

DEVICE FOR KEEPING AND DELIVERING A HOMOGENEOUS CELLULOSE SUSPENSION

The present invention is concerned with a device for keeping and delivering a homogeneous cellulose suspension, i.e. a substantially cylindrical mixing vessel and an inlet for the homogeneous suspension, a stirring shaft having stirring elements attached thereto, said stirring shaft being arranged axially within the cylindrical mixing vessel and a discharge device for the homogeneous suspension.

For some decades there has been searched for processes for the production of cellulose moulded bodies able to substitute the viscose process, today widely employed. As an alternative which is interesting among other reasons for its reduced environmental impact, it has been found to dissolve cellulose without derivatisation in an organic solvent and extrude from this solution moulded bodies, e.g. fibres, films and membranes. Fibres thus extruded have received by BISFA (The International Bureau for the Standardization of man made fibers) the generic name Lyocell. By an organic solvent, BISFA understands a mixture of an organic chemical and water.

It has turned out that as an organic solvent, a mixture of a tertiary amine-oxide and water is particularly appropriate for the production of cellulose moulded bodies. As the amine-oxide, primarily N-methylmorpholine-N-oxide (NMMO) is used. Other amine-oxides are described e.g. in EP-A - 0 553 070. A process for the production of mouldable cellulose solutions is known e.g. from EP-A - 0 356 419. The production of cellulose moulded bodies using tertiary amine-oxides is generally referred to as amine-oxide process.

In US-A - 4,246,221, an amine-oxide process for the production of spinnable cellulose solutions using as starting material among other substances a mixture of cellulose in liquid, aqueous N-methylmorpholine-N-oxide (NMMO) is described. This is a multi-step process. First, a suspension of cellulose in the aqueous amine-oxide solution is prepared

-2-

in a discontinually operated mixing device, the mixture being simultaneously heated at reduced pressure, while water is withdrawn and a first solution is prepared. Next, this first solution is kept in a tank serving as buffer vessel, then conducted to a filtration device and thereafter transformed into a mouldable solution in an extruder. Finally, the mouldable solution is spun to filaments in a forming tool, such as a spinneret, said filaments being eventually conducted through a precipitation bath.

From WO 94/28217, a process for the production of a premixture based on cellulose, wherefrom a mouldable cellulose solution may be prepared, is known. According to this process, shredded cellulose and an amine-oxide solution are introduced into a horizontal cylindrical mixing chamber exhibiting a rotor having axially spaced stirring elements. The mixture is stirred in the mixing chamber by turning the rotor at a rate of from 40 to 80 revolutions per minute. Preferably, the mixture in the mixing chamber is kept at a temperature of above 65°C. In WO 94/28217, there also is described a funnel-shaped tank which is vertically disposed and wherein stirring arms are provided. In this tank, the premixture is to be kept in a homogeneous state. The homogeneous premixture is removed by means of reciprocating pumps.

As mentioned above, the amine-oxide process involves a number of steps extending from the shredding of the cellulose, the preparation of the cellulose suspension, optionally a subsequent further homogenization of the cellulose suspension, and the transformation of the homogeneous cellulose suspension into a mouldable cellulose solution to the moulding process itself, i.e. the production of fibres, films or other moulded bodies. Since each of the process steps is required to deliver its corresponding product in a constant quality, it is desired to operate each of the process steps continuously and, if possible, without interruption. Still, when an interruption occurs at one step,

-3-

for instance because the forming tool is exchanged or the device wherein the cellulose suspension is produced is stopped for a short time, it is the endeavour of the expert that, if possible, the other process steps are not affected by this short-time interruption. Up to now however, this objective has not yet been satisfactorily attained.

Thus it is the object of the present invention to carry out the amine-oxide process in such a way that the process as a whole is able to overcome short-time interruptions and that a short-time interruption of one step of the process does not imply an interruption of the other steps.

According to the invention, this object is attained by providing a device exhibiting the following features:

- (1) a substantially cylindrical mixing vessel and an inlet for the homogeneous suspension,
- (2) a stirring shaft having stirring elements attached thereto, said stirring shaft being arranged axially within the cylindrical mixing vessel and keeping the suspension introduced through the inlet in a homogeneous state by means of rotation,
- (3) a discharge device for the homogeneous suspension,

and is characterized in that the discharge device is a conveyor screw attached to the bottom of the mixing vessel, the conveyor screw being connected to the interior of the mixing vessel.

The invention is based on the finding that the object of the present invention can best be attained by means of a vessel able to serve as a buffer for the homogeneous cellulose suspension, on the one hand always containing a certain amount of homogeneous suspension which when interrupting the production of suspension for a short time serves as a reserve

-4-

and whereby during the time of interruption cellulose solution may be produced and the forming tool may be fed, so that it is not necessary to interrupt e.g. the production of the fibres. On the other hand, the vessel according to the invention must have a certain void in order to be able to receive additional homogeneous suspension, so that it is not necessary to interrupt the production of the suspension during a short-time stop of the spinning operation, e.g. when exchanging the spinneret.

