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Study of Morphological Changes of The Lime Putties During Maturing by SEM/ESEM

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The lime putty belonged in the past to the traditional materials with a wide application in the construction. It used to be prepared from a stone lime and it featured with good workability, plasticity, and durability. The traditional preparation of the lime putty was replaced by the modern chemical-technological processes. The lime putty is essential for the restoration of the historic plaster, wall painting, sgraffito etc. Lime putty is obtained by hydration of calcined limestone in an excess of water according to the following equation [1, 2, 3, 4]: $CaO + H_2O \rightarrow Ca(OH)_2 + 65\ kJ \cdot mol^{-1}$.

The lime putties PA (the lime powder) and PB (the stone lime) were prepared by mixing 200 g of lime and 640 ml of boiled deionized water. The lime putty PC (the lime powder) was prepared in the same way as the lime putties PA and PB, only it was mixed 5 minutes after mixing. The fresh lime putties were immediately stored in the plastic bottles and they were supplemented with water to avoid carbonation with CO_2 and air drying. The samples were observed using the high resolution scanning electron microscope (HR-SEM) JEOL JSM 6700F (the beam energy 5 keV, the working distance of 8 mm, Everhart-Thornley detector) after 3, 30, and 90 days. The samples were rinsed with 10 ml of acetone in order to stop their hydration and 10 ml diethylether, which served to eliminate $CaCO_3$. Next, all samples were dried under the nitrogen atmosphere in order to eliminate the influence of CO_2 and gold sputtered. The sample of the lime putty PA was observed in its natural state using the environmental scanning electron microscope (ESEM) AQUASEM II (the beam energy 20 keV, the water vapour pressure of 800 Pa, the ionization detector).

During the maturation of the lime putties the regular hexagonal crystals of $Ca(OH)_2$ are transformed into the smaller irregular crystals which are coated with the layer of hydrogel which increases during the maturation (Fig. 1). The layer of hydrogel is already visible after three days of the maturation (Fig. 1BI and 1C1). The quantity of hydrogel is greatest at the lime putty PB (Fig. 1BIII) and the lime putty PC (Fig. 1CIII). Use of the stone lime is best for the maturing of the lime putties. The process of the particles disrupting immediately after the hydration accelerates the hydrogel formation on the surface of the crystals of $Ca(OH)_2$. The HR-SEM is a suitable for the evaluation of the morphological changes during the maturation of the lime putties; however, this method makes the heightened demands on the sample preparation and therefore it can introduce inaccuracies into the characterization of microstructure. ESEM provides very similar information as the HR SEM (Fig. 2) but samples are in natural state and free of artefacts. All requests for poster presentations will be honored [5].

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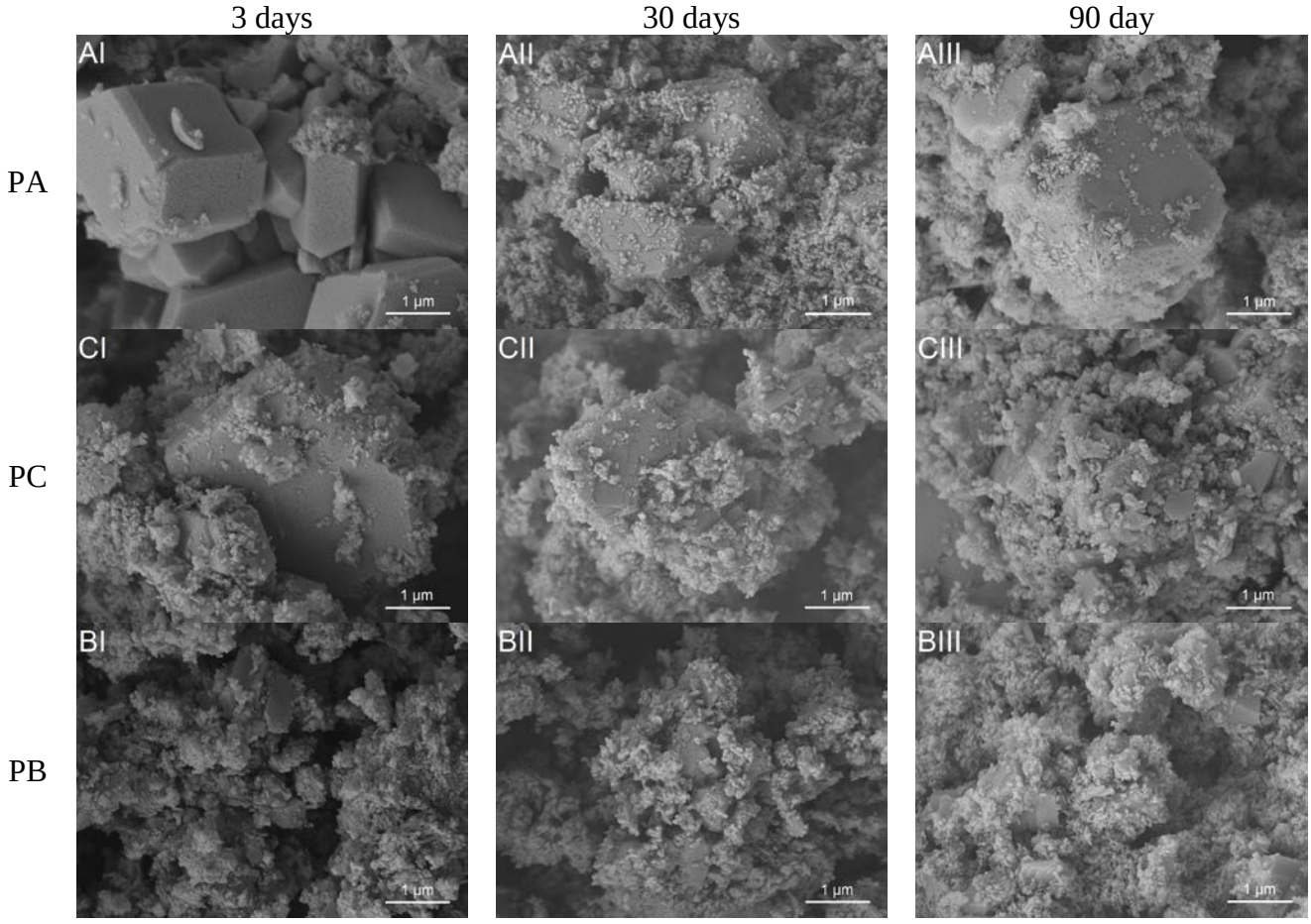

