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(54) **SYSTEM AND METHOD FOR CONTROLLING SEPARATION OF SOLID AND LIQUID PHASES**

(57) The present invention relates to a method for measuring an amount of a purged liquid phase from a rotating batch centrifugal basket using a sound sensor and/or a vibration sensor. The step of measuring the amount of the purged liquid phase from a rotating batch centrifugal basket may involve a determination of when the purging starts, when the purging ends, the purging intensity as a function of time and/or the distributions of frequencies in the purging signal from the sound sensor and/or the vibration sensor. The present invention also relates to an apparatus for carrying out the invention.

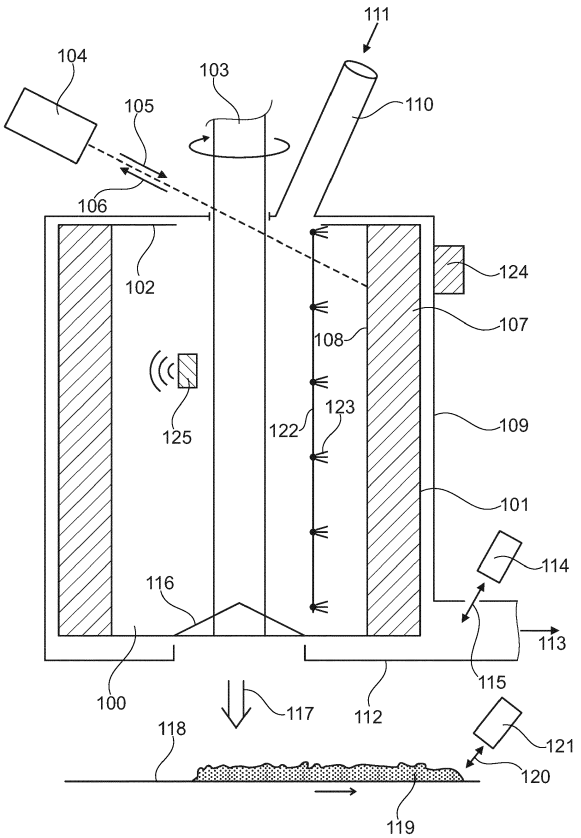

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a system and a method for controlling separation of solid and liquid phases in a centrifugal. In particular, the present invention relates to a system and a method for controlling an amount of washing liquid/spray water or steam to be added to a fill-mass inside a centrifugal basket.

BACKGROUND OF THE INVENTION

[0002] Many processes require separation of a blend of liquid and solid particles. This is typically done by filling the blend into a centrifugal, spinning the centrifugal's basket at a high speed, and letting the liquid escape through small holes in the basket, while retaining the solid particles inside the basket.

[0003] In sugar refining the blend of sugar crystals and syrup (mother liquor) is called fill-mass (massecuite). By spinning the fill-mass in a centrifugal the syrup is forced out of the centrifugal basket and the crystals retained. It is however impossible to apply a centrifugal force strong enough to remove all syrup from the surface of the crystals. Instead hot water is sprayed on the crystals to dissolve and remove the thin film of syrup.

[0004] An essential problem for the separation is the fact that the fill-mass is of constantly changing quality. This causes variations in the filling rate of the centrifugal basket, the filling level in the centrifugal basket, the optimum point in time to start the hot water spraying, the time needed to purge the syrup, and the necessary amount of spray water to clean the syrup film off the crystals.

[0005] To obtain the optimum separation, without using excessive energy, and without dissolving good sugar from the crystals, a persistent and uninterrupted adjustment of the centrifugal's settings is required. If the previous step in the sugar refining process has caused a large spread in the size of the crystals, then many smaller crystals will escape through the small holes in the centrifugal basket and reduce the amount of sellable sugar.

[0006] In case of a fill-mass with a very high viscosity, there is an important and serious safety issue, because the spinning centrifugal may start vibrating. Due to the high amount of rotational energy in the filled basket, the centrifugal may destroy itself or even part of the factory with potentially fatal consequences for people in the vicinity.

[0007] In order to comply with the above-mentioned problems it may be seen as an object of embodiments of the present invention to provide a system and a method where a purging liquid from a centrifugal basket may be monitored in an easy manner.

[0008] It may be seen as a further object of embodiments of the present invention to provide a system and a method where information about the purging liquid from a centrifugal basket may be used to control an amount of washing liquid/spray water or steam to be added to a fill-mass inside the centrifugal basket.

DESCRIPTION OF THE INVENTION

[0009] The above-mentioned objects are complied with by providing, in a first aspect, a method for measuring an amount of a purged liquid phase from a rotating batch centrifugal basket using a sound sensor and/or a vibration sensor.

