Description

The invention relates to a soft material separator according to the preamble of claim 1 and to a method for operating such a soft material separator.

A soft material separator is a device for isolating and separating a substance mixture made up of substance components having different consistencies. Soft material separators are used, for example, to process products having varying solid, varying flowable, or varying soft textures, particularly for processing food products, such as meat products. For example, soft material separators can strain and de-sinew different types of meat in order to produce so-called mechanically separated meat. Soft material separators are also suitable for the production of skinless and boneless fish farce, for the production of fruit and vegetable juices or pulps, and they are also well-suited for the production of purée made from tuber vegetables, such as potatoes. Some of the fields of application of soft material separators even extend all the way to the recycling industry, for example in order to extract the contents of discarded packaging.

A soft material separator typically has a perforated drum configured so as to be substantially rotationally symmetrical and to have holes on its circumference, and this drum can be turned about its rotational axis. A continuous squeezing band is positioned on a portion that runs tangentially to the circumferential wall of the perforated drum. The perforated drum and the squeezing band can be operated by means of a drive. The movements of the perforated drum and of the squeezing band are normally coordinated with each other in such a way as to bring about an equidirectional, preferably synchronous, circumferential movement in the region of their tangential overlap.

In a feed zone that is upstream of the overlap and that is laterally delimited, the perforated drum and the squeezing band run towards each other in the feed direction, so that, while the perforated drum and the squeezing band are running, a substance mixture introduced there is drawn in between the perforated drum and the squeezing band and is then pressed against the perforated circumferential wall of the perforated drum. In this process, at least one of the substance components passes through the perforation in the circumferential wall and enters the interior of the perforated drum, thereby becoming separated from the other substance components. The holes in the perforated drum are configured according to the application in such a way that, under the pressure exerted by the squeezing band, the circumferential wall of the perforated drum is permeable to at least one substance component having a certain consistency. The perforated drum is often also referred to as a hollow drum, the squeezing band is referred to as a pressing band, and therefore the soft material separator is referred to as a “separator of the hollow drum-pressing band type” or else as a “pressing band separating device”.

Normally, under a prescribed pressure, in other words, under a pre-tensioning, the squeezing band is in direct contact with the circumferential wall of the perforated drum in order to ensure a sufficiently high pressing force while the substance mixture is being passed through between the circumferential wall and the squeezing band. The contact pressure is transferred to the squeezing band by means of a pressure roller that is pre-tensioned relative to the perforated drum. In some application cases, for example in the production of potato purée, the squeezing band can also be positioned relative to the perforated drum in such a way that a minimal gap is left between the circumferential wall of the perforated drum and the squeezing band, so that the squeezing band only indirectly exerts a pressure that is directed against the perforated drum once the gap has been at least partially filled up by the substance mixture that is passing through.

The squeezing bands themselves are at least partially made of a resilient material or else are coated with a resilient material on the side facing the perforated drum. This serves to cause the substance components that are not entering the perforated drum to temporarily sink into the elastic squeezing band, which is softer in comparison to the perforated drum. For example, during the production of mechanically separated meat, the bones, in other words components of which the consistency is not so soft, are pressed into the elastic squeezing band, thereby preventing too much comminution of the bone parts due to an excessive pressure load, which would result particularly in bone splinters and cartilage fragments being present in the meat.

The softer and/or more flowable substances and/or less solid substances are processed or separated from the other substance components in the processing zone of the soft material separator formed by the overlap of the perforated drum and the squeezing band. The substance components that remain on the outside of the circumferential wall of the perforated drum are removed from the perforated drum or from the squeezing band by a scraper device situated in a discharge zone.

