STUDY OF THE NEED TO DEFINE THE TILE CUT IN MEASURING MOISTURE EXPANSION ACCORDING TO ISO 10545-10

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1. INTRODUCTION

ISO 10545-10 [1] was published in 1995 and presents the test method for determining the moisture expansion of ceramic tiles. The test methodology indicates that 5 whole tiles should be used. If the measuring equipment is unable to measure the entire tile, a specimen with a minimum length of 100 mm and a minimum width of 35 mm shall be cut from the center of each part.

In Brazil there are laboratories that make the measurement using the whole ceramic tile and others that use the cut tiles. The results obtained using the whole tile and the cut tile may diverge completely compromising the credibility of ISO 17025 accredited laboratories. Considering the trend of large format tile production, cutting the specimen is becoming increasingly necessary.

The aim of this study is to show the differences in results obtained when using whole and cut tiles to show the need to define the ceramic tile cut.

2. MATERIALS AND METHODS

For the development of this work, a study was carried out using samples of absorption groups BIa, BIIb and BIII, whole and cut pieces in the central and lateral regions of ceramic tiles with dimension of 5 cm x 15 cm.

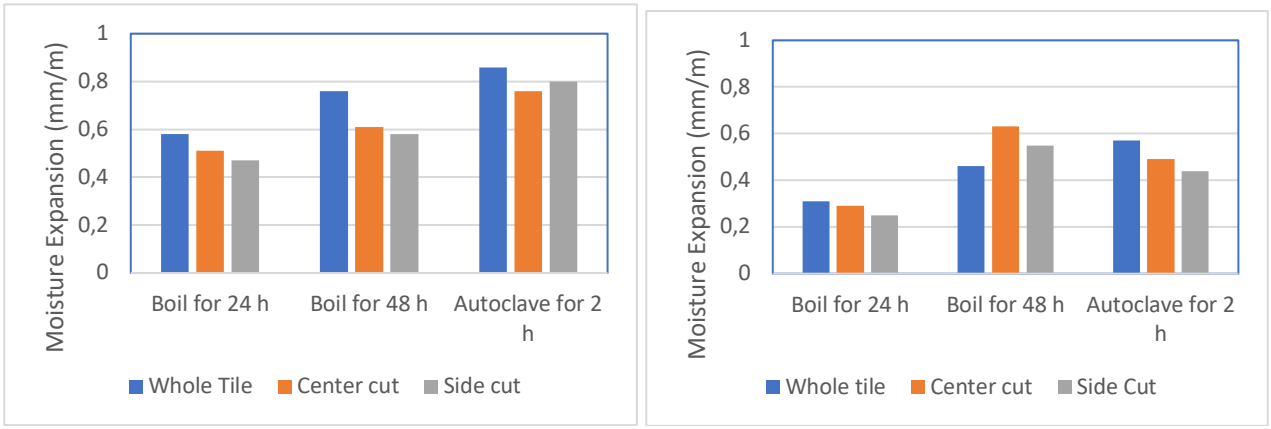
Three types of hydration were analyzed for the samples: boiling for 24 hours, boiling for 48 hours and autoclave (5 atm) for 2 hours. For the method of hydration by boiling for 24 hours, besides firing the specimens at the normative temperature of 550ºC, the samples were also refired at 500ºC.

Moisture expansion was measured using two types of equipment: 0.0005mm resolution dial and 0.01mm resolution caliper coupled to a measuring table.

3. RESULTS AND DISCUSSION

The samples corresponding to absorption groups BIa and BIII had moisture expansion values very close to zero and were therefore not considered in the study discussions. The study focused on absorption group (BIIb), which exhibited expansion that possibly enabled humidity measurement.

Figure 1 shows the results of moisture expansion for two BIIb samples at 550ºC for the 3 types of hydration studied with whole pieces, central sections and lateral sections. Whole parts exhibit greater moisture expansion when compared to cut parts, both center and side. It can also be seen that moisture expansion increases when the sample is subjected to more restrictive humidity and heat conditions.



(a) BIIb – sample A (b) BIIb – sample B

Figure 1. *Comparison of moisture expansion values as a function of cutting and hydration type: (a) BIIb - sample A and (b) BIIb - sample B.*

The moisture expansion results of the BIIb - A sample were also analyzed using Tukey 's multiple comparisons test in order to evaluate if the averages obtained are significantly equal in the whole and cut specimens in the central and lateral regions, as shown in the Table 1. Side Cut x Whole Tile, Center Cut x Side Cut and Central Cut x Whole Tile were analyzed in the three hydration methods studied.

In the 24-hour boiling and 48-hour boiling hydration methods the moisture expansion results obtained for the lateral and central sections are significantly equal. Comparing Side Cut x Whole Tile and Center Cut x Whole Tile the moisture expansion results obtained are significantly different.

Sample BIIb - A	Boiling 24 hours	Boiling 48 hours	Autoclave (5 atm) 2 hours
Central Cut	(0,51±0,04)	(0,61±0,05)	(0,76±0,03)
Lateral Cut	(0,47±0,02)	(0,58±0,03)	(0,80±0,02)
Whole Tile	(0,58±0,03)	(0,76±0,02)	(0,86±0,07)
Lateral Cut x Whole Tile	Significantly Different	Significantly Different	Significantly Equal
Lateral Cut x Central Cut	Significantly Equal	Significantly Equal	Significantly Equal
Central Cut x Whole Tile	Significantly Different	Significantly Different	Significantly Equal

Table 1. *Comparison of averages for different types of cut and hydration.*

Moisture expansion results for the normative 24-hour boil hydration method were analyzed using the Student's t-test to assess whether the averages obtained are significantly equal at the firing temperatures of 500 °C and 550 °C as shown in table 2.

Sample BIIb - A	Whole Tile	Central Cut	Lateral Cut
Boiling / 24 hours – Refired at 500ºC	(0,40±0,18)	(0,43±0,02)	(0,38±0,05)
Boiling / 24 hours – Refired at 550ºC	(0,58±0,03)	(0,51±0,04)	(0,47±0,02)
Boiling / 24 hours - 500ºC x 550ºC	Significantly Different	Significantly Different	Significantly Different

Table 2. *Comparison of moisture expansion averages values for different refiring temperatures.*

In the 24-hour boil hydration method, the moisture expansion results obtained for the refired temperatures of 500ºC and 550ºC are significantly different in all specimen types.

4. CONCLUSIONES

The results obtained in the study, so far, suggest the need for revision of ISO 10545-10 for the standardization of specimen cutting for the measurement of moisture expansion, considering that the results obtained in cut and whole parts differ significantly.

5. REFERENCES

[1] ISO 10545-10 (1995), Ceramic tiles Part 10: Determination of moisture expansion.