[0010] As addressed above the fill-mass (massecuite) may be a blend of sugar crystals (solid phase) and syrup (liquid phase). The purging of the liquid phase, i.e. syrup, takes place by spinning the fill-mass in a centrifugal basket whereby the syrup may be forced out of the centrifugal basket whereas the sugar crystals are retained.

[0011] The step of measuring the amount of the purged liquid phase from a rotating batch centrifugal basket may involve a determination of when the purging starts, when the purging ends, the purging intensity as a function of time and/or the distributions of frequencies in the purging signal from the sound sensor and/or the vibration sensor.

[0012] The method may further comprise the step of measuring a filling level and/or a filling rate of a fill-mass inside the batch centrifugal basket. Suitable arrangements may include optical triangulation sensors, radars or ultrasound sensors.

[0013] The method may further comprise the step of measuring colour changes of a fill-mass inside the batch centrifugal basket using for example a colorimeter. The colorimeter may also be used for measuring the presence of a liquid layer on the solid phase of the fill-mass. Such a liquid layer may induce waves and vibrations at high rotational speeds of the centrifugal basket. The method may further comprise the step of stopping the centrifugal in case an undesired packing of a solid phase and thereby blocking the purging of the liquid phase is detected for example via a colour measurement.

[0014] Even further, the method may further comprise the step of measuring a colour of a solid phase being emptied from the batch centrifugal basket using a colour sensor.

[0015] The method according to the present invention is advantageous in that overfilling of the centrifugal basket may be avoided, in particular in situations where the fill-mass has a low viscosity. The presence of a low viscosity fill-mass may often result in an early purging of the liquid phase. Also, a low viscosity of the fill-mass may often result in a fast filling rate with the risk of overfilling the centrifugal basket. Thus, by measuring the filling rate and/or by measuring an early purging of the liquid phase overfilling of the centrifugal basket may be avoided.

[0016] The method may further comprise the step of controlling washing liquid or steam to be added to the fill-mass inside the centrifugal basket. For example, washing liquid or steam may be added to the fill-mass when the purging of the liquid phase has reduced to a level where

added washing liquid or steam will not blend with the remaining liquid phase of the fill-mass.

[0017] The amount of washing liquid or steam may be controlled in response to the measured amount of purged liquid phase and/or a measured colour of a solid phase being emptied from the batch centrifugal basket and/or a change in the filling level of the centrifugal basket.

[0018] The method may further comprise the step of controlling a valve in the centrifugal, said valve being used for filling the centrifugal basket. The valve may be controlled to get an optimum filling of the centrifugal basket and avoid over-filling.

[0019] The method may further comprise the step of controlling a valve in the centrifugal, said valve being used for separating the different types of run-off leaving the centrifugal basket. The valve may be controlled to avoid mixing the highly different types of run-off.

[0020] In a second aspect the present invention relates to an apparatus for measuring an amount of a purged liquid phase from a rotating batch centrifugal basket, said apparatus comprising a sound sensor and/or a vibration sensor for measuring the purged liquid phase. The sound sensor and/or vibration sensor may be a retrofitted sensor secured to a stationary part of the centrifugal. It should be noted that a plurality of sensors, either of the same type or different types, may be applied for measuring the amount of a purged liquid phase.

[0021] Again, the fill-mass (massecuite) may be a blend of sugar crystals (solid phase) and syrup (liquid phase). The purging of the liquid phase, i.e. syrup, takes place by spinning the fill-mass in a centrifugal basket whereby the syrup may be forced out of the centrifugal basket whereas the sugar crystals are retained.

[0022] The apparatus may further comprise an arrangement, such as an optical triangulation sensor, a radar or an ultrasound sensor, for measuring a filling level and/or a filling rate of a fill-mass inside the batch centrifugal basket. The advantages associated therewith are addressed above.

[0023] The apparatus may further comprise an arrangement, such as a colorimeter, for measuring a colour change of a fill-mass inside the batch centrifugal basket. Also, the apparatus may further comprise a colour sensor for measuring a colour of a solid phase being emptied from the batch centrifugal basket. The advantages associated with the use of a colorimeter and a colour sensor are addressed above.

[0024] The apparatus may further comprise a separation arrangement for keeping a first portion of purged liquid phase separated from a second portion of purged liquid phase, said arrangement comprising a controllable valve. The first portion of the purged liquid phase (syrup) from a batch of fill-mass typically may contain a large amount of impurities, whereas the second portion of purged liquid phase (washing syrup) may be much cleaner than the first portion. It is therefore highly desirable to keep the first and second portions of syrup separated.

