

# Food Spoilage Monitoring Device

## Technical Field

- [1] The present invention relates to the technical field of monitoring the shelf life of food products, particularly beverages and other bottled products.

## Prior Art

- [2] An approach to food spoilage monitoring is described in US 9915638 13 March 2018 (PAKSTAITE) which provides a monitoring device in the form of a label that offers a tactile response indicating food spoilage when a layer of material above a bumpy or ridged surface has liquefied. Synchronising the phase transition of the material with the rate of spoilage of the packaged foodstuff allows a more efficient indication of food quality than the traditional best before date marking. This is because the label and the food product are subject to the same environmental conditions during transit and storage.

## Technical problems

- [3] However, some products will only start the decay or spoilage process after a package has been opened. In some products opening will accelerate the decay or spoilage process. Therefore, there is a technical problem in monitoring this, as it then becomes necessary to activate the label so that it replicates the same conditions as the product only after activation. There is therefore a technical problem in providing for activation on opening of a package.
- [4] When using a tactile sensing device, it is necessary for the device to be supported on the packaging such that it can be felt easily without interference from other responses generated by the packaging. There is therefore a technical problem in providing support for the device.
- [5] The present invention therefore addresses the above described technical problems.

## Solution of the Present Invention

- [6] The present invention is defined in the appended claims.
- [7] Many beverages and food products are packaged in bottles which use a standard screw cap or lid closure and embodiments of the present invention are designed to be incorporated into such a lid. Preferably the device is activated using the same motion that is necessary to open the lid of the container. The device can be supported within the lid which typically already has a sufficiently rigid underlying surface. This facilitates reliability and the use of the tactile monitoring device.

## Description of the Drawings

- [8] In order that the invention can be well understood some embodiments thereof will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:
- [9] Figure 1 shows a cross section through a lid incorporating an activatable spoilage monitoring device in accordance with a first embodiment of the invention in a pre-activated condition;
- [10] Figure 2 is a cross section through the lid of Figure 1 after activation;
- [11] Figure 3 is an exploded view showing the component parts of a lid incorporating the device of Figure 1 and 2;
- [12] Figure 4 shows a cross section through a lid incorporating an activatable spoilage monitoring device in accordance with a second embodiment the invention in a pre-activated condition;
- [13] Figure 5 is a cross section through the lid of Figure 4 after activation;
- [14] Figure 6 is an exploded view showing the component parts of a lid incorporating the device of Figure 4 and 5; and
- [15] Figure 7 is a side view of the lid of the first or second embodiment prior to activation; and

- [16] Figure 8 is a cross section on line A-A in Figure 7 at right angles to the section shown in Figures 4, showing the internal structure of the second embodiment of the invention and the locked relative position of the parts of the cap before activation.

## Description of an Embodiment

- [17] An activatable food spoilage monitoring device 2 is mounted into an upper part 4 of a two-part cap or lid 6. The lid 6 may be of any standard size either for fitting to a glass or plastics bottle or jar or any other packaging container having a screw neck. A lower part 8 of the lid 6 has an annular wall component 12 having an internal screw thread 10 to engage in a conventional manner with a screw neck. The annular wall component is closed at its upper surface by a recessed top panel 14. The top panel 14 has a circular indentation 16 which engages with a correspondingly shaped circular projection 18 in the upper part. The profile in plan of the indentation and projection could take any appropriate shape provided they match and interlock and permit at least a limited relative rotation of the indentation and projection. As shown in this first embodiment, the indentation has a circular rib 20 which supports a lower wall of the projection 18 which contains the spoilage monitoring device 2. On the outer side of the wall component 12, oppositely disposed, elongate L-shaped grooves 24 are formed. This groove 24 is best shown in Figure 3 where its shape can be appreciated. Each groove is designed to cooperate with an inwardly projecting peg 26 formed on an inner wall surface of the upper part of the lid. The groove has an entry section 30 which extends from an intermediate point in the wall to the top panel. The entry section merges with a downwardly sloped track 32 so that on rotation of the upper part relative to the lower part, the two parts compress together into the configuration shown in Figure 2. It will be appreciated that more than two guidance grooves could be used for larger diameter lids. Alternative guidance systems that function in a similar manner can also be employed.
- [18] The upper part 4 of the lid 6 is a cup-shaped member having an annular wall 28 and a top panel 34. The top panel contains the circular shaped projection 18 which defines within it a recessed cavity 38 into which the monitoring device 2 can be received. The cavity has a base 40 which has a flexible central portion surrounded by a flexible, peripheral, downwardly-sloped annular wall section 42. As can be seen in Figure 1,

