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Ways of intensification the processes of cellulose esterification and displacement of waste acids

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Abstract

The paper analyzes the industrial production of cellulose nitrates with ternary mixtures of acids, shows the main disadvantages of the technology and the negative impact on the environment. Development of new environmentally friendly and economically acceptable technologies for cellulose nitration and expanding the field of practical use of cellulose nitrates in the form of special films, biological membranes, etc. with more stringent requirements for their molecular homogeneity, stimulates the development of research in this direction.

It is shown that the formation of an activated complex for the nitration of cellulose in an aqueous solution of nitric acid is the molecular form of nitric acid in the form of a dimer ($\text{HNO}_3 \cdot \text{HNO}_3$). The dissolution of cellulose depends on the rate of diffusion of the polymer into the solution and occurs on the outer surface of the cellulosic material. The joint occurrence of a chemical reaction - the process of swelling-dissolution - of the polymer re-settling is described by the Damkeller criterion. The requirements for the feedstock to reduce the formation of a gel-like solution at the stage of cellulose nitration and on the suitability of cellulose nitrates for further processing into products have been identified.

It is shown that the transition from the traditional technology of cellulose nitration with mixtures of nitric and sulfuric acids to a new technology of sulfur-free cellulose nitration is promising. Works on cellulose nitration in devices for gas-liquid interaction of cellulose particles in the form of "rhombs" for wetting and separation from the nitrating reagent have been carried out. Cellulose in the gunpowder industry is used in the form of roll paper, which is cut into particles with dimensions of 3x3x0.35 mm. The process of cellulose esterification was tested stepwise in a cascade of apparatus in the industrial conditions of a gunpowder factory.

New devices for stepwise wetting and separation of the spent acid mixture from cellulose nitrates in a countercurrent flow improve the quality of the resulting product, significantly reduce the duration of the process and solve the problem of environmental protection.

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