[0025] The apparatus may further comprise an arrangement for providing washing liquid or steam to the fill-mass inside the centrifugal basket. A control unit may be provided for controlling a washing liquid or steam added to the fill-mass inside the centrifugal basket in response to a measured amount of the purged liquid phase and/or a measured colour of a solid phase being emptied from the batch centrifugal basket and/or a change in the filling level of the centrifugal basket.

[0026] In a third aspect, the present invention relates to a method for controlling separation of solid and liquid phases, the method comprising the steps of

- providing a fill-mass into a centrifugal basket, and
- monitoring a purging of the liquid phase from the centrifugal basket using a vibration sensor or a sound sensor.

[0027] As addressed above the fill-mass (massecuite) may be a blend of sugar crystals (solid phase) and syrup (liquid phase). The purging of the liquid phase, i.e. syrup, takes place by spinning the fill-mass in a centrifugal basket whereby the syrup may be forced out of the centrifugal basket whereas the sugar crystals are retained.

[0028] The step of monitoring the purging of the liquid phase may involve a determination of

1) when the purging starts,

2) when the purging ends,

3) the purging intensity as a function of time, and/or

4) the distributions of frequencies in the purging signal from the vibration sensor or sound sensor.

[0029] The monitoring of the purging of the liquid phase may advantageous be used for controlling the centrifugal in general. As an example, an amount of washing liquid/spray water or steam to be added to the fill-mass inside the centrifugal basket may be controlled in accordance with a detected vibration signal level or sound signal level.

[0030] In one embodiment a predetermined amount of washing liquid/spray water or steam may be added to the fill-mass when a first predetermined vibration signal level or sound signal level has been reached. Alternatively or in combination therewith the addition of the washing liquid/spray water or steam to the fill-mass may be interrupted when a second predetermined vibration signal level or sound signal level has been reached. Even further the purging intensity over as a function of time and/or the distributions of frequencies in the purging signal from the vibration sensor or sound sensor may be used to control the amount of washing liquid/spray water or steam to be added to the fill-mass.

[0031] The method according to the first aspect may further comprise the step of monitoring a filling rate and

a filling level of the fill-mass in the centrifugal basket. Appropriate techniques, such as optical triangulation techniques, may be applied in relation to monitoring the filling rate and a filling level.

[0032] The present invention finds its primary use in connection with batch centrifugal baskets.

[0033] In a fourth aspect the present invention relates to a centrifugal system for separation of solid and liquid phases, the system comprising

- a centrifugal basket, and
- a vibration sensor or a sound sensor for monitoring a purging of the liquid from the centrifugal basket using.

[0034] The centrifugal system according to the second aspect is particular useful for carrying out the method of the first aspect.

[0035] The centrifugal system may further comprise a centrifugal housing at least partly surrounding the centrifugal basket. Upon rotation of the centrifugal basket the purged liquid hits an interior surface portion of the centrifugal housing. The impact between the purged liquid and the interior surface portion generates detectable vibrations as well as a detectable sound signal. These signals may be detected by vibration sensor or the sound sensor in the form of a microphone being is secured to the centrifugal housing. The vibration sensor or the sound sensor may advantageously be secured to an exterior surface portion of the centrifugal housing as this allows retrofitting of the vibration sensor or microphone to the centrifugal housing.

[0036] The centrifugal system may further comprise a control unit for determining when the purging starts, when the purging ends, the purging intensity over as a function of time and/or the distributions of frequencies in the purging signal from the vibration sensor or sound sensor. The control unit may be adapted to control an amount of washing liquid/spray water or steam to be added to a fill-mass inside the centrifugal basket in accordance with a detected vibration signal level or sound signal level. As an example the control unit may be adapted to add a predetermined amount of washing liquid/spray water or steam to the fill-mass when a first predetermined vibration signal level or sound signal level has been reached. Alternatively or in combination therewith the control unit may be adapted to interrupt the addition of the washing liquid/spray water or steam to the fill-mass when a second predetermined vibration signal level or sound signal level has been reached. Even further the purging intensity over as a function of time and/or the distributions of frequencies in the purging signal from the vibration sensor or sound sensor may be used to control the amount of washing liquid/spray water or steam to be added to the fill-mass.

[0037] An arrangement for monitoring a filling rate and a filling level of the fill-mass in the centrifugal basket may be provided as well. Appropriate techniques, such as optical triangulation techniques, may be applied in relation to monitoring the filling rate and a filling level. The present invention finds its primary use in connection with batch centrifugal baskets.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The present invention will now be described in further details with reference to the accompanying figures, wherein

Fig. 1 shows a cross-sectional view of a batch centrifugal including a sound and/or a vibration sensor for monitoring purging liquids.

