POLISHING OF HIGH-PERFORMANCE GREEN CERAMIC TILES MADE WITH INDUSTRIAL WASTE:A NEW PERSPECTIVE.

Soares Filho, J. E.[1,2]; Aurich, J. C.[1]; Sousa, F. J. P.[1,2]; Nascimento, R. M.[2]; Paskocimas, C. A[2]

[1]Institute for Manufacturing Technology and Production System - FBK Department of Mechanical and Process Engineering – FBK - University of Kaiserslautern PO Box 3049, D-67653, Kaiserslautern – Rheinland Pfalz – Germany

[2]Graduation Program in Materials Science and Engineering – PPGCEM Department of Materials Engineering - Federal University of do Rio Grande do Norte PO Box 1524, CEP 59078-900, Natal – Rio Grande do Norte – Brazil

1. INTRODUCTION

Currently, the literature is able to offer many fruitful results about the tribological behaviour and polishing process of porcelain stoneware tiles. Nevertheless, most of the investigations were focused on the range of the optimisation of the kinematics [1], abrasive sequence optimisation [2][3], computational simulations [4], and other phenomenological aspects of the polishing process of commercial compositions of porcelain stoneware tiles [5][6], as well as the examination of the polishing final quality with the consumer view [7]. Parallelly in previous works, several studies dealing with recycling and reuse of industrial wastes as alternative raw materials in porcelain tile manufacturing, but focusing on the ceramic processing and evaluation of the mechanical properties [8][9].

Although the link between both topics could be interesting from the economic and environmental point of view, the combination still lacks research. Thus, this investigation deals with a new perspective: the polishing of "green" porcelain stoneware tiles.

2. EXPERIMENTAL

The workpieces of porcelain stoneware floor tiles used for the polishing testing were obtained with *Grog* incorporated in 5 wt.%. In order to reproduce an industrial scratching condition as close as possible, an automatic laboratory polishing machine was used. The equipment and the polishing system are shown in figure 1. The sequence of the abrasive particles sizes used is described as the sequence of the grit numbers:#40, #60, #80, #120, #180, #240, #320, #400, #600, #1200, and #2500.

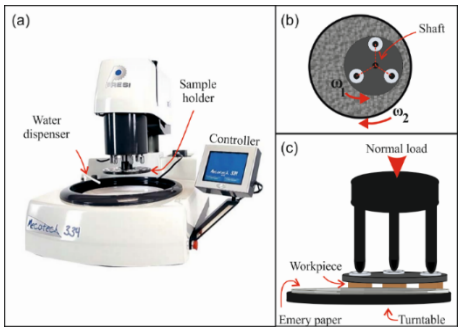

Figure 1. *(a) Tribometer used with the details of the (b) plan view of the top and the (c) plan view of the mounted system.*

3. RESULTS AND DISCUSSION

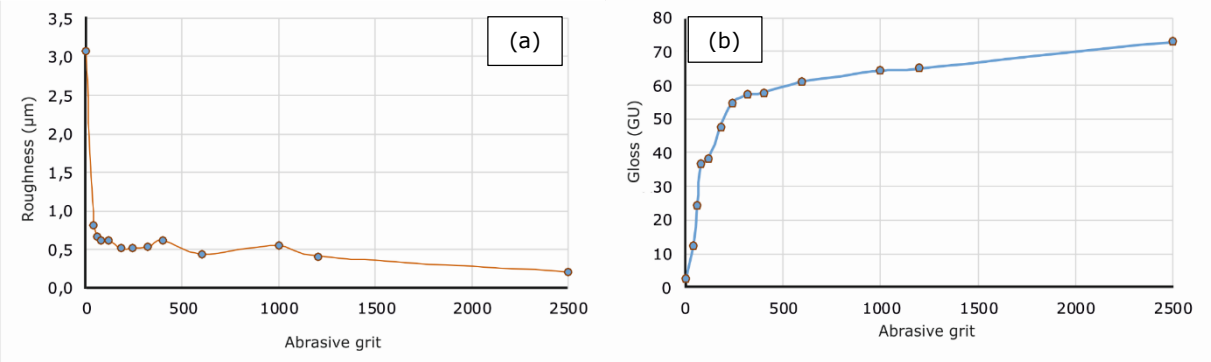

Figure 2. *Roughness (a) and gloss (b) development through the abrasive sequence.*

