MS DRYTECH – Continuous evolution in the dry preparation of raw materials

The advantages of dry preparation with respect to the conventional wet process are by now well known and appreciated:

- A drastic reduction in the cost of raw materials.
- Considerable lowering in electric and heat consumption.
- An extremely low emission of greenhouse gas.
- Minor consumption of water.
- Elimination of the additional costs needed for proper management of slurries.
- Total recovery of production wastes.
- Reduction of space and structures needed for installation.
- A healthier and safer environment for workers.
- Practical to run and service.

The prevailing aspect that still lies behind the choice of one technology with respect to the other is the performance of the preparation line downstream both in terms of output and of finished product.

Apart from being the only company in the world that has been addressing its efforts to the development of this technology for 50 years, Manfredini & Schianchi is the only company that can provide a valid answer to these questions by virtue of its outstanding experience in the elaboration of ideal ceramic mixtures, and of the many systems that it has installed and that are in operation.

Today, with data in hand, with the evidence of the one thousand million square metres of tiles produced every year with the MS Drytech milling system, dry technology is absolutely the most profitable choice for the end user. This system is basically composed of the new MOLOMAX® pendular mill combined with FORGIA Granulators/Agglomerators of the vertical type.

The use of powder agglomerates in the production of pressed ceramic tile, as an alternative to spray drying, has been the subject of exhaustive research by Manfredini & Schianchi over the last decades. Over the last 30 years, Italian and foreign companies have offered solutions based on vertical twin-roller mills and subsequent granulation. These solutions have proved to be unsuccessful and inconsistent, for the following reasons:

- A strong limitation in the choice of suitable mixtures and of their initial moisture content.
- Poor operation versatility of the mill in terms of fineness of milled material.
- Serious particle size segregation phenomena.
- Impossibility to guarantee constant parameters for pressing both in terms of particle size and of moisture content.
- Chronic unreliability during management of the various stages of production due to the reasons mentioned above.
- Considerably high electricity and heat consumption costs.
- Extremely higher maintenance costs.
- Restriction in the range of products, both in terms of surface quality and structure.
- Adverse effects on the production output and quality levels of the line downstream for the preparation of raw materials.

The granules of ceramic bodies obtained with these alternative dry milling technologies, apart from drastically limiting energy saving, do not reproduce or replace the intrinsic properties of granules obtained by spray drying, owing to the strong difference in moisture between the outer layers of the granules (dry) and the compact and moist centre.

These systems have therefore demonstrated how it is impossible to produce tiles with a constant and high standard of quality, especially when it comes to glossy or semi-glossy products that need smooth and even surfaces.

On the contrary, the FORGIA Vertical Granulator guarantees an even and constant supply of water to granulated particles thanks to an extremely accurate system for batching incoming material and measuring its moisture content. This system also gives the granule a shape and structure that is similar to that of the fine powder agglomerate produced by a spray dryer and it is known that this type of granule facilitates ejection of air during pressing.
Let us analyse, for instance, powder that has been dry milled using the MS DryTech technology, to be used for the production of monoporosa, the particle size curve of which features a correct distribution, even of the finest particles, as shown below:

- 250 µm: 0%
- 150 µm: 0.14%
- 125 µm: 0.40%
- 63 µm: 12.26%
- < 63µm: 87.20%

Material milled in this manner, apart from having the optimal grain size distribution for the type of product it will be used for (obtained thanks to the combined action of a rough milling process and of milling performed by the MOLOMAX® pendular mill), is composed of particles with different shapes and structures, unlike mixtures processed by means of alternative dry milling systems, in which particles of milled material have basically the same shape and structure.