[0039] While the invention is susceptible to various modifications and alternative forms a specific embodiment has been shown by way of an example in the drawing and will be described in details herein. It should be understood, however, that the invention is not intended to be limited to the particular form disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0040] In its broadest aspect the present invention relates to an arrangement for controlling a process in a centrifugal. This process may involve separation of solid and liquid phases, such as separation of solid crystalline sugar and liquid syrup in a centrifugal. The present invention further relates to a method for controlling separation of solid and liquid phases in a centrifugal by monitoring a purging liquid from a centrifugal basket and use this information to control for example an amount of washing liquid/spray water or steam to be added to a fill-mass inside the centrifugal basket. The monitoring of the purging liquid is provided by a sensor arranged on a stationary part of the centrifugal, such as on an exterior surface portion of a housing at least partly surrounding a centrifugal basket, cf. Fig. 1. It is advantageous that the sensor may be retrofitted to existing centrifugals.

[0041] The method according to the present invention aims at optimisation and prevention of undesirable consequences by:

1) Monitoring the intensity and timing of the purging of the syrup in a centrifugal by installing a sound or vibration sensor on a stationary part of the centrifugal hit by the purged syrup.

2) Analysing the signal from the sensor to determine

a. When the purging starts,

b. When the purging ends,

c. The profile of intensity over time, and/or

d. The intensity of frequencies in the signal.

3) Monitoring the filling rate and filling level in the centrifugal basket by installing a level sensor on the centrifugal.

4) Monitoring the occurrence of a layer of liquid inside the layer of sugar crystals in the basket during acceleration and spinning of the centrifugal basket by a colorimeter.

[0042] When the fill-mass has a low viscosity too rapid filling of the centrifugal basket tends to happen. When this occurs, a standard setting for closing the large and slowly moving filling valve cannot ensure a timely stop of the flow into the basket in due time, and the basket overfills. If the operator detects this situation immediately, the centrifugal is taken out of service and cleaned, causing a minor stop in the production, only. If the overfill is not detected the fill-mass flows to the conveyor with good product. Shortly after the fill-mass, which is this sticky stuff, reaches the dryer and blocks it. This requires a stop of many hours for the whole factory and causes imbalance in the processes. The rapid filling can according to the present invention be detected by detecting the unusually rapid purging of syrup from the centrifugal basket using a sound or vibration sensor. Due to the very short period of time available to close the filling valve an additional measure may be taken by applying the filling rate from a filling sensor to also give a signal to close the filling valve.

[0043] Usually the centrifugal baskets are filled to a level far below the theoretical capacity, due to the risk of overfilling. By having arrangement to detect rapid filling and by constantly monitoring the filling level it is possible to fill the basket to near the theoretical capacity. The filling sensor thus has the double function of allowing better utilisation of the centrifugals and preventing overfilling. An arrangement for monitoring the filling rate and the filling level may be based on optical triangulation.

[0044] Sugar technologists have tested the influence on the sugar quality parameters colour and ash by varying the point in time for applying a washing liquid/spray water. Both parameters colour and ash depend heavily on the correct timing of the application and both have their minimum (best quality) at the same timing. However, the sugar factories are reluctant to apply this knowledge due to the risk of vibration, when the fill-mass without warning changes to high viscosity. However, with the sensing of the rate and timing of the purging by the sound and/or vibration sensor, and the monitoring of the unwanted liquid inside the centrifugal by the colorimeter, then the risk from liquid inside the layer of crystals can be prevented by blocking the addition of water, when liquid is present, and by stopping the centrifugal, when purging is too slow. Usually, the layer of crystals in the centrifugal is compacted by the centrifugal force during purging. At slow or no purging, the compaction is reduced. This means the filling level sensor can detect a slower compaction and consequently give a third indication of slow purging.

[0045] The correct time to start applying the washing liquid/spray water is a compromise between two determining factors. If spraying is started when syrup is still in the layer of crystals, then the spray water may catch up with the syrup, be mixed with the syrup, and lose some of its efficiency for cleaning. (Pure water can better dissolve and clean the syrup off the crystals.) On the other hand, if the syrup has left the layer of crystals, then the centrifugal force will press air through the layer of crystals and dry the thin film of syrup on the surface of the crystals, making the layer more difficult to dissolve and remove. With the present invention and a real-time colorimeter measuring the colour quality of the sugar leaving the centrifugal, it is easy to determine the optimum timing.