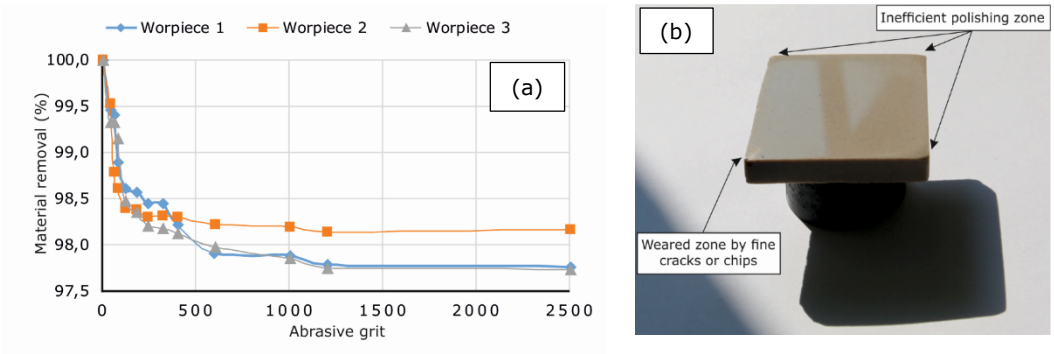

Figure 3. *Roughness (a) and gloss (b) development through the abrasive sequence.*

4. CONCLUSIONS

The experimental results presented in the paper demonstrate that innovative "green" product with excellent performance combined with great aesthetics can be produced by incorporating red grog ceramic into porcelain stoneware tiles compositions, valuing a waste used as landfill in civil construction or otherwise disposed wrongly in the environment.

5. REFERENCES

[1] F. J. P. Sousa, D. S. Hosse, J. C. Aurich, M. Engels, W. L. Weingaertner, and E. Alarcón, "Simulation and analysis of an alternative kinematics for improving the polishing uniformity over the surface of polished tiles," *Boletín la Soc. Española Cerámica y Vidr.*, vol. 49, no. 4, pp. 242–247, 2010.

[2] I. M. Hutchings, K. Adachi, Y. Xu, E. Sánchez, M. J. Ibáñez, and M. F. Quereda, "Analysis and laboratory simulation of an industrial polishing process for porcelain ceramic tiles," *J. Eur. Ceram. Soc.*, vol. 25, no. 13, pp. 3151–3156, 2005.

[3] I. M. Hutchings, Y. Xu, E. Sánchez, and M. J. I. M. F. Quereda, "Optimización del proceso de pulido para piezas de gres porcelánico," in *Qualicer*, 2006, no. 1, pp. 405–414.

[4] F. J. P. Sousa, W. L. Weingaertner, and O. E. Alarcon, "Computational Simulation of the Polishing Process of Porcelain," pp. 359–367, 2008.

[5] F. J. P. Sousa, R. G. de Souza, O. E. Alarcon, and M. Engels, "Glossiness and Slipperiness of Polished Porcelain Stoneware Tiles," *Int. Ceram. Rev.*, vol. 2, pp. 128–133, 2010.

[6] F. J. P. Sousa, O. E. Alarcon, W. L. Weingärtner, M. C. Fredel, M. F. Q. Vázquez, and E. S. Vilches, "Evaluation of texture distribution during the industrial polishing process of porcelain stoneware tiles," *J. Eur. Ceram. Soc.*, vol. 33, no. 15–16, pp. 3369–3378, 2013.

[7] C. Cass and B. E. D. T. Técnico, "Optical haze on polished porcelain tiles, a consumer ' s perspective," in *Qualicer 2010.*, 2010, pp. 1–16.

[8] K. Kim, K. Kim, and J. Hwang, "Characterization of ceramic tiles containing LCD waste glass," *Ceram. Int.*, vol. 42, no. 6, pp. 7626–7631, 2015.

[9] D. Gouvêa, T. T. Kaneko, H. Kahn, E. De Souza Conceição, and J. L. Antoniassi, "Using bone ash as an additive in porcelain sintering," *Ceram. Int.*, vol. 41, no. 1, pp. 487–496, 2015.