The mechanical structure of known soft material separators already displays good wearing and efficiency properties during continuous operation and under high loads. However, dry running, that is to say, operation without a substance mixture, is something that needs to be avoided in any case since it causes very high wear and tear, particularly of the squeezing band but also of other component parts. Unnecessarily high squeezing band speeds also have a detrimental effect on the service life of the machine since this causes greater wear and tear of the components. In this context, high temperatures sometimes arise due to the stresses that occur between the perforated drum and the squeezing band. Under certain circumstances, it is necessary to cool the pressure rollers or to cool down the substance mixture before it passes through the soft material separator to such an extent that, even though the substance mixture picks up heat from the soft material separator, it nevertheless remains below temperature limits that may have been prescribed.

For this reason, measures are therefore known from the prior art which are aimed at preventing the soft material separator from running dry and which are aimed at adapting the processing speed to the product feed or the product feed to the processing speed.

Document DE 196 37 640 A1 describes a monitoring system that uses a temperature sensor to detect whether a product to be processed has been introduced into the feed zone. The temperature sensor detects the heat radiation of the squeezing band in the feed zone and is configured to detect any interruption of the heat radiation along a line of sight. An interruption of the heat radiation in the line of sight of the sensor always occurs when a piece of the product to be processed that is dropping into the feed zone crosses the line of sight of the temperature sensor. This makes it possible to monitor whether a product is currently being fed into the feed zone. If the heat radiation along the line of sight of the temperature sensor is constantly interrupted, then the system assumes that the product to be processed has backed up in the feed zone and is thus accumulating there. In order to prevent the feed zone from overfilling, the drive of a charging device situated upstream from the feed zone is automatically stopped. In turn, if there is a constant temperature signal of the squeezing band, the system assumes that no product is currently being fed in. The drive of the squeezing band and of the perforated drum is then automatically switched off in order to prevent dry running.

A similar approach is taught in document EP 0 375 876 B1, in which an optical or acoustic tactile sensor is meant to detect a product that is crossing or blocking a line of sight of the sensor, so that the squeezing band and the perforated drum or a feeding device can be stopped or activated as needed. Document EP 0 375 876 B1 also teaches automatically adapting the processing speed to the product feed or the product feed to the processing speed. This approach for optimising the capacity utilisation, however, has proven to be unreliable and not expedient. For this reason, it was discarded decades ago and has not been tried again. Therefore, the processing speed of the soft material separators used nowadays has to be manually set by trained and experienced machine operators and adapted whenever needed. In practice, soft material separators are generally operated at the maximum processing speed. Any necessary adaptations to a fluctuating material feed are made by automatically switching off the product feed or the soft material separator. Soft material separators that can switch on and off automatically as protection against running dry or overfilling, however, entail the disadvantage that the frequent switching procedures cause a great deal of wear and tear, are energy-intensive or technically not practicable, and consequently should be avoided to the greatest extent possible. As a rule, soft material separators are designed for, and manually set to, the maximally anticipated product volume per unit of time, in other words, to a high processing speed, and this leads to relatively frequent triggering of the automatic switch-off device to protect against dry running and thus to protect the component parts that are prone to wear and tear. In comparison to continuous operation, each instance of switching on and off translates into greater wear and tear, into greater energy consumption and thus into greater heat input into the energy-intensively cooled environment of the food product processing.

DE 25 48 980 B1 discloses a straining machine which has a straining drum, an endless pressing band which loops around the drum over part of the circumference thereof, and a loading hopper 21, which is arranged above the feed point of the pressing band with the straining drum.

Proceeding from the disadvantages described above, the object of the invention is to propose an improved soft material separator that, in terms of its wear and tear and energy consumption, entails only negligible losses or none at all in the processing yield.

This object is achieved by a soft material separator according to claim 1 and by a method according to claim 15.

According to an embodiment of the invention, a soft material separator is provided having a perforated drum, which is perforated on the circumference, and having a squeezing band, which is guided along a circumferential section of the perforated drum. The squeezing band can be operated together with the perforated drum. The soft material separator has a feed zone, from which a substance mixture consisting of substance components of different consistencies is drawn in between the perforated drum and the squeezing band for isolating and separating the substance components contained therein. The invention is distinguished by a detection system for quantitatively determining the filling state of the feed zone and by a control device, which is connected to the detection system and is intended for adapting the speed of the perforated drum and the squeezing band depending on the filling state.

