INTERLABORATORY TESTS OF CERAMIC TILES ACCORDING TO INTERNATIONAL STANDARDS ISO 10545

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Brazil is at present the world's second largest producer of ceramic tiles. However, its export volume is very low compared to that of other countries like China, Italy, and Spain, because most of its production is consumed in the domestic market.

The main importers of Brazilian products are from South America, Central America, and North America, while a small part also goes to Europe, Africa, and Asia.

Brazilian ceramic tiles are evaluated and tested according to Brazilian standard NBR 13818, which is similar to international standards ISO 13006 and ISO 10545. Recently, the Brazilian Association of Technical Standards (ABNT) approved a change in the Ceramic Tile Committee with a view to mirroring the ISO/TC 189 Committee. Brazil has participated effectively on the ISO/TC 189 Committee, which is reviewing standards ISO 13006 and ISO 10545, and the Ceramic Tile Committee will adopt the relevant changes and put them into effect. However, Brazil will not be adopting standard ISO 13006:2012 because it exhibits some incongruities with relation to Brazilian standard NBR 15463: Ceramic tiles – porcelain stoneware tile.

With a view to preparing for the adaptations of the ISO 10545 international standards, the CCB (Ceramic Centre of Brazil) Test Laboratory performed international tests with three reference laboratories in different countries (USA, Spain, and Portugal).

The following tests were conducted: dimensional characteristics - ISO 10545-2, Water absorption - ISO 10545-3, Modulus of rupture and breaking strength - 10545-4, Resistance to deep abrasion - ISO 10545-6, Resistance to surface abrasion - ISO 10545-7, Moisture expansion - ISO 10545-10, Chemical resistance - ISO 10545-13, Stain resistance - ISO 10545-14 and Slip resistance - Pendulum method - UNE-ENV 12633- Appendix A, Critical angle of slip - Ramp method - DIN 51130:2004 Section 5, Dynamic coefficient of friction - Tortus Method.

The tests were performed on products with water absorption classes BIa and BIIb and are detailed in Tables 1 and 2.

The performance of these interlaboratory tests allowed it to be verified and determined whether there were differences in the results of a sample of a given lot and in the tests in different laboratories. The results of this study were very interesting and few differences were identified between the participating laboratories (deep abrasion and surface abrasion).

The greatest difficulty found in this study was the shipment of the samples, as many reached their destination broken or such that some of the tests could not be performed. The weight of the samples also contributed to sample breakage and the difficulty of transporting the materials.

TEST	PART	PRODUCT	REQUIREMENT	A	B	C	D
Dimensional characteristics	2	Bianco Plus 40	Size (%) Maximum	-0.09	-0.03	---	0
			Thickness (%) Maximum	-1.44	-1.9	---	1.4
			Straightness (%) Maximum	0.02	0.02	---	0.03
			Rectangularity (%) Maximum	-0.04	-0.16	---	-0.17
			Centre Curvature (%) Maximum	-0.06	-0.06	---	-0.02
			Edge Curvature (%) Maximum	-0.10	-0.10	---	-0.05
			Warpage (%) Maximum	-0.03	-0.07	---	0.08
Water absorption	3	Bianco Plus 40	(%) average	0.0	0.1	0.05	0.04
Water absorption	3	BIIb (33701)	(%) average	7.9	8.0	---	---

Modulus of rupture and breaking strength	4	Bianco Plus 40	Modulus of rupture (N) average	2277	2400	2303	2133
			Modulus of rupture under bending (MPa) average	59.41	60	51.3	51.8
Resistance to deep abrasion	6	Bianco Plus 40	(mm^3) average	152.0	122	44.4	128
Resistance to surface abrasion	7	Orient Gold	Class (cycle)	2 (600)	2 (600)	---	3 (1500)
Resistance to surface abrasion	7	BIIb (Ilusão Black)	Class (cycle)	0 (100)	0 (100)	2 (600)	0 (100)
Moisture expansion	10	BIIb (Fortim CZ)	mm/m (average)	0.28	0.2	0.19	0.3
Chemical resistance	13	Bianco Plus 40	Ammonium chloride 100 g/L	UA	UA	UA	UA
			Sodium hypochlorite 20 mg/L	UA	UA	UA	UA
			Hydrochloric acid 3%	ULA	ULA	ULA	ULA
			Citric acid 100 g/L	ULA	ULA	ULA	ULA
			Potassium hydroxide 30 g/L	ULA	ULC	ULB	ULA
Chemical resistance	13	Pastilha	Ammonium chloride 100 g/L	GA	GA	GA	---
			Sodium hypochlorite 20 mg/L	GA	GA	GA	---
			Hydrochloric acid 3%	GLB	GLB	GLA	---
			Citric acid 100 g/L	GLB	GLB	GLA	---
			Potassium hydroxide 30 g/L	GLB	GLB	GLB	---
Stain resistance	14	Bianco Plus 40	Green staining agent	5	5	3	5
			Iodine in alcohol solution	3	5	5	5
			Olive oil	5	5	3	5

Table 1. Results of the tests according to standard ISO 10545.

TEST	STANDARD	PRODUCT	REQUIREMENT	A	B	C	D
Critical angle of slip	DIN 51130	Versatile AC	Angle (Class)	---	3.5º	---	---
Slip resistance	ENV 12633	Versatile AC	USRV (Class)	---	18 (Clase 1)	---	19 (Clase 1)
Dynamic coefficient of friction	TORTUS	Versatile AC	Dry	0.5	0.57	---	0.59
			Wet	0.4	0.43	---	0.56

Table 2. Results of the slip tests.