

## **Title: EcoPrep – New concepts for tile production**

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### **ABSTRACT**

The concerns about the process costs, product quality and preventing of damage to the environment have always been important factors for the choice of industrial processes. In this work we will present economical processes for the production of high-quality dry-pressed tiles. With the similar technology and only some modifications we can also produce extruded products. The focus is the reduction of production costs without losing, but even increasing the product quality. In this article we will explain the advantages of the Eirich EcoPrep technology compared to the most common wet process for the preparation of press granules.

### **INTRODUCTION**

We will concentrate on the production of dry-pressed tiles. With the use of new Eirich technologies, we can reduce the production costs without losing quality and still reducing damage to the environment.

The main points:

- **Energy:**

Energy, both thermal and electric, has great influence on the costs for the preparation of ceramic coverings. In general, the stages where energy is mostly consumed are: preparation of press granules and sintering. In this paper, we will concentrate on the dry preparation of press granules.

Furthermore, we can hand out a paper about energy reduction during grinding and increasing the kiln capacity by using the wet process.

- **Additives:**

For wet preparation, liquefiers-for increasing the density have to be added to the slip. The kind and amount of these liquefiers is depending on the raw material properties and batch composition.

- **Water:**

We will show new processes in comparison with the wet process where we have a reduction in the amount of used water.

- **Sintered reject products (chamottes):**

As per the improvement of preparation control, even when working with low-quality raw material, it is possible to achieve a cost reduction through smaller amounts of rejects.

## PREPARATION CONCEPTS

### Wet process

In Mexico this process is mainly used.

We need to show which kind of process is used generally in Mexico.

- Wet milling – Ball Mill
- Spray Drier
- Press

### Eirich suggests the “EcoPrep” technology.

Dry preparation of press granules

The key point of the DryPrep technology is:

#### **Producing a homogeneous press powder with a good flowability for high-quality dry-pressed tiles at lower preparation costs**

Most of the ceramic press granules for high-quality tiles are produced with a spray drier generated from a slip with a water content of approx. 30 - 39 %. In some cases the water content can be higher, or if the raw material has good liquefaction properties, the water content can be less.

With the dry granulating process only 11 % - 12 % of water is necessary.

To create good press granules with both technologies, the water has to be evaporated.

With a final moisture of the press granules of 6 %, using the spray drier 24 % - 33 % of water has to be evaporated, with the dry-granulated press granules only 5 % - 6 %.

Physically, approx. 2253 kjoule are necessary to evaporate 1 kg of water. The real energy consumption for water evaporation in a spray drier or a fluid-bed drier can be assumed between 3350 kjoule and 3560 kjoule.

