

Production of microcrystalline cellulose by reactive extrusion

Abstract

This process involves feeding cellulose into an extruder with an acid solution. The extruder is comprised of a screw and a barrel. The screw is rotated so as to pressurize the cellulose, and the cellulose undergoes acid hydrolysis and forms microcrystalline cellulose. The invented process can be accomplished by using pure cellulose or a lignocellulosic material as the starting material. If a lignocellulosic material is used, then a basic solution is added to it and the lignocellulosic material is fed through an extruder so as to obtain a mixture comprising lignin, hemicellulose and cellulose. The lignin and hemicellulose are extracted and the remaining cellulose is processed, as discussed previously, to form microcrystalline cellulose.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide a process for producing microcrystalline cellulose by means of reactive extrusion in order to provide a quicker process for producing microcrystalline cellulose.

Another object of the present invention is to provide a continuous process for producing microcrystalline cellulose so that MCC may be produced in a quick and efficient manner.

It is a further object of the present invention to provide a process of producing MCC that uses less acid than previous processes so that less acid waste is created.

Another object of the present invention is to provide a process for producing small particles of MCC so that there is no need for mechanically grinding the particles produced.

A further object of the present invention is to provide a simple, economical, and environmentally-friendly process for producing microcrystalline cellulose so that microcrystalline cellulose may be created for a variety of applications.

According to the present invention, the foregoing and other objects are achieved by a process for producing microcrystalline cellulose by means of reactive extrusion. This process can be a one-step process if pure cellulose is used as a starting material and is a two-step process if a lignocellulosic material is used as the starting material.

In the first step of this process, the lignocellulosic material is extruded with a basic aqueous solution in order to destroy the lignocellulosic complex. The lignocellulosic complex is broken into lignin, hemicellulose, and cellulose. Following extrusion, the lignin and the hemicellulose are extracted with a heated basic solution, and the remaining cellulose is washed. The cellulose can be bleached or further processed to microcrystalline cellulose without bleaching.

In the second step of this process, pure cellulose or the cellulose obtained from the lignocellulosic material undergoes reactive extrusion. The cellulose material is fed into an extruder with an acid solution. The cellulose, which is pressurized by the screw of the extruder, is hydrolyzed by the acid. After extrusion, the resulting microcrystalline cellulose product is washed, bleached and dried. The size of the resulting microcrystalline cellulose particles depends on the starting material used and the extrusion conditions.

Additional objects, advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned from practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.