The term “quantitative determination of the filling state” refers to the process of ascertaining a measured value that depends on how much substance mixture is present in the feed zone. As a function of this measured value, the control device sets the speed of the perforated drum and of the squeezing band by actuating their drive. The automatic adaptation of the processing speed of the soft material separator to the quantity of substance mixture introduced into the feed zone makes it possible for the perforated drum and the squeezing band to always be operated at the lowest possible speed while maintaining a substantially constant throughput of the product. The service life of the component parts that are particularly prone to wear and tear such as the perforated drum and the squeezing band can be noticeably prolonged in this manner since the number of stopping and re-starting procedures is reduced. This can also bring about a reduction in the consumption of the drive energy. The invention can even make it possible to dispense with a dedicated feeding device that is provided on the soft material separator and that serves as a buffer for the substance mixture, thus simplifying the structure of the soft material separator. It is even possible to install the soft material separator, which up until now has been a free-standing device, as an integral member in a processing line, since the processing speed of the soft material separator, which up until now has always been consistently set for the maximum anticipated quantity of material, can now automatically set itself to the speed at which the substance mixture is being fed.

In a preferred manner, the filling state is determined contactlessly. This embodiment has the advantage that no moving parts are needed in order to determine the filling state. This simplifies the hygienic cleaning of the soft material separator and prevents mechanical malfunctioning of the detection system. Preferably, the determination is carried out optically or acoustically, which has proven to be reliable, particularly in the field of food product processing. The determination can particularly be carried out optically by means of laser scanning or camera recording, or acoustically by means of ultrasonic measurement.

In a development of this embodiment, it can be provided that the detection system has at least one sensor, preferably an optical, acoustic and/or imaging sensor, the detection area of which extends in at least two, preferably three, spatial directions and is directed at the feed zone, at least in certain regions.

The special advantage of such a sensor lies in the fact that, at least to a certain extent, it is possible to “have an overview” of the feed zone, which has a complex shape due to the convergence of the perforated drum and the squeezing band. After all, the substance mixture introduced into the feed zone often consists of irregularly shaped individual pieces that do not become automatically and uniformly distributed in the feed zone. Sometimes, the substance mixture behaves like bulk material or piece goods, which, due to the different consistencies of the individual substance components, tend to agglomerate or stick together. This can lead to an irregular distribution within the feed zone, something which can hardly or not at all be detected by sensors that function one-dimensionally. The detection area of a sensor that detects two-dimensionally or three-dimensionally, for example, can be directed at the entire width of the squeezing band so as to monitor the capacity utilisation of the squeezing band width. The speed of the perforated drum and of the squeezing band can then preferably be made dependent additionally or exclusively on whether the squeezing band width is covered with a substance mixture or not.

The invention can also be developed such that the detection system ascertains the filling state by means of at least one distance measurement, which determines the distance between at least one sensor of the detection system and the substance mixture located in a detection area of the detection system. This type of quantitative determination of the filling state has proven to be particularly well-suited. The distance can be measured, for example, by means of one or more ultrasound sensors.

According to another variant of the invention, the detection system can be designed for generating a measurement signal dependent on the filling state and for calculating a filling state signal derived from the measurement signal. In this context, the filling state signal corresponds substantially to a filling state, a degree of filling or a filling quantity. In this case, the control device is designed for adapting the speed of the perforated drum and the squeezing band depending on the filling state on the basis of the filling state signal.

In this manner, the adaptation of the working speed of the perforated drum and of the squeezing band can be made dependent on different secondary values derived from the sensor signal. The filling state is the filling height of the substance mixture as measured from a reference point at the base of the feed zone, for example from a reference point on the squeezing band. The degree of filling is the percentage value that indicates to what extent the feed zone is filled with the substance mixture, relative to the total volume of the feed zone. This derived measured value can be particularly advantageous if the feed zone is configured as a hopper that is open towards the top, in which the filling height does not correlate linearly or proportionally with the degree of filling.

