PRODUCING POROUS POLYMER COMPOSITES

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ПОЛУЧЕНИЕ ПОРИСТЫХ ПОЛИМЕРНЫХ КОМПОЗИТОВ

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Аннотация. *В данной работе мы экспериментально убедились в целесообразности использования метода прессования форм из композита с примесью NaCl с последующим удалением соли для получения пористой структуры композитов.*

Introduction. One of the most important problems in contemporary medicine and biochemistry is producing materials for bound defects substitution to meet the necessary requirements, that is, mechanical strength, biocompatibility, bioactivity, and bioresorbability. Polylactide- and hydroxyapatite-based materials display the mentioned qualities, namely, hydroxyapatite induces bone tissue regeneration – while polylactide is capable of bioresorbable frame function performance. To make practical application more efficient, we need to prioritize the porous structure composites production process. Our research target is to examine and apply more efficient methods of porous structure obtainment for the purpose of their further application. There exist numerous of ways to obtain porous structure, such as foaming, porogen removing, loose packing, 3D-printering, etc. Pressing shapes from a composite with a) simultaneous NaCl addition and b) subsequent rinse are one of the quick and cheap techniques for the porogen removal method.

Materials and research methods. To produce porous structure, we used a composite containing hydroxyapatite (30%) and polylactide (70%). We mixed powders of the initial components adding various quantitative values of NaCl (25%, 35%, and 50% of the sample weight). Composite mixture was stirred with a hand press and then placed into distilled water for salt removal. The soaking was being conducted throughout one-week period upon permanent water change. To ensure the complete porogen removal, the authors determined chloride-ions via qualitative reaction with silver nitrate. Upon completion of this stage, the samples were dried. For porosity evaluation, the SEM method was employed. Electron photomicrohraphs were obtained via Hitachi TM–300 at acceleration voltage = 15 kV under condition of sample electrostatic elimination (electron-beam gun, $5 \cdot 10^{-2}$ Pa, sample chamber, 30-50 Pa). The received images corresponded to 1000 and 3000 times enlargement.

Results. Composite samples with NaCl addition (50%) proved to be mechanically unstable, which possibly goes up to the after-removal bond absence between the matrix and the filler. Samples with 25% and

35% salt addition demonstrate sufficient mechanical strength and surface roughness. SEM-images confirm the fact that composites with 25% and 35% of NaCl addition display of micrometer scale.