Figure 1. The microstructure of the lime putties PA, PB, and PC during their maturation and at the time 3, 30, and 90 days (HR-SEM JEOL JSM 6700F)

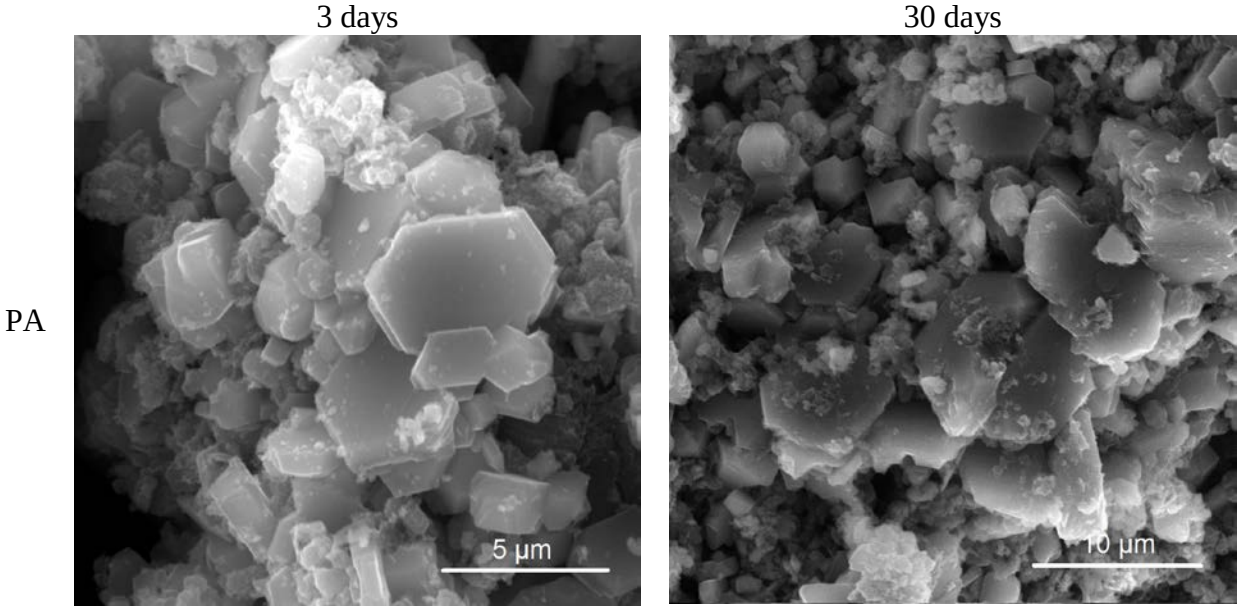

Figure 2. The microstructure of the lime putties PA during their maturation and at the time 3 and 30 days (ESEM AQUASEM II)

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