[0046] The filling sensor indicates the amount of crystals to be cleaned, so it can give a signal to increase/decrease the amount of spray water, even within the same centrifugal cycle where the filling is measured.

[0047] In general, two types of centrifugals exist -namely batch centrifugals (also called discontinuous centrifugals) and continuous centrifugals. In batch centrifugals separations of solid and liquid phases are performed in batches, whereas in continuous centrifugals separations of solid and liquid phases are performed continuously. The present invention primarily finds its use in connection with batch centrifugals where it provides the following immediate advantages

1) Washing/spraying of the fill-mass using liquid or steam may be started at an optimal point in time whereby washing liquid/spray water or steam may be saved and consequential dissolution of an otherwise high-quality product may be avoided

2) Waves in the centrifugal basket due to over exposure of washing liquid/spray water can be avoided - this increases safety during operation of the batch centrifugal

3) Undesired packing of the solid phase and thereby blocking the purging of the liquid phase may be detected and the centrifugal stopped

4) The batch centrifugal can be operated at maximum capacity, i.e. with maximum fill-mass in the centrifugal basket whereby electrical power and washing liquid/spray water or steam may be saved

5) Overfilling of the centrifugal basket can be avoided

6) Undesired blending of purged mother liquor and wash syrup may be avoided by detecting the timely purging of the two and controlling a valve at the run-off outlet from the centrifugal

[0048] Moreover, it is advantageous that the sensor for monitoring the purging liquid may be retrofitted to exciting installations in that the sensor is arranged on an exterior surface portion of an outer housing surrounding a centrifugal basket, i.e. no changes of the exciting centrifugal is required. Moreover, the sensor for monitoring the purging liquid is not in direct contact with the rather harsh interior environment inside the centrifugal.

[0049] Referring now to Fig. 1 a cross-sectional view of a centrifugal for use in connection with the present invention is depicted. The centrifugal shown in Fig. 1 comprises a rotatably mounted centrifugal basket 100 in a batch centrifugal being configured to rotate around axis 103 with a controllable speed of rotation. The drive unit for rotating the centrifugal basket 100 is not shown.

[0050] Upon rotation of the batch centrifugal basket 100 the fill-mass 107 will be pressed against the vertical sidewall 101 of the centrifugal basket 100. As liquid, such as syrup, is allowed to penetrate or escape through pinholes in the vertical sidewall 101 upon rotation of the centrifugal basket 100, separation of solid and liquid phases may be provided. The liquid penetrating or escaping the centrifugal basket 100 is collected by the outer housing 109 and led to the outlet channel 112 where it leaves the centrifugal as indicated by arrow 113. A colour sensor 114 measures the colour of the liquid phase as indicated by the arrow 115.

[0051] After separation from the liquid phase the solid phase leaves the centrifugal basket 100 via the valve 116 in the bottom of the centrifugal basket 100 as indicated by arrow 117. Upon leaving the centrifugal basket 100 the solid phase 119 falls onto a conveyer arrangement 118 as indicated by the horizontal arrow. A colour sensor 121 measures the colour of the solid phase 119 via optical reflections as indicated by the arrow 120.

[0052] The centrifugal also contains a feeding arrangement 110 for feeding fill-mass into the centrifugal basket 100 as indicated by arrow 111. An arrangement 112 for emptying the centrifugal basket 100 for purging liquid as well as an arrangement for removing the solid phase from the inner sidewalls of the centrifugal basket is also provided. The latter of the two is not shown in Fig. 1. An edge 102 ensures that the fill-mass is maintained inside the centrifugal basket 100.

[0053] During rotation of the centrifugal basket 100, the fill-mass 107 forms an inner surface 108. A sensor arrangement 125, such as an optical triangulation arrangement, a radar or a ultrasound sensor, may be provided for determining a filling rate as well as a filling level of the centrifugal basket 100. In addition, an optical triangulation arrangement, a radar or a ultrasound sensor may be used to reveal undesired situations where the fill-mass or a liquid layer swirls around inside the centrifugal basket 100. A swirling fill-mass or liquid layer inside the centrifugal basket 100 may bring the centrifugal basket 100 out of balance. As the combined weight of the fill-mass and the rotating centrifugal basket 100 of the centrifugal is several tons such an unbalanced situation should be avoided.

[0054] During rotation of the centrifugal basket 100, the filling material forms the inner surface 108 onto which light from the colorimeter 104 is projected. As indicated by the arrow 105 light emitted from the colorimeter 104 is directed toward the surface 108. Similarly, a portion of the light reflected by the surface 108 is detected by the colorimeter 104 as indicated by arrow 106.

