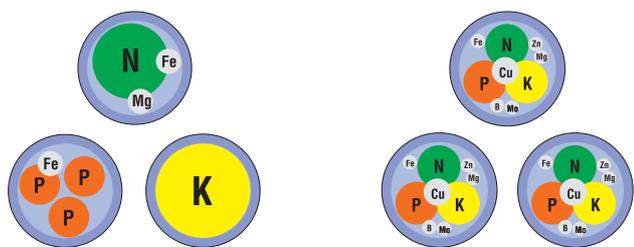
### Homogeneous dry mixes

Every partial quantity or grain fraction of the granule should have the same chemical composition. This makes it necessary to start by producing a preferably homogeneous pre-mixture/dry mixture. Here in particular, the EIRICH mixer demonstrates its strengths based on the properties described above. During just a single rotation of the mixing pan, 100% material turn-over takes place. The mixer therefore mixes without the demixing described for ploughshare mixers and other mixing systems. Just short mixing times already deliver high mix qualities.

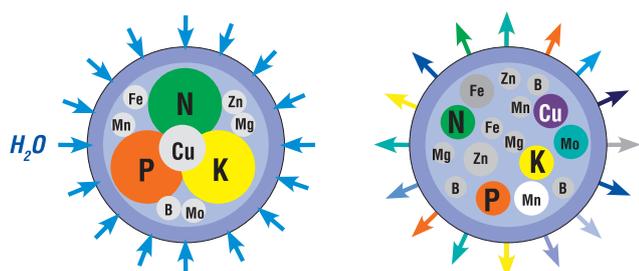
### Granulate formation

Build-up agglomeration normally runs in a batch process, with a batch time of approximately 5 min. The raw materials (of which there can be more than 20 in some cases) are loaded in batches into the mixer. After dry mixing, granulating liquid is added. As a rule, it is not necessary to add this via nozzles. Varying the tools and speeds can have a considerable influence on the grain spectrum. Granules with a  $d_{50}$  value ranging from  $<100 \mu\text{m}$  to more than 5 mm are possible, depending on the material. The granulating liquid can be water or a salt solution. Likewise, it is also possible to add process slurries or filter cakes from wet grinding or recycling processes; substances with any consistency are distributed in a matter of seconds in the mix.

In addition to build-up granulation from powdery components, the production of granulates from a moist or wet



**Figure 4.** Comparison of conventional (only mixed) and EIRICH granulate. Left: conventional granulate with different composition of the granules. Right: EIRICH granulate (each granule contains the complete nutrient composition).



**Figure 5.** Nutrient release. Left: every fertilizer granule contains all the nutrients; the nutrients are dissolved by water. Right: a concentrated nutrient solution is created; the nutrients are released in a controlled manner.



**Figure 6.** The right system concept is key to economic success. Plant design example with mixer and disk pelletiser.

agglomerate through the addition of dry substances is also possible. Plants are often designed so that both production routes are possible. This makes them very versatile in their potential applications. On the one hand, different products can be produced in a single plant. On the other hand, the plants are future-proof; changes to the type and consistency of raw materials do not necessitate changes to the plant. Likewise, in the production of organic fertilizers on the basis of secondary raw materials or soil improvers, the EIRICH technology is cost-effective. It can also be used to process all kinds of fibrous components.

### Granulate finishing

In coating processes, the granulates are coated with the aim of achieving specific surface properties. Many fertilizer properties, such as flow properties, colouration, hygroscopicity, grain hardness, selective resolution, controlled release of nutrients, etc., can thus be adjusted, as can the inhibition of chemical processes.

The coating material, which is added at the end of the granulating process, can be a solid or a liquid, or a solution or suspension. If necessary, different substances can be applied in several layers one above the other.

### Partner for fertilizer manufacturers

In addition to mixing and granulating technology, the range of products and services from EIRICH for fertilizer manufacturers also includes the construction of turnkey plants. In addition to the mixing granulators, EIRICH can also supply all the system components for transport of the raw materials, preparation, storage and transport of the fertilizer premix, for dosing and weighing, for fluidised bed drying, and for sizing. Plus the steel structures (including their planning) and the system controller, along with installation and commissioning of the plant.

For the areas of grinding, granulation and drying, tried and tested system solutions are available. Depending on the project scope, anything from individual granulating systems right up to turnkey fertilizer plants for batch or continuous operation with throughput rates of 0.5 – 30 tph can be supplied. The investment costs are comparatively low here, and the plants are low maintenance by virtue of the system.

Companies including BASF, Compo, Ecophos, EUROCHEM, Hauert, K+S and Nordkalk have all opted for an EIRICH system solution.

EIRICH will help interested parties to find the least expensive/best conditions for the granulating process. At the test centre in Hardheim, Germany, and at many other sites worldwide, feasibility studies can be performed with customer materials all year round. Here, in addition to mixers ranging from 1 to 400 litres, a disk pelletiser is also available at the test centre in Hardheim. With the combination of 'production of microgranulate in the mixer' and 'granulating on the disk pelletiser', granulates with the highest possible sphericity and a very narrow grain spectrum can be produced if required.

### Conclusion

Mixing granulators are important means in producing high quality and cost-efficient fertilizer. This is particularly advantageous for those fertilizer manufacturers who desire customised products or microsized granules and aim for the premium segment. **WF**