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КОМПОЗИТЫ ЦЕЛЛЮЛОЗА–ХИТОЗАН: ТЕНДЕНЦИИ РАЗВИТИЯ НОВЫХ ТЕХНОЛОГИЙ И ПЕРСПЕКТИВЫ ИХ ВНЕДРЕНИЯ

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Цель работы — анализ современного состояния исследований в области получения композитов целлюлоза–хитозан и оценка перспектив масштабирования предлагаемых лабораторных технологий до промышленного уровня.

Приводится описание способов получения композитов целлюлоза–хитозан в виде волокон, пленок, мембран и свойств полученных продуктов. Выделено три основных метода получения композитов: поверхностная обработка целлюлозных волокон растворами или дисперсиями частиц хитозана; введение микро- или наноразмерных частиц одного полимера в раствор другого и совмещение полимеров в растворе. Показано, что в зависимости от способа получения композиционного материала совмещение целлюлозы с хитозаном осуществляется на уровне макромолекул, надмолекулярных образований и наночастиц. Предложен новый способ совмещения целлюлозы с хитозаном путем их растворения в ортофосфорной кислоте с образованием гомогенных растворов, пригодный для реализации производства композитов целлюлоза–хитозан в промышленном масштабе. Для всех остальных способов указаны причины, ограничивающие возможности их внедрения, которые обусловлены как неудовлетворительными механическими свойствами в случае получения композиционных материалов из гетерогенных многофазных систем, так и многостадийностью или нерентабельностью процесса из-за высокой стоимости растворителей в случае формования из растворов.

Ключевые слова: композиты, нанокомпозиты, целлюлоза, хитозан, растворы, волокна, плёнки, мембраны.

CELLULOSE–CHITOSAN COMPOSITES: TRENDS IN THE DEVELOPMENT OF LABORATORY TECHNOLOGIES AND PROSPECTS FOR IMPLEMENTATION

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The purpose of this work is to analyze the current state of research in the field of obtaining cellulose–chitosan composites and to assess the prospects for scaling the proposed laboratory technologies to an industrial level.

A description is given of methods for obtaining cellulose–chitosan composites in the form of fibers, films, membranes, and the properties of the obtained products. Three main methods for obtaining composites have been identified: surface treatment of cellulose fibers with solutions or dispersions of chitosan particles; the introduction of micro- or nano-sized particles of one polymer into a solution of another and the combination of polymers in solution. It is shown that, depending on the method of obtaining a composite material, the combination of cellulose with chitosan is carried out at the level of macromolecules, supramolecular formations, and nanoparticles. A new method for combining cellulose

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with chitosan by dissolving them in phosphoric acid with the formation of homogeneous solutions is proposed, which is suitable for the production of cellulose–chitosan composites on an industrial scale. For all other methods, the reasons limiting the possibilities of their implementation are indicated, which are due to both unsatisfactory mechanical properties in the case of obtaining composite materials from heterogeneous multiphase systems, and the multi-stage or unprofitable process due to the high cost of solvents in the case of spinning from solutions.

Keywords: composites, nanocomposites, cellulose, chitosan, solutions, fibers, films, membranes.

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