[0055] A sensor 124 in the form of a sound sensor or vibration sensor is arranged on an exterior surface portion of the outer housing 109. During rotation of the centrifugal basket 100 purging liquid penetrates through the basket wall 101 before hitting the inner side of the outer housing 109. When hitting the inner side of the outer housing 109 sound and/or vibration signals are generated. At least one of these signals may be detected by one or more sensors 124 arranged on the exterior surface portion of the outer housing 109. In Fig. 1 a single sensor 124 is depicted as being secured to an upper portion of the outer housing 109. It should be noted however, that the sensor 124 may alternatively be secured to other portions of the outer housing 109, such as a middle portion, a lower portion etc. Moreover, additional sensors may be secured to the outer housing 109. In case a plurality of sensors are secured to the outer housing 109 these sensors may be distributed around the outer housing 109 in any pattern, such as being distributed evenly around the outer housing 109. The plurality of sensors may be of the same type or they may be different types of sensors, such as a combination of sound and vibration sensors.

[0056] As previously addressed the properties of the detected signal (sound signal and/or vibration signal) may be analysed in terms of for example 1) when the purging starts, 2) when the purging ends, 3) the profile of intensity over time, and/or 4) the intensity of frequencies in the signal in order to provide information about the status of the separation of the solid and liquid phases. This information may be used to control (in real time) an amount of washing liquid/spray water or steam to be added to the fill-mass via the washing arrangement 122. A control unit (not shown) may be used to analyse the detected signal or detected signals from one or more sensors (sound and/or vibration sensors) as well as to control the appliance of washing liquid/spray water or steam added to the fill-mass via the washing arrangement 122.

[0057] As depicted in Fig. 1 the washing arrangement 122 has a plurality of nozzles 123 so that a homogeneous washing/spraying of the fill-mass 107 across the surface 108 may be provided.

[0058] According to the present invention the information derived from the sound and/or vibration sensor 124 may be used to

1) initiate washing of the fill-mass,

2) alter the amount of washing liquid/spray water or steam added to the fill-mass, and

3) terminate washing of the fill-mass.

[0059] The washing of the surface 108 may be initiated when the liquid phase of the fill-mass leaves the surface 108. If too much washing liquid/spray water is applied too fast to the surface 108, an undesired liquid layer will form on the surface 108. This should be avoided as such a liquid layer may generate waves and thereby instability within the centrifugal basket 100 upon rotation thereof. A liquid layer may be formed due to for example a slowly moving liquid phase (towards the centrifugal basket wall 101) or due to packing of the solid phase near the centrifugal basket wall 101. A colorimeter may be applied to reveal the existence of such a liquid layer.

[0060] The first portion of the purged liquid phase/syrup from a batch of fill-mass typically contains a large amount of impurities. According to the present invention it is possible to determine when this first portion of contaminated syrup has left the fill-mass 107 using information from the sound sensor or vibration sensor. At this point in time the washing liquid or steam may be activated and the resulting second portion of purged liquid phase (washing syrup) is much cleaner than the first portion. It is therefore highly desirable to keep the first and second portions of syrup separated. This may be achieved via a valve (not shown) positioned near the outlet channel 112 so that the first portion of syrup follows a first route, whereas the second portion of syrup follows a second and different route.

[0061] In conclusion, the present invention addresses a system and a method for controlling separation of solid and liquid phases in a centrifugal. In particular, the present invention addresses a system and a method for controlling an amount of washing liquid/spray water or steam to be added to a fill-mass inside a centrifugal basket in response to a measured sound signal and/or a measured vibration signal. Other sensor arrangement for determining the filling rate and the filling level may advantageously be provided as well.

[0062] Further aspects of the present invention will now be described by way of reference to the following clauses:

1. A method for controlling separation of solid and liquid phases, the method comprising the steps of

- providing a fill-mass into a centrifugal basket, and
- monitoring a purging of the liquid phase from the centrifugal basket using a vibration sensor or a sound sensor.

2. A method according to clause 1, wherein the step of monitoring the purging of the liquid phase involves a determination of when the purging starts, when the purging ends, the purging intensity as a function of time and/or the distributions of frequencies in the purging signal from the vibration sensor or sound sensor.

3. A method according to clause 1 or 2, further comprising the step of controlling an amount of washing liquid or steam to be added to the fill-mass inside the centrifugal basket in accordance with a detected vibration signal level or sound signal level.