For the purposes of optimising the operation of the soft material separator, it can also be advantageous to carry out the filling-state-dependent adaptation relative to the quantity of substance mixture that is actually present in the feed zone. The capacity utilisation of the squeezing band width can also be optimised by measuring and controlling, for example, the filling height of the substance mixture present on the squeezing band. The substance mixture that accumulates as bulk material or piece goods on the squeezing band or in the feed zone becomes distributed while forming a natural angle of repose in the feed zone. Setting a natural angle of repose that is dependent on the properties of the substance mixture can improve the capacity utilisation of the entire squeezing band width and thus the uniform processing yield of the soft material separator.

According to an advantageous embodiment, fixed speed values assigned to specific filling states can be stored in the control device. The control device, which is simply structured in this case, can then, on the basis of the ascertained filling state, actuate the drive of the perforated drum and of the squeezing band to run at the speed that is prescribed for this. Such a set-up of the control loop allows the use of simple drive technology, nevertheless implementing a quasi-proportional regulation.

Preferably, the control device has a continuous-action controlling element, which controls the speed in dependence on the filling state of the feed zone, for example proportionally in relation to the filling state of the feed zone. This entails the advantage that a continuous control allows the speed to be raised and lowered uniformly, so that the change of the speed is implemented in a manner that is particularly gentle on the material.

In a development of this idea, the control device can be additionally formed with at least one integrating and/or differentiating controlling element. For one thing, the use of a differentiating controlling element improves the response behaviour. The soft material separator can then respond more quickly to a change in the feed of substance mixture. The use of an integrating controlling element, which can generate a time slope of the control signal that is dependent on the control deviation, makes it possible to improve the precision of the control of the filling state as well as the response behaviour of the drive so as to be gentle on the material.

According to an advantageous embodiment, the perforated drum and the squeezing band can be operated by means of a drive and the control device can be integrated to the drive. This has the advantage that the detection system can be connected directly to the drive, thus simplifying the set-up of the soft material separator. Here, the control device can be integrated, for example, into a frequency converter of the drive, wherein the frequency converter itself can be part of the electric motor, or else it can designed as a component part connected to the electric motor of the drive.

In a preferred manner, the control device can be designed for adapting the speed of the perforated drum and of the squeezing band below a maximum value and/or above a minimum value. Specifying a maximum value can be practical in order to allow an adaptation to the speed of processes that take place downstream of the soft material separator. Specifying a minimum value can serve to optimise the feeding behaviour of the substance mixture in the feed zone since, in order to attain a reliable material feed into the processing zone, in the case of substance mixtures having certain compositions the feed should not fall below a minimum speed.

In this process, input means for adjusting the maximum and/or minimum value of the speed of the perforated drum and the squeezing band can preferably be provided on the soft material separator, thus allowing the user to adjust the speed during operation.

In addition to adapting the speed of the perforated drum and of the squeezing band to the filling state of the feed zone, the control device can be designed for completely stopping the perforated drum and the squeezing band when the filling state is below a prescribed minimum value. This additional safety measure can reliably prevent dry running if there is a prolonged interruption in the feed of the substance mixture or if the quantitative determination of the filling state is faulty.

In a development of this variant, the detection system can have at least one sensor for quantitatively determining the filling state of the feed zone and at least one sensor for detecting when the filling state is below a minimum value and/or when the filling state is above a maximum value. This additional safety measure can prevent dry running, for example if the quantitative determination of the filling state were to become faulty. It can also prevent overfilling of the feed zone and thus blocking of the soft material separator if a maximum filling state is exceeded. In order to prevent dry running, the perforated drum and the squeezing band are stopped in response to the sensor signal. In order to prevent overfilling, a feeding device can be stopped in response to the sensor signal.