## 1. Eirich EcoPrep Technology for dry granulation of press granules

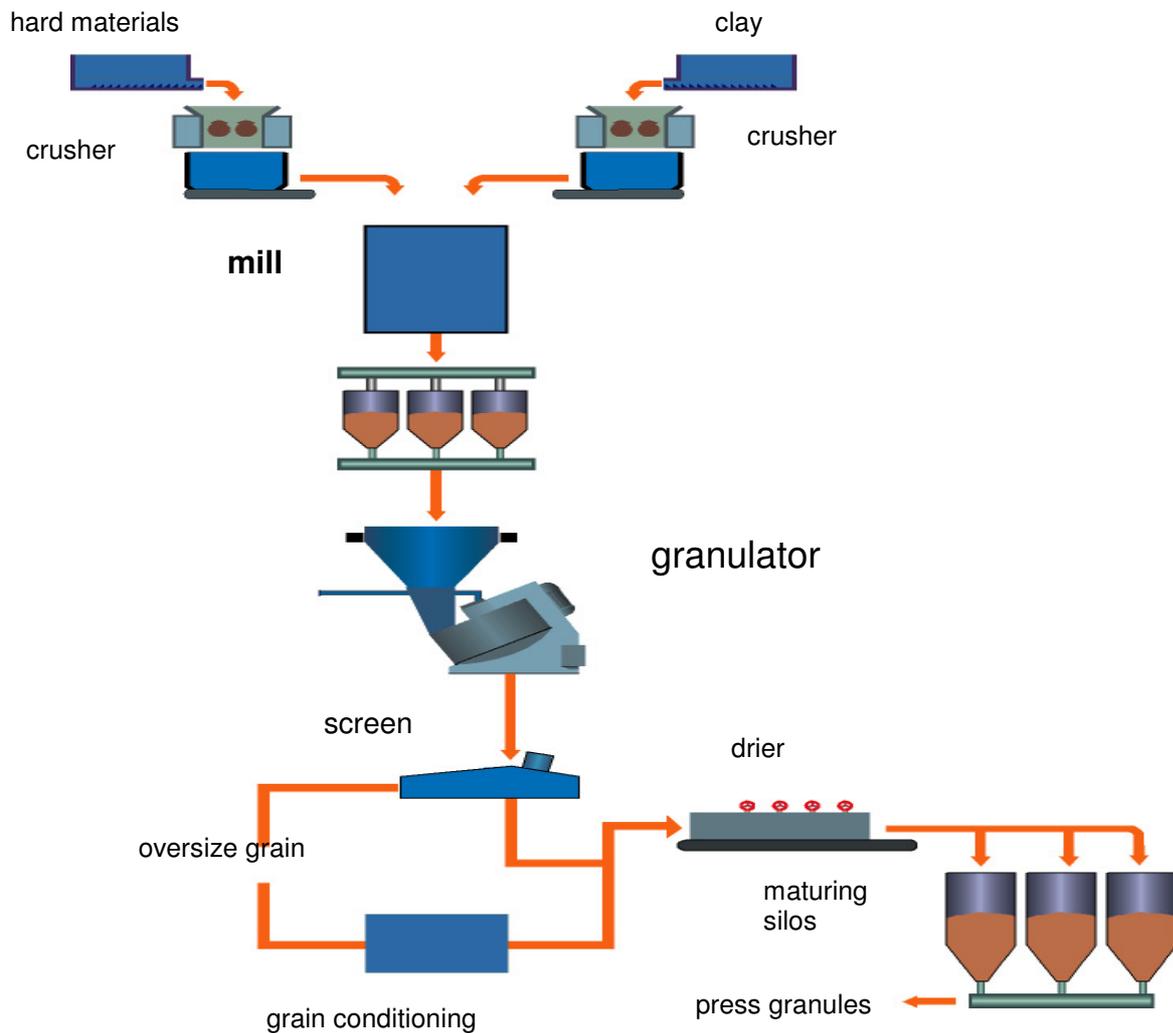


Figure 1: scheme dry granulation

### 1.1 Grinding

The raw materials can be ground together or if this is not possible, each raw material can be ground separately. To get a good efficiency during grinding, the moisture of the raw material should be around 4 %. If the raw material has a higher moisture content, the material has to be dried during grinding or separately before grinding. The grinding system can be adjusted to the requirement. The ground material is stored as a batch or as single materials into silos.

## 1.2 Granulating

From the silos the ground material is fed into a hopper scale above the granulator and scaled.

After scaling, the raw material batch is guided into the mix granulator and homogenized. The homogenization period takes about 1 minute. After that time the required water for pelletizing will be injected with high pressure. For a good granulation, the moisture content should be between 11 and 12 %.

The size of the granules can be adjusted by the water content and also by the speed of the agitator in the mixing granulator.

When the granulation process is finished, the granules are discharged from the mixing granulator.

As a normal effect of granulation, the granules are not completely in the required size range; there are some agglomerates and oversize granules.

To get good press granules with good press properties, the oversize granules and agglomerates has to be separated and conditioned according to the requirement.



Figure 2: granules after discharging from the mixing granulator

### 1.3 Conditioning of granules

The separated oversize granules and agglomerates will be processed with a grain optimizer. This reduces the size of the granules and agglomerates and shapes them to a spherical granule.



Figure 3: conditioned granules



Figure 4: conditioned granules

The conditioned press granules are added to the good-size granules from the mixing granulator. The granules are dried with a fluid-bed drier to the required press moisture of about 6 %.

## 1.4 Granule properties

The flowability of the dry granulated press granules is nearly the same as the flowability of the press granules prepared with the spray drier.



Figure 5: flowability of dry granules      Figure 6: flowability of spray granules

The granulated granules differ from the spray grain. They are solid and not hollow inside.

This gives the granules a higher density of approx. 1.1 - 1.2 (for floor tiles), and less air has to be pressed out of the cavet during the pressing process.

For certain products it is necessary to increase the specific press pressure to get the same surface of the product.

Below you can see the energy savings comparing the EcoPrep and wet preparation.

The figures for the wet preparation are taken from an actual wet process in Mexico.

## 1.5 Comparison of energy savings

The high benefit is the saving of energy and liquifier.

For comparison, the following parameters for the wet process have been given to us:

- **Body composition**
  - 45 % clay
  - 55 % hard materials
- **Moisture of raw material (%)** 7.6
  - yearly average moisture
  - clay 12 %
  - hard material 4 %
- **Weight of tiles (kg/m<sup>2</sup>)** 20.0
- **Density of the slip (kg/l)** 1.75
- **Water content of the slip (%)** 32.0
- **Press moisture of the granules (%)** 6.0
- **Grinding energy**
  - wet (kWh/t) 25.0\*
  - grinding media Al<sub>2</sub>O<sub>3</sub>
  - grinding media consumption 2 % 2 kg/t
  - costs/grinding media US\$/t 2110

\*These data are assumptions based on our experience

	dry granulation kWh/t	spray drier kWh/t
Grinding energy	22	25
Drying energy*	116	406
Granulating energy	8	
Granulate design energy	6	
Additional plant energy	4	
Additional screening energy	1	
Total energy consumption	<b>157</b>	<b>431</b>
Additives* US\$/t		<b>3.30</b>
Water l/t	<b>95</b>	<b>388</b>

\*These data are assumptions based on our experience

With the dry granulation approx. **274 kWh/t** or approx. **64 %** can be saved.

Additional savings:

- Liquefiers approx. **3.30 US\$/t** of prepared granules
- Water approx. **400 l/t** of prepared granules

## 1.6 Conclusions

With these technologies you have the possibility to produce a high-quality ceramic body with lower energy consumption. Not only the energy consumption and savings of liquefier in the preparation have to be taken into consideration. Granules from evenly prepared raw materials will stabilize subsequent production steps and increase the quality.