4. A method according to clause 3 wherein a predetermined amount of washing liquid or steam is added to the fill-mass when a first predetermined vibration signal level or sound signal level has been reached.

5. A method according to clause 4, wherein the addition of the washing liquid or steam to the fill-mass is interrupted when a second predetermined vibration signal level or sound signal level has been reached.

6. A method according to any of clauses 1-5, further comprising the step of monitoring a filling rate and a filling level of the fill-mass in the centrifugal basket.

7. A method according to any of clauses 1-6, wherein the centrifugal basket is a batch type centrifugal basket.

8. A centrifugal system for separation of solid and liquid phases, the system comprising

- a centrifugal basket, and
- a vibration sensor or a sound sensor for monitoring a purging of the liquid from the centrifugal basket using.

9. A centrifugal system according to clause 8, further comprising a centrifugal housing at least partly surrounding the centrifugal basket, wherein the purged liquid hits an interior surface portion of the centrifugal housing, and wherein the vibration sensor or the sound sensor is secured to said centrifugal housing.

10. A centrifugal system according to clause 9, wherein the vibration sensor or the sound sensor is secured to an exterior surface portion of the centrifugal housing.

11. A centrifugal system according to any of clauses 8-10, further comprising a control unit for determining when the purging starts, when the purging ends, the purging intensity over as a function of time and/or the distributions of frequencies in the purging signal from the vibration sensor or sound sensor.

12. A centrifugal system according to clause 11, wherein the control unit is adapted to control an amount of washing liquid or steam to be added to a

fill-mass inside the centrifugal basket in accordance with a detected vibration signal level or sound signal level.

13. A centrifugal system according to clause 12, wherein the control unit is adapted to add a predetermined amount of washing liquid or steam to the fill-mass when a first predetermined vibration signal level or sound signal level has been reached.

14. A centrifugal system according to clause 12 or 13, wherein the control unit is adapted to interrupt the addition of the washing liquid or steam to the fill-mass when a second predetermined vibration signal level or sound signal level has been reached.

15. A centrifugal system according to any of clauses 8-14, wherein the centrifugal basket is a batch type centrifugal basket.

16. A centrifugal system according to any of clauses 8-15, further comprising an arrangement for monitoring a filling rate and a filling level of the fill-mass in the centrifugal basket.

Claims

1. A method for measuring an amount of a purged liquid phase from a rotating batch centrifugal basket using a sound sensor and/or a vibration sensor.

2. A method according to claim 1, wherein the step of measuring the amount of the purged liquid phase from the rotating batch centrifugal basket involves a determination of when the purging starts, when the purging ends, the purging intensity as a function of time and/or the distributions of frequencies in the purging signal from the sound sensor and/or the vibration sensor.

3. A method according to claim 1 or 2, further comprising the step of measuring a filling level and/or a filling rate of a fill-mass inside the batch centrifugal basket.

4. A method according to any of claims 1-3, further comprising the step of measuring colour changes of a fill-mass inside the batch centrifugal basket.

5. A method according to claim 4, further comprising the step of stopping the centrifugal in case an undesired packing of a solid phase and thereby blocking the purging of the liquid phase is detected via a colour measurement.

6. A method according to any of the preceding claims, further comprising the step of measuring a colour of a solid phase being emptied from the batch centrifugal basket.

7. A method according to any of the preceding claims, further comprising the step of controlling an amount of washing liquid or steam to be added to the fill-mass inside the centrifugal basket.

8. A method according to claim 7, wherein the washing liquid or steam is controlled in response to the measured amount of purged liquid phase and/or a measured colour of a solid phase being emptied from the batch centrifugal basket.

9. A method according to any of the preceding claims, further comprising the step of controlling a valve in the centrifugal, said valve being used for filling the centrifugal basket and changing the filling level of the centrifugal basket.

10. An apparatus for measuring an amount of a purged liquid phase from a rotating batch centrifugal basket, said apparatus comprising a sound sensor and/or a vibration sensor for measuring the purged liquid phase.

11. An apparatus according to claim 10, further comprising an arrangement, such as an optical triangulation sensor, a radar or an ultrasound sensor, for measuring a filling level and/or a filling rate of a fill-mass inside the batch centrifugal basket.

12. An apparatus according to claim 10 or 11, further comprising an arrangement, such as a colorimeter, for measuring a colour change of a fill-mass inside the batch centrifugal basket.

13. An apparatus according to any of claims 10-12, further comprising a colour sensor for measuring a colour of a solid phase being emptied from the batch centrifugal basket.

14. An apparatus according to any of claims 10-13, further comprising a separation arrangement for keeping a first portion of purged liquid phase separated from a second portion of purged liquid phase, said arrangement comprising a controllable valve.