As an alternative or in addition, the invention can also be supplemented in that the control device is designed for outputting a control signal when overfilling of the feed zone is detected, in order to slow down or stop a feeding device arranged upstream of the soft material separator. By means of such a safety measure, an overfilling and thus a prolonged downtime of the soft material separator caused by a malfunction can be effectively prevented, or at least made less likely.

The method according to the invention for operating a soft material separator is characterised in that the speed of the perforated drum and the squeezing band is adapted to the filling state of the feed zone, in particular is controlled in dependence on the filling state of the feed zone. In this manner, the soft material separator is always operated at an optimal speed, in other words, at an optimal operating point.

Other embodiments of the method according to the invention are provided analogously from the advantageous embodiments of the device according to the invention.

Description of the invention

Further objectives, advantages, features and possible applications of the present invention arise from the following description of an exemplary embodiment with reference to the drawing. All of the features described and/or illustrated, on their own or in any reasonable combination, constitute the subject matter of the present invention, independently of the summary thereof in the claims or their references back.

In the drawings:

Figure 1 shows a schematic side view of a soft material separator according to the invention; and

Figure 2 shows a schematic sectional view along the line of section A-A according to Figure 1.

Identical or equivalent components are given reference signs in the figures of the drawings shown below using an embodiment to improve readability.

Fig. 1 and Fig. 2 show the device according to the invention in the form of a soft material separator 1 for separating a substance mixture 14 made up of substance components 12, 13 having different consistencies, for example meat, which is to be separated from bone, cartilage or sinew. The soft material separator has a rotationally symmetrical perforated drum 2. In the present exemplary embodiment, the perforated drum 2 is cylindrical and its circumferential wall 15 is perforated by a plurality of openings 16 provided therein. The perforated drum 2 is held inside a machine body 28 and is mounted therein so as to be rotatable about its axis of symmetry 17. The perforated drum 2 can be rotated about the axis of symmetry 17 by means of a drive 11. The drive 11 is operatively connected to the perforated drum 2 by means of a coupling device 26.

The device also has an endless squeezing band 3 that consists at least partially of an elastic material. The term “elastic material” refers to a material that is more resilient than the material of the perforated drum 2, which is made, for example, of steel. The elastic material can be, for example, natural rubber, polyurethane or artificial rubber, in other words, synthetic rubber such as EPDM. As an alternative, a firm squeezing band 3 made, for example, of steel can be provided with an elastic layer, not shown here, made of one of the above-mentioned elastic materials. The squeezing band 3 can be manufactured seamlessly as an endless band, or else it can be configured as a band portion whose ends have been joined together.

The squeezing band 3 runs over a roller guide which, in this case, has a pressure roller 4 that is cooled in certain variants, and also a pair of rollers 5. The roller guide is configured in such a way that part of the squeezing band 3 runs tangentially along a portion of the circumferential wall 15 of the perforated drum 2. This region is referred to below as the processing zone or as the overlap 19. In the region of the overlap 19, the squeezing band 3 can be configured so as to be in contact with the circumferential wall 15 or at a distance from it. In any case, the pressure roller 4 exerts a pressure or elastic pre-tension onto the squeezing band 3 in such a way that the squeezing band rests directly against the perforated drum 2 under constant pre-tensioning, or else a pre-tension is exerted onto the substance mixture and thus indirectly onto the perforated drum 2 only once a substance mixture 14 is passing through the processing area. The pre-tension against the perforated drum 2 can be built up and set by means of a hydraulic unit 30 that is connected to the mount of the pressure roller 4.

