

# A dry mortar production plant in China with highest grade of automation

## Trockenmörtelwerk in China mit höchstem Automatisierungsgrad

### 1 Introduction

The new and quite impressive dry mortar production plant, located in the Beijing area is designed to deliver in two shift operation up to 300 000 t/a per line. To meet this demand two separate lines were realized, one so-called "dry mortar line" and the other line called "dry putty line". The hourly output per line is up to 80 t/h. A huge number of totally different dry mortar products can be produced.

A high grade of automation was one of the key demands of the president of the Maco Group. The Maco Group, as a leading manufacturer in the dry mortar industry in China, believes that the use of high technology equipment is a necessary precondition to produce high quality dry mortar products. High quality is only achievable with equipment of high accuracy, a high automation grade and an efficient mixing technology, adaptable to the needs. The Chinese company Maco has ten subsidiary companies and is using a strategic market layout to supply their products throughout the whole country. ▶ Fig. 1 shows an outside view of the new plant.

### 2 Plant concept

The plant concept includes the following process steps, for each line:

- ▶ Storage of main raw materials in 18 high volume silos
- ▶ Storage of additives in 32 silos
- ▶ Dosing and weighing of the main materials via 18 dosing screw conveyors into two major weighing hopper scales
- ▶ Dosing and weighing of the minor materials and additives via 32 fine dosing screw conveyors into four high accuracy weighing hopper scales
- ▶ Volumetric feeding of lightweight material
- ▶ Automatic dosing and weighing of PA fibers
- ▶ Automatic dosing and weighing of natural fibers under ATEX conditions

- ▶ Manual weighing and feeding devices for additional interim components
- ▶ Eirich intensive mixer RV24 with a batch size of 3000 l and up to 24 batches/h
- ▶ Complete emptying and cleaning with an automatic pneumatic system for residue-free and fast formula change
- ▶ Plant control system and batch logging with power equipment, PLC and visualization

#### 2.1 Conveying and storage of the raw materials

The aggregates with four grain sizes that arrive on site are sieved and dried. By means of a vertical bucket elevator followed by conveying screws with high wear protection then the aggregates are guided towards the corresponding silos. All other main materials like binder, lightweight aggregate or fly ash are transported into the silos by pneumatic conveying directly from the silo trucks.

Big Bags and bags are used for the additives, minor materials and pigments. Dust-tight coupling devices ensure an environmentally friendly emptying of the bags. ▶ Fig. 2 shows the silo feeding.

#### 2.2 Dosing and weighing

Via frequency controlled dosing screw conveyors the main materials are fed into gravimetric hopper scales made from mild steel. To reach the necessary accuracy, two separate hopper scales are used for small and large quantities. This keeps the maximum load relatively low hence the load cells have a smaller variation rate (▶ Fig. 3). The additives and medium ingredients are fed into two additional small hopper scales made from stainless steel and the fine dosing screw conveyors are additionally equipped with quick-actuation throttles to reach a high accuracy of  $\pm 10$  g.

In a third dosing and weighing group the minor additives and pigments are also fully automatically handled. The high accuracy weighing module is mechanically de-coupled from



Figure 1: Outside view of the new plant



Figure 2: Silo feeding



Figure 3. Main material hopper scale with dosing screw conveyors

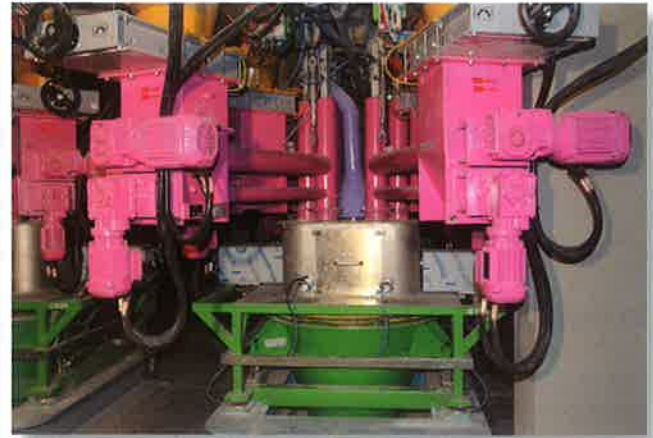


Figure 4. Micro weighing station with dosing screw conveyors

the steel structure to avoid any negative influences caused by vibration or oscillation. 16 double-dosing screw conveyors are feeding each of the four micro-weighing stations (► Fig. 4) and afterwards the total amount is collected by high accuracy weighing hoppers in down flow, where a double check of the total amount is done. With this configuration a high accuracy of  $\pm 2$  to 3 g is realized. All equipment parts coming in contact with material are made from stainless steel and the surfaces are additionally electrically polished to avoid any adhesion.

conveyor ensure an ideal fiber dosing. The weighing is done by a loss-in-weight system. The automatic proportioning of the natural fibers (wood fibers) is another highlight of the dosing and weighing system of this plant (► Fig. 6).