15. An apparatus according to any of claims 10-14, further comprising an arrangement for providing washing liquid or steam to the fill-mass inside the centrifugal basket.

16. An apparatus according to claim 15, further comprising a control unit for controlling a washing liquid or steam to the fill-mass inside the centrifugal basket in response to a measured amount of the purged liquid phase and/or a measured colour of a solid phase being emptied from the batch centrifugal bas-

ket and/or a change in the filling level of the centrifugal basket.

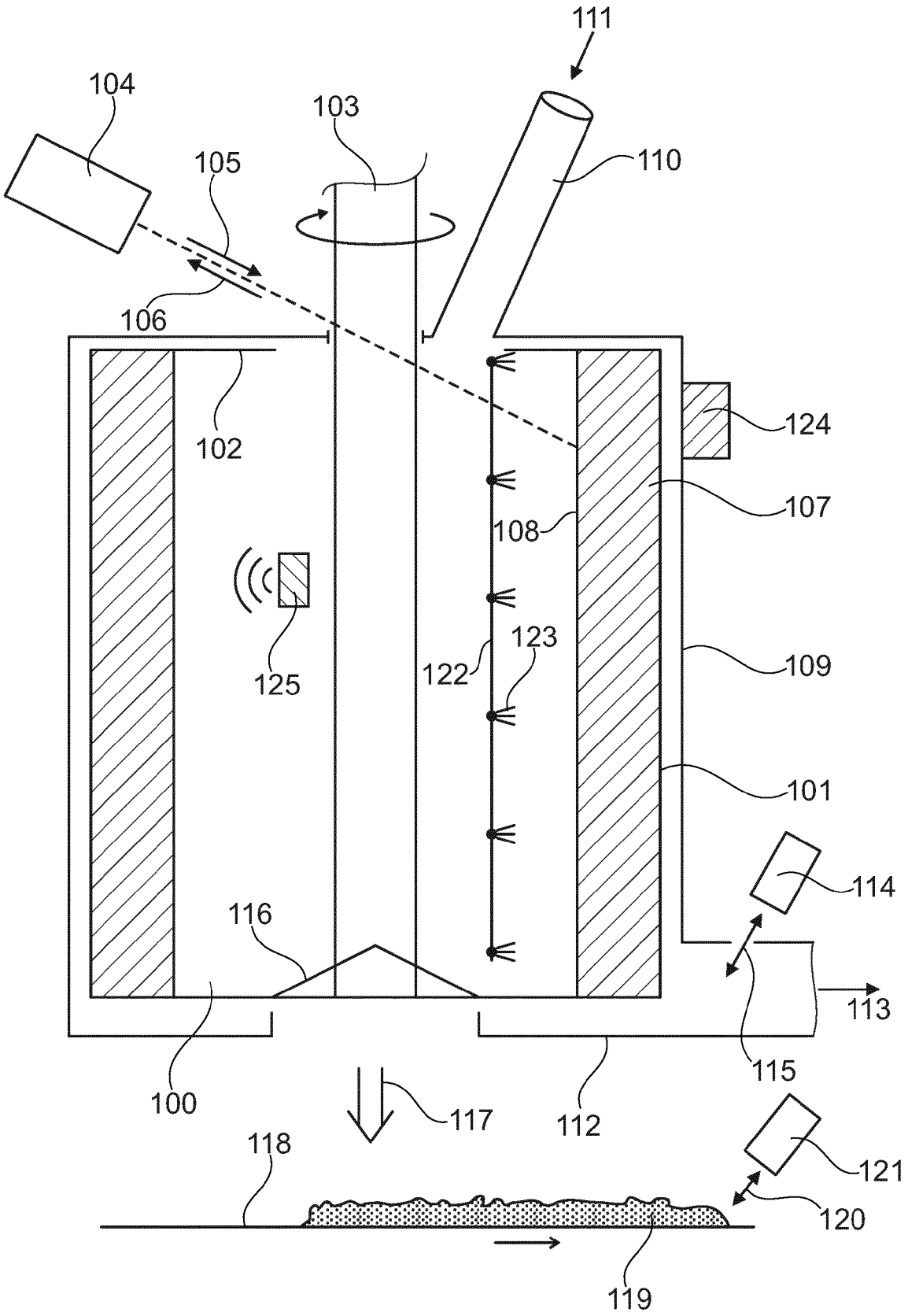
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Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 9050

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Place of search	Date of completion of the search	Examiner
Munich	14 December 2017	Finzel, Jana

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