With regard to driving the squeezing band 3 by means of the coupling mechanism 26, for example a chain drive, the rollers of the pair of rollers 5 and the pressure roller 4 are operatively connected to the drive 11 and, at the same time, synchronised with the perforated drum 2. The squeezing band 3 is wound onto the roller guide under pre-tensioning, so that the driving movements 36 that are transferred to the pair of rollers 5 and to the pressure roller 4 by means of the coupling device 26 can be transferred substantially slip-free to the squeezing band 3. The perforated drum 2 and the squeezing band 3 are synchronised in such a way that the area of the overlap 19 is traversed substantially without a different relative speed between the squeezing band 3 and the perforated drum 2 in the circumferential direction. In the area of the overlap 19, the perforated drum 2 and the squeezing band 3 perform a joint circumferential movement 20 about the axis of symmetry 17 of the perforated drum 2.

At the sides of the perforated drum 2 as well as of the squeezing band 3, there are delimiters 6 that guide the squeezing band 3 along the side, in other words, they laterally delimit the area of the overlap 19 as well as a feed zone 7 located upstream of the processing zone. The feed zone 7 is formed by the squeezing band 3 that converges tangentially with the perforated drum 2 in a feed direction 18 as well as by the lateral delimiters 6.

A hopper 8 that is arranged physically above the feed zone 7 feeds the substance mixture 14 to be processed to the feed zone 7. A feeding device 24 is situated upstream of the hopper 8. The feeding device 24 can be part of the soft material separator 1. When the soft material separator 1 is used in a processing line, the feeding device 24 is a separate machine which is located upstream of the soft material separator 1 and which is arranged physically next to or above the soft material separator 1 and from which the substance mixture 14 that is to be fed drops into the feed zone 7. The feeding device 24 can be designed here, for example, as a silo dispenser, feed band, or manual feed.

As shown here, the feeding device 24 can also have a conveying device 27, for example a feed screw, by means of which substance mixture 14 is fed from an upstream container into the hopper 8 and thus into the feed zone 7. The feeding device 24 has a drive 23 for operating the conveying device 27. The drive 23 and the conveying device 27 are operatively connected to each other by means of a coupling device 37.

A sensor 25 of a detection system 9 is arranged in a housing 29 on the machine body 28 and, according to the invention, this sensor detects the quantitative filling state or the filling volume, the filling state, or the degree of filling in the feed zone 7.

An optional additional sensor 32 of the detection system 9 can serve to provide a purely qualitative monitoring of the feed zone 7 in respect of whether a substance mixture 14 is being fed. The sensor 32 can be, for example, a reflective light scanner that can detect the presence of objects along its line of sight 34. The sensor 25 and the optionally additionally provided sensor 32 of the detection system 9 are connected to a control device 10 by means of a sensor line 38. A constant presence of objects along the line of sight 34 of the sensor 32 indicates that the feed zone 7 is overfilled, in other words that a maximum filling state has been exceeded. A constant absence of objects along the line of sight 34 of the sensor 32 indicates that the feed zone 7 is running empty, and therefore that the filling state has fallen below a minimum value.

The sensor 25 uses the detection system 9 to detect the actual value of the filling state of the substance mixture 14 in the feed zone 7, preferably continuously, and the sensor then transmits to the control device 10 a corresponding measured value or a filling-level value derived from the measured value. For example, the measurement is made by means of an ultrasonic measurement carried out by the sensor 25 in order to ascertain the shortest distance between the substance mixture 14 and the sensor 25 within its detection area 22.

As can be seen from the fan-shaped lines 33 shown in Fig. 1 and 2, the detection area 22 of the sensor 25 extends along the length of the fan-shaped line 33 as well as approximately in the shape of a cone or lobe in the direction of the squeezing band 3, in other words in three spatial directions. In particular, the detection area 22 of the sensor 25 inside the feed zone can be directed at an area of the squeezing band 3 directly before the beginning of the overlap 19, for example at an area amounting to about 0 cm to 40 cm starting at the beginning of the overlap 19, as seen oppositely from the feed direction 18.