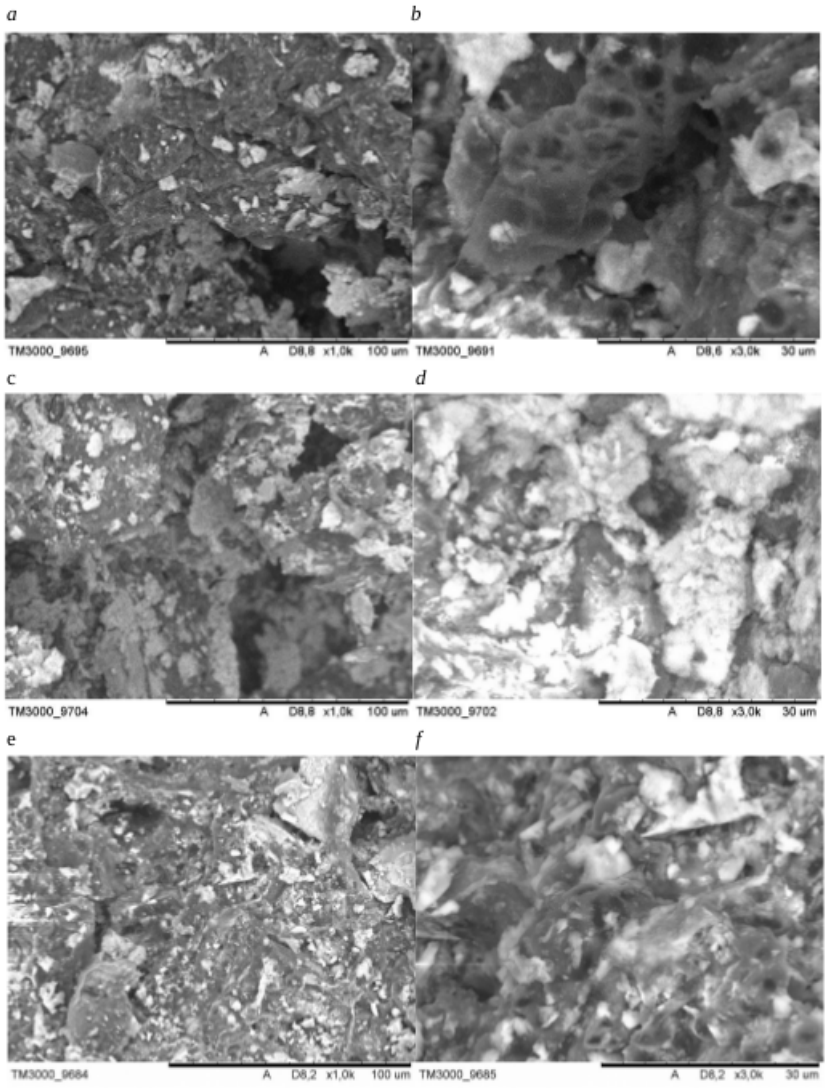

Fig. 1. SEM-image of samples with 25% NaCl addition, zoom x1000(a), x3000(b); 35% NaCl addition, zoom x1000(c), x3000(d); 50% NaCl addition, zoom x1000(e), x3000(f)

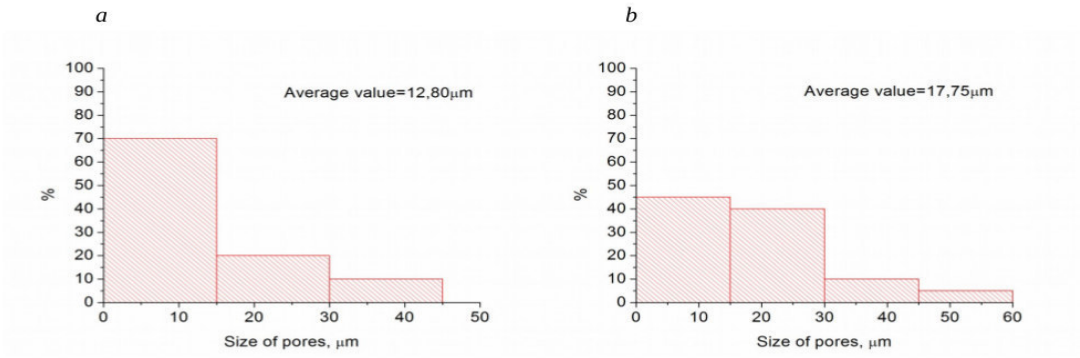

Fig. 2. Histogram of pores size for samples with 25% NaCl addition(a); 35% NaCl addition(b)

According to the histogram (Fig. 2), pore size for these samples is practically identical and variates from 5 to 60 micrometers. The sample with 50% NaCl addition displays relative pore absence. Sample breakage is presumably connected with mechanical instability of composite material; moreover, we can note that hydroxyapatite particles are located regularly within the polylactide frame. according to the histogram (Fig. 3), the particle size variates from 1 to 60 micrometers. As it could be predicted, the pore size and localization predominates in case of the second sample containing higher percentage of salt component.

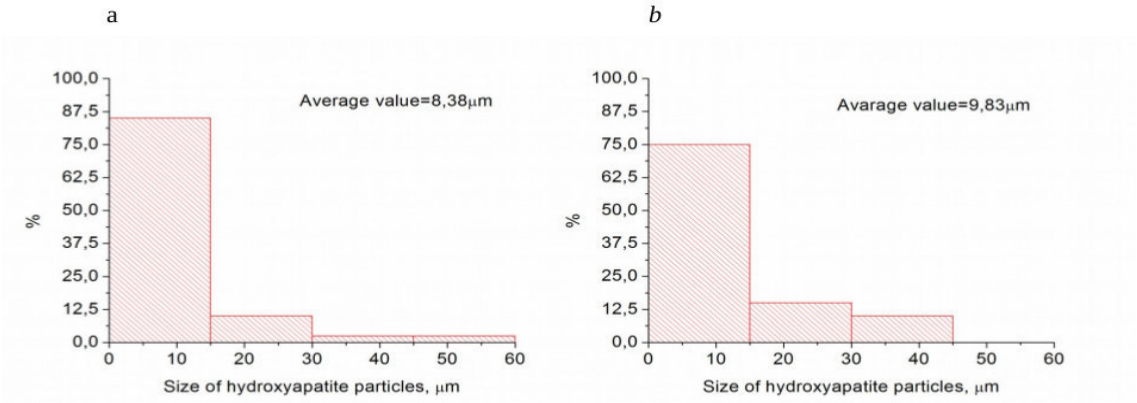

Fig. 3. Histogram of hydroxyapatite particles size for samples with 25% NaCl addition(a); 35% NaCl addition(b)

Conclusion. Porous composite samples containing 70% of polylactide and 30% of hydroxyapatite have been obtained. We added variable amounts of NaCl into the samples for obtainment of required composite porosity. Pores have been produced via addition of NaCl (25%, 35%, and 50%). The selected method is simple and available enough for producing composites with up to 50–70 micrometer porosity.

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