THE ACTIVE PARAMETERS IN THE PRODUCTION OF FLOOR TILES

Lhan Akkurt, Kaan Kayaci

Kalebodur Seramik Sanayi A., 17430 Çan-Çanakkale-TURKEY

It is important to provide water absorption and shrinkage of the body with good surface quality in the production of ceramic tiles. There are a lot of raw materials and production parameters that affect water absorption and shrinkage properties. If the production capacity reaches 30,000,000 m^2/year and you use 475.000 t/year of raw material, 42 batch mills, 4 spray dryers, 40 presses, 22 kiln for this production, you have some difficulties controlling the parameters that come from these facilities.

Also, it is more difficult to go from EN 177 to EN 176 for the production class without changing the size of dies. This is due to the fact that while the firing shrinkage is about 1 % and the water absorption limit is 10-15 % in wall tiles produced according to EN-159, these values are roughly 6 % and maximum 3 % respectively, in stoneware tiles produced according to EN-176. Therefore a small deviation in the parameters used in producing stoneware tiles has an immediate effect on dimensions and the water absorption value. Thus, difficulties are encountered during production in maintaining the dimensional and water absorption limits that are to be met. Even differences greater than 1mm in dimensions will cause problems in tile installation. Initially, we used to check only the chemical analysis data of our raw materials. In order to avoid some fluctuations, we set certain acceptance criteria with regard to the properties of our raw materials that we considered particularly important. Homogenization pools were also constructed for the mill and blunger slips. The residue content range was changed to 4.0-4.5 % with a range of 0.5 %. The grinding of the composition is done using 42 discontinuous mills and 5 blungers.

Since in later studies it was found that the opening of clays only by adding water without prior grinding in the blungers (clay mixers) caused changes in the residue and

water absorption values, to the extent that this affected the results, this slip was also put under close observation, to maintain a 0.5 % range for the residue as in the mills. The final slip was obtained by preparing a mixture in the mixing pools so that the blunger slip content would be 40 % and the content of the slip of hard aggregates ground in the mill would be 60 %. This was shown to be an important factor in ensuring a residue content with a 0.5 % deviation. In order to achieve this, a sufficient number of spray-drier pools were constructed and by mixing the products of the pools with different characteristics, it was attempted to obtain a homogenous mixture. Furthermore, with regard to the dimensional distribution checks for the press dies to be employed, a difference of 0.5 mm was adopted as the maximum allowable limit for a single press compartment, that is, for the difference between the dimensions of the 4 sides of a tile, and a difference of maximum 1mm in dimensions when all press compartments are taken into consideration. It has thus been possible to take the necessary measures for keeping the process parameters under control, which is regarded as the most import factor besides the raw materials and the composition. In order to achieve the same firing performance in all the kilns, the distribution of heat inside the kiln, and at kiln sides and centre should be homogenous. This required allowing a deviation of maximum 0.3 mm for a single kiln channel and a maximum of 0.5 mm for all the 22 channels. Furthermore a maximum ±5°C fluctuation was allowed in firing temperature in order to obtain desired dimensions.

Processes		1992	1999	Precautions
Raw Materials		Chemical Analysis	Chemical Analysis Shrinkage, Water Absorption Colour, Particle Size	To create parameters To ensure desired results
Residue	Range	5 – 6%	4,0 - 5,0%	To carry out the processing with maximum 0.5 % deviation at a suitable point in the 4.0-5.0 % range that would give the desired Result
	Max.Deviation	1%	0,5%	
Shaping Moisture	Range	5-6%	5,0 - 6,0%	To carry out the processing with maximum 0.5 % deviation at a suitable point in the 5-6 Range that would give the desired result
	Max.Deviation	1%	0,5%	
Specific Consolidation	Range	280 kg/cm^2	320 kg/cm^2	To carry out the process at a constant point In the 320±20 kg/cm^2 range that would give the desired result
	Max.Deviation	-	40 kg/cm^2	
Presses	In one compartment	-	0,5 mm.	To render the necessary controls and Adjustments in order to be able to carry out The process with defined deviations
	In all compartments	-	1 mm.	
Firing	Max. Temperature	1180 °C	1180 °C	To carry out the process at a suitable point in the 1180±5 °C range that would give the Desired result
	Max.Deviation	-	10 °C	
	Max. Deviation in One channel	-	0,3 mm.	To render the necessary controls and Adjustments in order to be able to carry out The process with defined deviations
	Max. Deviation In all channels	-	0,5 mm.	
Dimensional Calibration For 330x330 mm.	Dimensional Range	4 mm.	1,6 mm.	To render the necessary calibrations In the 1.6 mm dimensional range, with 1.2 mm working range
	Working Range	-	1,2 mm.	
Water Absorption	Max.	6,0%	3,0%	To render the necessary controls and Adjustments in order not to exceed the maximum 3 % limit
	Average.	4,0%	2,3%	

Table 1. *Working Parameters*

The table shows that as a result of all these studies, it was achieved to hold 98 % of the products within a single dimensional range, the remaining 2 % representing the deviation from this range being graded as second quality products.

If our target (as dictated by the existing market conditions) is to perform production with a single dimensional range with very narrow limits, then we are required to develop very consciously designed production parameters by fulfilling the following requirements:

- The acceptance criteria for raw materials should be well defined.
- The recipe should ensure grinding within very narrow limits, and a sufficient number of slip homogenizing pools should be provided.
- A very narrow range of shaping moisture content should be employed.
- A suitable specific consolidation pressure should be employed.
- The dimensional distribution of tiles between different compartments of pressing dies should be well monitored.
- Homogenous firing should be ensured in the kilns, both within a single channel and from channel to channel.