The control device 10 can be connected to a programmable logic controller or else it can be formed by such. The control device 10 compares the measured actual value of the filling state to a prescribed target value and then controls the speed of the drive 11, to which the control device is connected via a control line 39, depending on the filling state and/or depending on the control difference between the target value and the actual value.

If the sensor 25, and optionally the sensor 32, detects that the maximum value of the filling state has been exceeded, in other words that overfilling is imminent or already occurring, then the control device 10 can emit a special signal by means of which the drive 23 of the feeding device 24 or the upstream feed can be stopped by way of an exception in order to prevent overfilling. For this purpose, the control device 10 can be additionally connected to the drive 23 via a control line, not shown here. If the sensor 25 and optionally the sensor 32 have detected that the filling state has fallen below a minimum value, then the control device 10 can stop the drive 11 of the soft material separator 1 in order to prevent the perforated drum 2 and the squeezing band 3 from running dry.

The processing method carried out with the soft material separator 1 provides for processing a substance mixture 14 made up of substance components 12, 13 having different consistencies in such a way that the substance components 12 having a first consistency are separated from the substance components 13 having a second consistency. For example, residual meat can be separated from bone, cartilage or sinew.

The consistency of the substance mixture 14 can refer to the firmness of the tissue that is to be isolated, to its hardness, flowability, or the like. For example, during the de-sinewing process, the firmness of the sinew contained in the meat is greater than the firmness of the meat that surrounds the sinew. The production of mechanically separated meat from poultry carcasses or the production of fish farce by separating the skin and bone components can involve different levels of hardness or softness of the individual substance components 12, 13. In the production of fruit juice or fruit pulps, the consistency of the individual substance components 12, 13 can be described in terms of different levels of flowability of the fruit components.

The substance mixture 14 with both substance components 12, 13 having different consistencies is shown in Fig. 1 and 2 in such a way that the first substance component 12 having the first consistency is depicted by dotted hatching while the second substance component 13 having the second consistency is depicted by a cross-hatching of diagonal lines.

As can be seen in Fig. 1 and 2, the substance mixture 14 that is initially kept ready in the hopper 8 contains the substance components 12 having the first consistency as well as the substance components 13 having the second consistency. The substance mixture 14 drops out of the hopper 8 into the feed zone 7 and from there onto the squeezing band 3.

The substance mixture 14 accumulates in the feed zone 7 and is drawn in by the feeding movement 18 that occurs at the perforated drum 2 and the squeezing band 3 into the area of the overlap 19, that is to say into the processing zone, where the squeezing band 3 exerts a contact pressure onto the substance mixture 14 in the direction of the circumferential wall 15 of the perforated drum 2.

Under the effect of the pressing force, the substance components 12 of the substance mixture 14 are separated from the substance components 13 and then enter the interior 31 of the perforated drum 2 through openings 16 along its circumference. The substance components 13 having the second consistency, in contrast, remain between the circumferential wall 15 and the squeezing band 3, at least some of these components sinking into the elastic areas of the squeezing band 3 and thus being protected from an excessive load exerted by the pressing force. This serves particularly to prevent undesired substances from these substance components 13 from being released and prevents them from being transferred into the substance components 12 in the interior 31 of the perforated drum 2. For example, when chicken carcasses are being processed, it can be important for the chicken bones that are present between the squeezing band 3 and the perforated drum 2 not to be comminuted too strongly, so that the meat component that is entering the interior 31 of the perforated drum 2 only absorbs a limited amount of calcium originating from the comminuted chicken bones.

After passing through the processing zone, the substance components 13 of the substance mixture 14 that have not been separated are collected in a discharge device 21. The discharge device 21 can also be a container that is regularly replaced.

At the beginning of the process, the perforated drum 2 is run together with the squeezing band 3 at a prescribed starting speed at which the substance mixture 14 present in the feed zone 7 is drawn in and processed. The starting speed can be a minimum speed that can be adjusted using an input means 35, said minimum speed being one that is required to reliably draw the substance mixture 14 from the feed zone 7 into the processing zone, in other words into the overlap 19. Setting a minimum speed also ensures that, if the feed of substance mixture 14 into the feed zone 7 stops, the feed zone is emptied out before the perforated drum 2 and the squeezing band 3 have been automatically stopped as protection against their running dry.

