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Evaluation of performance of modified sodium lignosulfonate additives as reinforcing agent in porcelain stoneware tiles

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ABSTRACT

Different kinds of sodium salt lignosulfonate at different percentages were added to a porcelain stoneware suspension and the effects of these modified lignosulfonates on the rheological properties of slips and on the mechanical properties of formed samples were investigated. As the presence of sulfonates groups can change the stability of dispersion, a rheological characterisation was necessary to find the critical concentration to obtain well dispersed suspensions and high MOR values. The interaction between the dispersant and the additive was also studied to evaluate the possibility to reduce the dispersant amount in the presence of the additive. The suspensions stability was tested by oscillatory measurements and the increase of elastic modulus in the suspension corresponded in a MOR and in Young's modulus increase as well.
The results of this study indicate that an increment of additive causes an increase of viscosity and time dependency so that, it is important don't increase the additive amount more than 0.5wt%. The increment of additive concentration causes probably a network between the clay particles as the time dependency phenomena. This indicates that a building up process occurs when the additive concentration increases. At 1wt%, this phenomenon is particularly significant and MOR increases in these samples. The MOR increase is probably due to the structure which was formed in the presence of additive. This structure is maintained until the lignosulphonate is present, but when it is burnt, the particles probably tend to maintain a memory of the previous structure. In fact, after a thermal treatment at 300°C, the MOR values of samples with lignosulfonate were higher than those of the non additivated samples even though these values decreased when compared with the values found testing the dried samples. These results suggested to explain this behaviour by means of the model described in the attached Figure, where the authors supposed that during the sintering process, the liquid phase should substitute the burnt lignosulfonate.
However, this assumption in not enough to justify the trend under examination. In fact, considering a sample in which the particles are got closer because of the presence of polymer, it is justified to expect a probable decrease of the sintering temperature as well as a value of MOR higher than that relative to the sample without the additive. These hypotheses are in agreement to the model above proposed in which it was suggested that the material retains a memory of the process before firing.