When keeping homogeneous suspensions of cellulose in an aqueous amine-oxide solution, a particular problem consists in avoiding a segregation of the homogeneous suspension, i.e. a separation of the cellulose from the liquid phase. This risk also occurs when the homogeneous suspension is delivered to the subsequent process step. Both problems have been solved by means of the device according to the invention. It has been shown that a separation of the cellulose at the discharge step can be successfully avoided when a conveyor screw connected to the interior of the mixing vessel is provided for discharging. Thus the catchment zone of the conveyor screw is to open directly into the interior of the mixing vessel.

In the device according to the invention, it is also possible to avoid the sticking of cellulose particles impregnated by amine-oxide solution to the vessel wall or the formation of agglomerates. It is decisive to keep the suspension constantly moving.

Furthermore, it has been shown that in the device according to the invention no segregation of auxiliary agents such as stabilizers, dispersants, auxiliary spinning agents, reactivity-improving reagents, incorporation media of an inorganic or organic nature (barite, activated carbon, SiO₂, CMC, modifiers (polyethyleneglycoles) and other polymers such as nylon; dyes contained in the suspension; will occur. This is of decisive importance for these auxiliary agents to

-5-

develop their maximum effect. A preferred embodiment of the device according to the invention is characterized in that stirring elements are provided which are arranged such that they sweep over the discharge outlet.

Another appropriate embodiment of the device according to the invention consists in that the conveyor screw is provided diametrically opposed to the inlet.

It has proven advantageous to design the device according to the invention in such a way that the ratio of the receiving capacity of the discharge element to the receiving capacity of the cylindrical mixing vessel amounts to at least 1 : 100.

By means of the attached drawings, an embodiment of the device according to the invention will be described in more detail.

The Figure schematically shows a longitudinal section of a horizontally mounted mixer consisting substantially of a cylindrical vessel 1 having a double-jacket for indirect heating (not represented) and a rotor 2 having stirring blades 3 attached thereto being arranged centrically within vessel 1. Rotor 2 is driven by means of a motor 4.

The homogeneous cellulose suspension is introduced into the cylindrical vessel 1 through inlet 5, seized by the transport blades 3 and constantly mixed and kept moving in the interior of vessel 1 by means of stirring blades 3.

The homogeneous suspension is removed from vessel 1 by means of the conveyor screw driven by motor 9 and conducted by means of a pump 8 for instance to a device (not shown) wherein the suspension is transformed into a mouldable solution in a continuous manner. Appropriately, a thin-film treatment apparatus is employed for this procedure. Such a process is known from EP-A - 0 356 419.

-6-

The catchment zone of conveyor screw 7 is directly connected to the interior of vessel 1. Conveniently, the conveyor screw 7 is attached by flange to the bottom of vessel 1, and the outlet 6, that is to say the connection between the catchment zone of conveyor screw 7 and the interior of vessel 1, may have square or rectangular shape.

At normal operation, approximately half of vessel 1 is filled with homogeneous suspension.

A device disposed as a mixer and consisting substantially of vessel 1, rotor 2 having stirring elements 3 attached thereto, motor 4 and inlet 5, is commercialized by the company Draiswerke GmbH, Mannheim, Germany, under the name of turbulent mixer of the KT 1000 FM I type. In this turbulent mixer however, the outlet is provided centrically as a kind of flap at the lower end of the bulge of the vessel. This kind of removal of mixed material is not appropriate for homogeneous cellulose suspensions, since the mixed material would segregate when removed. On the contrary, segregation is successfully avoided by means of the conveyor screw provided according to the invention.

CLAIMS



1. A device for keeping and/or delivering homogeneous suspensions of shredded cellulose in a liquid, aqueous tertiary amine-oxide exhibiting the following features:

 (1) a substantially horizontal cylindrical mixing vessel having an inlet for the homogeneous suspension,

 (2) a stirring shaft having stirring elements attached thereto, said stirring shaft being arranged axially within said cylindrical mixing vessel and keeping the suspension introduced through said inlet in a homogeneous state by means of rotation,

 (3) a discharge device for the homogeneous suspension,

 characterized in that the discharge device is a conveyor screw attached to the bottom of the mixing vessel, the conveyor screw being connected to the interior of the mixing vessel.
2. A device according to Claim 1, characterized in that stirring elements are provided which are arranged such that they sweep over the discharge outlet.
3. A device according to Claim 1 or 2, characterized in that the conveyor screw is provided diametrically opposed to the inlet.
4. A device according to one of the Claims 1 to 3, characterized in that the ratio of the receiving capacity of the discharge device to the receiving capacity of the cylindrical mixing vessel amounts to at least 1:100.