The sensor 25 of the detection system 9 that is situated physically above the feed zone 7 determines the filling state of the feed zone 7. As soon as the filling state rises or falls, the processing speed of the perforated drum 2 and of the squeezing band 3 is raised or lowered, with the aim of maintaining a uniform filling state in the feed zone 7. This brings about an automatic adaptation of the processing speed to the quantity of substance mixture 14 present in the feed zone 7. Maintaining a prescribed filling state can ensure, for example, that the substance mixture 14 that is to be drawn into the processing zone can be reliably drawn in if there is always sufficient material above it weighing down on the squeezing band 3. Different filling heights or levels can be prescribed, for example, for different types of substance mixtures 14.

With the aim of maintaining a prescribed filling state, the feed zone 7 also automatically functions as a material buffer that can temporarily compensate for interruptions in the feed of the substance mixture 14 into the feed zone 7 and can also prevent a standstill of the drive 11.

The algorithm in the control device 10 from which the speed adaptation is derived can be based, for example, on the fact that each filling state value is always associated with a certain speed value. This can also be achieved with very simple control devices. The associated values can even compensate for non-linearities that are present in the device, for example an irregular geometric shape of the feed zone 7, in order to obtain satisfactory control results.

As an alternative, the control device 10 can also be designed in such a way that a steady control is carried out involving continuous determination of a control difference stemming from the measured actual value of the filling state and the prescribed target value, and the speed of the drive is always readjusted in order to maintain the prescribed filling state. On the one hand, this can serve to allow a quick response to greatly fluctuating filling states or else to set the drive control so slow that high-wear acceleration and braking procedures are prevented. Also in the case of a steady control of the speed of the perforated drum 2 and of the squeezing band 3 as a function of the filling state, a minimum speed can be prescribed at which the perforated drum 2 and the squeezing band 3 are operated in order to reliably empty the feed zone 7 before the switch-off procedure that serves to prevent dry running is performed.

The steady control can be designed, for example, as a simple proportional-action control or else as a controller with an additional integrating control element and/or differentiating control element, in other words as a so-called PID controller.

The detection system 9 can be configured to carry out an ultrasonic measurement which ascertains the highest point of the substance mixture 14 that has accumulated in the feed zone 7. As an alternative, however, it is also possible to use an optical sensor, for example a laser sensor or a camera, which is oriented towards the feed zone 7 so that, on the basis of the detection of individual sub-units of the substance mixture, a conclusion can be reached about the actual filling state. Measurement by radar is likewise conceivable.

The sensor 25 can also be designed in such a way that it allows a two-dimensional or three-dimensional imaging of the feed zone 7, on which basis the volume of substance mixture contained in the feed zone 7 can then be calculated.

Therefore, the system can always be operated at the lowest possible speed, so that wear and tear of the squeezing band 3 as well as of other parts is minimised. Likewise, the consumption of energy by the system is reduced while the processing yield remains constant.

List of Reference Symbols

1 soft material separator
2 perforated drum
3 squeezing band
4 pressure roller
5 pair of rollers
6 lateral delimiter
7 feed zone

8 hopper
9 detection system
10 control device
11 drive
12 substance component having a first consistency
13 substance component having a second consistency
14 substance mixture
15 circumferential wall
16 openings
17 axis of symmetry
18 feed direction
19 overlap
20 circumferential movement
21 discharge device
22 detection area
23 drive
24 feeding device
25 sensor
26 coupling device
27 conveying device
28 machine body
29 housing
30 hydraulic unit
31 interior
32 sensor
33 fan-shaped line
34 line of sight
35 input means
36 driving movement
37 coupling device
38 sensor line
39 control line