ABSTRACT

Alginates are biopolymers of natural origin with unique properties such as biodegradability, biocompatibility and the ability to form gels. These allow them to be widely used in the food, pharmaceutical and medical industries, as well as in the textile industry, including the manufacture of fibres. An unavoidable limitation when forming alginate fibres is the possibility of using only low concentrations of sodium alginate spinning solutions. The solution to this limitation may be using ammonium alginate as a spinning fluid. The spinning solutions of this polymer are characterised by lower values of dynamic apparent viscosity, which makes it possible to significantly increase the concentration of the solution and, thus, the efficiency of the spinning process.

The research aimed to assess the possibility of using ammonium alginate in alginate fibre formation. The first stage of the research was to develop a process for modifying alginic acid to obtain ammonium alginate solutions. The first method involved the synthesis of ammonium alginate in the gas-solid phase, from which aqueous solutions were then prepared. The second method analysed in this study was the direct dissolution of alginic acid in an aqueous ammonia solution to obtain ammonium alginate solutions.

The next stage of the research carried out in this study was to evaluate the possibility of using ammonium alginate solutions in the process of fibre formation from calcium alginate using the wet-spinning method. The ammonium alginate solutions produced in the study are characterised by high stability over time and homogeneity, with relatively low values of apparent dynamic viscosity even at a concentration of 15%, twice that of the solutions obtained for sodium alginate. A slightly lower tenacity at break characterised the fibres obtained during the work compared to those obtained from the sodium alginate solution. However, it is important to note that the efficiency of this process was 2.5 times higher compared to the classic process of forming alginate fibres using sodium alginate as the spinning fluid. In addition to calcium alginate fibres, the work also produced copper alginate and zinc alginate fibres with slightly lower or similar tenacity at break compared to calcium alginate fibres.

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The possibility of using solutions of much higher concentration, compared to the traditional approach using sodium alginate, makes it possible to obtain homogeneous fibres of high quality.

The research carried out in this study has confirmed that highly concentrated ammonium alginate solutions allow fibres to be formed from them using wet solution and electrospinning methods.