

METHOD AND DEVICE FOR DETERMINING THE BRIGHTNESS OF RICE

The invention relates to a method for determining the brightness of rice, in particular of polished white rice, and further relates to a device for determining the brightness of such rice.

The production of white rice by polishing rice is sufficiently known. The achieved smooth surface or surface brightness here expresses the achieved polishing quality. However, the brightness is evaluated manually, and hence depends on the subjective opinion of the evaluator.

EP-A-296956 discloses a brightness indicator, with which a comparison standard is to be provided through contrasting with a standard surface. According to DE-A-3312948, the brightness of any surface can be quickly determined by finding the luminance spectrum of the surface irradiated with light pulses and transforming it into electrical signals. The determination of surface brightness by finding the intensity of reflected light or the like is disclosed, for example, in EP-A-183270, JP56197959, WO 96/33401 or WO 01/20308. This can also be accomplished with an NIR spectrometer (EP-A-240185).

WO 96/33401 discloses a device for measuring the brightness of object with irregular or curved surfaces, wherein only one object at a time is gripped in a mount of the device. The brightness is determined by evaluating the refraction of the object exposed to light.

Stick-slip effects between surfaces moved relative to each other are known, and have been described by means of different models, e.g., the surface topology has been described (Bermann et al: Origin and characterization of

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different stick-slip friction mechanisms/ Langmuir, American Chemical Society, Vol. 12, No. 19, 1996, pp. 4559-4563).

Known for measuring the flow characteristics of loose materials is an annular shear device, which permits measurements of hardening over time and measurements at low hardening stresses (D. Schulze: Development and application of a new kind of annular shear device/ Aufbereitungstechnik, Vol. 35, Issue 10, 1994, pp. 524-526, 528). The loose material sample is in an annular shearing channel, and loaded from above with an annular cover. Carriers are intended to prevent the sample from sliding during the shearing process.

While it is also known that the whiteness level or color of white rice can be determined quite well with optical devices, the color analysis does not provide much information as to the smoothness and brightness of a rice grain, and hence as to product properties and buying interest.

Therefore, the object of the invention is to develop a method for determining the brightness of rice, in particular white rice, which makes it possible to objectively and economically evaluate the brightness of polished rice grains. This object is achieved with the features in claim 1.

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A surprisingly easy determination of stick-slip effects relative to rice grains enables a comparative evaluation of the brightness or smoothness of white rice, which allows both manufacturers and consumers to objectively assess the processing quality relative to the brightness or smoothness of the grain surface. This can be achieved by introducing a shear stress in a specific quantity of rice grains and determining the stick-slip effects in the process, in particular average values.

The time intervals of the stick-slip effects during exposure to a shear stress must be determined. These are subsequently averaged and displayed.

The object of the invention is further to provide a device for evaluating brightness that is reliable, cost-effective and easy to operate. This object is achieved with the features of claim 6.

The device comprises a very slow-running rotary table, which carries an annular channel that can be filled with rice. Also provided is an electronic evaluator to acquire torque changes, minimum and maximum values, interval times and resultant data relating to brightness. The device is based on the so-called annular shear cell, with which shearing forces of bulk material can be determined in a measuring channel and subsequently displayed. Such annular shear cells are used to determine the height and exact progression of shearing forces, while the device according to the invention measures only the time intervals between "shearing force drops". These times are then used as parameters for the brightness of a cereal grain, for example.

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The invention will be described in greater detail below in an exemplary embodiment based on a drawing. The drawing shows:

Fig. 1: a measuring readout for conventional white rice

Fig. 2: a diagrammatic representation and two views of the device (a, b)

The device consists of a rotary table 1, which carries an annular container 2. The container 2 is equipped with carrier strips 3 on the floor. A rice charge 4 in the container 2 fills it completely.

The rotary table 1 is driven via a (synchronous) belt drive 5 powered by a geared motor 6, which has a high transmission ratio, so that the rotary table 1 with the container 2 only rotates a few mm on the periphery per measuring process.

Situated opposite the rotary table 1 is a hinged, flip-open counter-table 7, the bottom of which is equipped with carriers.

The counter-table 7 can be pressed against the rice surface via springs 8, a pressure plate 10 and a spindle 11 with handle. A latch 12 is used to lock the cover system 19.