Thanks to the dosing and weighing software a continuous optimization process takes place automatically which keeps the accuracy always at the highest possible level. For automatic dosing and weighing of PA fibers the plant is equipped with a fiber dosing unit, developed and manufactured by Eirich (► Fig. 5). Distribution devices followed by a vibrating

The whole area, starting from the storage silo, to the conveying screw and ending with the weighing-dosing-devices is realized according to ATEX standard as the fines of these natural fibers are highly sensitive for explosion. An additional filter with a burst plate is installed in the mixer to guide the overpressure in a controlled way, in case it is required. Finally, the weighing and dosing of lightweight aggregates is done by a so-called "volumetric measuring unit." This unit checks not only the volume but also the weight of the lightweight aggregates. This ensures an accurate proportioning of the same despite the fact that the bulk density has a certain variation (► Fig. 7).



Figure 5: Eirich intensive mixer with fiber dosing unit



Figure 6: Eirich intensive mixer with natural fiber dosing unit

### 2.3 Mixing

The Eirich intensive mixer type RV24 has an effective volume of 3000 l and can handle a material mass of up to 3900 kg per batch. Unlike other horizontal mixers the mixing vessel is rotating as well as the mixing tool. With the aid of a stationary material deflector in the mixer, the mixture is guided towards the high intensive rotor tool, which can run with variable speeds. The combination of these three characteristic features – rotating mixing vessel, stationary material deflector and rotating high intensive rotor tool – ensures a complete movement of all particles within the batch and even finest amounts of additives or pigments in the range of ppm are homogeneously distributed in the shortest time (► Fig. 8). Another important point is that the mixed product does not segregate again, even when mixing times are particularly longer, for instance, while a soft distribution of fibers is required. This means that the mixed products are both material- and time-independent with no possibility of over-mixing or segregation.



Figure 8: Function principle of the Eirich intensive mixer



Figure 7: Volumetric measuring unit for lightweight aggregates

As the high intensive rotor tool (mixing tool) is driven by a frequency-controlled drive, the mixing force can be adapted easily according to the necessity of the respective formula composition.

Thanks to the pneumatic system with various air nozzles installed inside the mixer, fast automatic and residue-free cleaning can be done. This allows a fast changing of the recipe with only minor interruptions of the production process. Mechanical knockers, as well as a special de-dusting sequence, support this cleaning process.

### 2.4 Final product handling

After a mixing time of 90 to 180 s the so-called “dry mortar” mixing line empties into a twelve spout roto packer for filling

of 20 kg/25 kg/50 kg bags, connected to a fully automatic palletizer followed by a foil wrapping station. Via a rotary dust proofed distributor the special dry mix products are conveyed into 6 numbers of single packing stations for filling of small bags with a material mass of 5 to 10 kg.

After discharging the batch of the so-called “dry putty” mixing line, it either goes to a Big Bag filling station or a fully automatic ten spout rotary packer, followed by a fully automatic palletizer inclusive foil wrapping station. This part of the plant was realized by the customer himself with the guidance and engineering of Eirich.

### 3 Dust extraction

To meet a high standard of environmental protection each of the mixing lines are equipped with a central dust extraction system. All plant equipment is connected via a specified piping network to the central filter. The customer has purchased this system locally based on detailed preliminary engineering done by Eirich.

### 4 Process control system

Each mixing line is connected to an independent PLC system using Siemens S7 units which allow the entire plant to be operated fully automatically. The in-house developed EDS

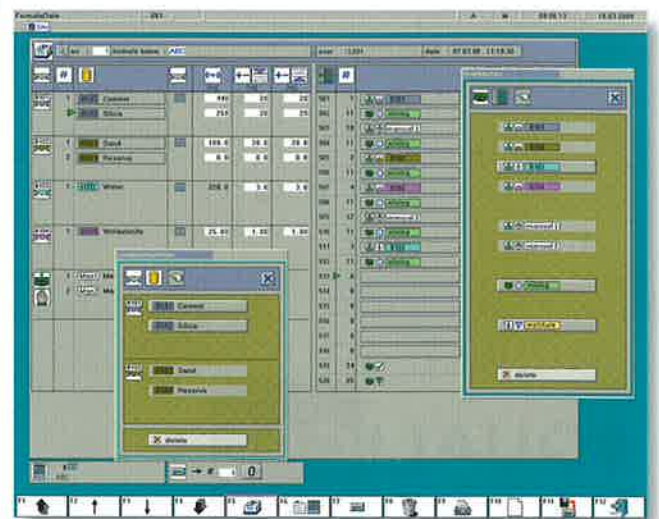


Figure 9: Formular database

controller performs the dosing and weighing processes for each batch according to the chosen recipe from the main database. It includes an automatic after-flow optimization of the dosing screw conveyors for maximum reduction of discrepancies to set point values. All of the parameters specified by the formula database (Fig. 9) are implemented and actual values are logged and achieved. The integrated database function allows the consumed raw materials to be balanced against the production quantities. Up to 1000 different formulas can be managed and retrieved by the sequence program.

The in-house developed Eirich visualization system/SCADA program is user friendly and enables an easy operation of the plant while observing the different processes on a central monitoring system. Any required changes or updates to the visualization or PLC program can be done via a secured internet link from the Eirich headquarter located in Hardheim, Germany.

## 5 Final remarks

A modern dry mortar production plant has to offer high efficiency and high quality products. With such a high grade of automation as realized in this plant, the possibly influencing human factor is almost eliminated. On the other hand an output capacity with a high and constant quality is ensured.

Thanks to the features of the plant, a high grade of flexibility enables the customer to adjust the type of products easily and quickly according to the market demands. The Eirich intensive mixers with their variable mixing system can be called the heart of the plant. ♦

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