The combination of particles with different shapes, obtained using the MS-DRYTECH milling system, allow for perfect integration, even of the finest particles, after the wetting/agglomerating process. After processing in a FORGIA Vertical Granulator, the particle size curve is as follows:

- 800 µm: marginal
- 800-250 µm: 25-40%
- 250-125 µm: 20-25%
- 125-63 µm: 20-25%
- < 63µm: 20-15%

As clearly visible in the images taken using an Environmental Scanning Electron Microscope (ESEM), the agglomerated particles obtained with the FORGIA vertical granulators are soft, not too hard or compact, extremely even both in terms of grain size and composition of the granules themselves. This means that they are easy to press, exactly like spray dried material (the compression ratio of material fed to the press is similar to that of spray dried material, namely 1:1.2).
This perfect blending of components of the ceramic body is obtained thanks to the combined action of two processes: milling (i.e. rough milling plus milling in a MOLOMAX® pendular mill) and effective blending, still offered by the MOLOMAX® mills, which can guarantee both optimal milling and perfect blending of components, even when the mixture of raw materials has a 12% moisture content.
The homogeneity of these granules, their softness and the perfect blend of components of the ceramic body contribute to the creation, during pressing, of incredibly smooth tiles, without the surface defects that can adversely affect subsequent glazing, especially of glossy products. These characteristics also drastically improve the technical parameters of the product. We are talking about resistance of green, dried and fired material (it is important to note how an increased mechanical resistance can offer great advantages, such as for instance the possibility to subject pressed pieces to more glazing operations without compromising integrity or quality).

The microscopic analysis, along with the particle size and powder density analyses, have demonstrated how the agglomeration process of FORGIA Vertical Granulators allows for an effective reduction of the ultrafine particles, which are also involved in the formation of granules. The MS-DRYTECH dry milling system will allow you to obtain particularly diversified particle sizes hence granting an effective reaction of the particles during the firing cycle.

The subsequent action of FORGIA granulators ensures easy management and the production of agglomerate that includes even the finest particles. This makes the resulting milled body easy to process during the pressing cycle. Furthermore, as demonstrated in existing plant (such as the Manfredini & Schianchi system installed in the facilities of the RAK group), with respect to spray dried material, mixtures created with local raw materials, by virtue of the different morphological characteristics of the material milled with M&S systems, have allowed for a substantial reduction of the firing cycle (15 - 20 % shorter) and a considerably higher production output, as well as the possibility to prevent the risk of black core developing. In many cases, it has been possible to reduce the firing cycle to less than 30 minutes.
To attest to the benefits of MS DRYTECH technology, the square metres produced per day at RAK have increased from the 9000 – 10000 m²/day of the first single-firing system with wet milling equipment to the 14000 - 15000 m²/day produced with the M&S dry milling system.

The comparison with pendular mills of the old generation, the development of which was interrupted decades ago, is of course unbalanced. The solutions offered by new MOLOMAX® mills, namely the size of the rollers, the construction of the milling track, the optimised internal air flow and the level of dynamic separation, are an extraordinary combination that leads to a high production output and to optimal particle size curves for any type of ceramic material.

The latest development of the MOLOMAX® series, the MS6/500, featuring 6 extra large rollers combined with a grinding track having a large diameter, can guarantee a production of 60 tons/hour (one machine), as well as perfect blending of components and, of course, perfect milling.
An effective milling process also allows for the formation of extremely fine particle sizes that guarantee perfect control over any type of mixture and consequently a high quality of the final product, irrespective of whether you are dealing with red body double-firing, top quality monoporosa or sophisticated products, such as porcelain stoneware.

In our case, the results described above are not the mere result of technological or commercial conjectures. They are above all the result of analyses conducted by our Technological Laboratory, with its Manfredini & Schianchi pilot plant (the only system in the world dedicated exclusively to dry milling) and of the great experience acquired with the co-operation of our customers in the hundreds of systems sold all over the world.

MS technology and MS-DRYTECH raw material preparation systems are undergoing continuous evolution. The development of new machines proceeds hand-in-hand with increased production, improvement of quality of the final product, fulfilment of the market’s needs and the reduction of waste and of production costs and, last but not least, protection of the environment.