After the cover system 19 is closed, the spindle 11 can be used to move the pressure plate 10 in such a way as to pre-tension the springs 8 until the pressure plate 10 exerts a desired pressure on the rice surface. A marking 14 signaling a preset pre-tensioning level when it is flush with the surface of the pressure plate 10 is located on a spring bolt 13, so that an identical pressure can be set for each measurement. The marking 14 is visible through a window 15.

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The gear motor 6 is pivoted in the casing 16 around its driving axle, and supported against a load cell 18 via a lever arm 17. The bolt 20 serves as a carrier for the container 2.

The pre-tensioning could also be generated by compressed air by installing a pneumatic power component between the cover and counter-table 7, and setting the admission pressure using a control valve. A constantly identical pre-tensioning is always obtained at a defined air pressure.

For a measuring process, the container 2 is first filled to capacity with rice and placed on the rotary table 1. The cover 19 is closed, and the admission pressure on the rice surface is set via the spindle 11. After starting up the gear motor 6, the rotary table 1 is slowly made to rotate, and exerts a reaction moment on the drive. The measuring transducer acquires the repulsive force of the gear motor 6, and the response time is evaluated.

If stick-slip intervals arise after a time, the period between oscillation processes is measured, and displayed as an average by the control system.

After the measurement is complete and the motor turned off, the pre-tensioning must be removed again or, in the pneumatic variant, the pressure must be incrementally reduced. The reaction moment could also be gleaned at the counter-plate 7 and/or the pressure plate 10 using a force or torque sensor.

An electronic evaluator determines both minimum and maximum values, along the time and interval progressions.

The rotary table 1 rotates at very low speeds, and stick-slip effects inside the rice layer come about after a response time T_2 of several minutes, resulting in torque

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changes. The time T1 for the entire measuring cycle is adjustable.

Increasing the speeds makes it possible to shorten the response time, and hence the measuring process.

After response time T2, each time the prescribed minimum torque is not reached, encompassing even a portion of the measured maximum torque, is counted. After a preset measuring period, the measuring duration is divided by the determined number of events, yielding the average time of stick-slip effects, which is displayed. This only requires a counter and preset response and measuring period.

We here find that the effect has varying intervals, depending on the degree of polishing. The brighter and smoother the rice, the shorter the changes in torque over time. The gap in time for a single interval will measure only a few seconds for highly polished and bright rice, while being considerably higher for less polished rice.

Determining the measured time intervals T3 yields a value for the gaps in time for the stick-slip effects, which reflects the average brightness of the rice grains. In this case, the smaller the number for T3, the brighter and smoother the rice.

The invention is not limited to the embodiment shown.

REFERENCE NUMBERS

- 1 Rotary table
 - 2 Container
 - 3 Carrier strip
 - 4 Rice
 - 5 Belt drive
 - 6 Gear motor
 - 7 Counter-plate
 - 8 Spring
 - 9 Hinge
 - 10 Pressure plate
 - 11 Spindle
 - 12 Latch
 - 13 Spring bolt
 - 14 Marking
 - 15 Window
 - 16 Casing
 - 17 Lever arm
 - 18 Load cell
 - 19 Cover
 - 20 Bolt
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- T1 Measuring cycle time
 - T2 Response time
 - T3 Interval

CLAIMS

1. Method for determining the brightness of rice, in particular of white rice, with the following steps:
 - a) exposing a quantity of rice grains to a shear stress for a preset response time (T2)
 - b) recording stick-slip effects and their time intervals (T3)
 - c) allocating the intervals to prescribed brightness values.
2. Method according to claim 1, characterized in that the recorded time intervals (T3) are averaged.
3. Method according to claim 1 or 2, characterized in that the shear stress is applied via a rotating motion.
4. Method according to claim 3, characterized in that torque changes and/or flow changes are recorded.
5. Method according to claim 1, characterized in that the shear stress is generated by a linear motion and a counter-force applied perpendicularly thereto.
6. Device for determining the brightness of rice for executing a method according to claims 1 to 5, characterized in that it comprises a moving device in which is situated a space or annular container (2) to be filled with rice (4) to apply a shear stress, and the moving device contains a sensor arrangement to record forces and/or torques, which is connected with an electronic evaluator to determine time intervals of stick-slip effects.

7. Device according to claim 6, characterized in that the means for applying a shear stress have a rotary table (1) and a counter-table (7) for applying a pressure.