when the device is in a pre-activated condition, the central portion of the base 40 is supported on the rib 20 of the indentation 16 in the lower part. Due to the flexibility of the annular ring 42, the central portion 40 can be inverted or “popped up” in order to activate the device when the two lid parts are rotated relative to one another. In this first embodiment the annular ring 42 is made of a weakened thin material so that the base can be pushed flat against the bottom of the device 2.

- [19] The annular wall 28 is provided with two oppositely disposed pegs 26 which seat within the grooves 24 of the lower part. The pegs 26 are visible in Figure 1. In Figure 2, the upper part has been rotated relative to the lower part which forces the upper part downwardly into the configuration shown in Figure 2. During this rotation the central portion of the base will be forced to pop up into the configuration shown in Figure 2.
- [20] The cavity 38 receives the spoilage monitoring device 2. This device consists of a reservoir defined within the bottom of the cavity 38. This reservoir contains a digester fluid or liquid. An insert tray 62 with a base provided with a tactile pattern of protuberances, such as a series of ridges or bumps or pimples 68 sits above the reservoir cavity. The tray receives a layer 64 of a digestible material, for example, gelatine, gel, hydrocolloid or hydrogel. The term gel will be used as a generic term for this material layer. The gel may contain other chemicals to moderate its decay process into a liquid. The choice of digester liquid and digestible material is dependent on the contents of the product package within the container sealed by the lid. A flexible film 66 seals the device 2 within the cavity 38.
- [21] The base of the tray 62 has a central channel 82 which in the pre-activated condition is sealed by a dumbbell shaped rubber valve 90 which is push fitted into the channel prior to the introduction of the layer of digestible gel. The valve 90 has a portion 92 which is retained below the channel and a sealing portion 94 held above it. When the base 40 of the recess 38 comes into contact with a lower portion 92 of the valve, it pushes the upper sealing portion 94 away from the channel 82 opening the valve to allow digester fluid to flow through the channel.
- [22] The gel layer 64 has a thin layer of material or cloth 84 at its lower surface. This cloth could be made of paper or sponge or any other absorptive material that is capable of

absorbing the digester liquid in order to disperse it when it enters the tray on activation.

- [23] It is necessary in this embodiment that the sides of the tray are to be fitted tightly to the upper part of the cap so that the digester liquid can only go through the valve seal channel. This tight fit can be achieved by the addition of a snap fit groove 100 around an upper external wall of the tray. An inwardly projecting nib 102 is provided around the upper circumference of the cavity in order to engage with the groove 100 to seal the device 2 into the cavity 38, in such a way that any digester liquid in the reservoir cannot escape.
- [24] In operation, when the lid is unscrewed in the normal way about an axis which is vertical in ordinary use, the first part of the rotation will cause the two parts of the lid to axially compress together reducing the spacing between the two parts. As a result, pressure on the lower portion of the valve from the base 40 results in the opening of the valve 90 allowing the digester liquid to be squeezed up and through the channel 82 onto the bottom of the tray under the gel. The valve 90 can be made of various different designs. It can be opened either mechanically by being pushed by the flexible base as described above or be opened by the increased pressure that is created underneath the tray when the flexible base is pushed up during activation. Once the digester liquid is in the tray, the thin cloth 84 absorbs the liquid quickly in order to disperse the liquid over the entire bottom surface of the gel. The gel then absorbs the digester liquid from the cloth. The cloth ensures an even spread of the digester liquid over the surface of the gel and prevents the digester liquid from running back under the tray should the flexible base 40 be re-expanded
- [25] Further rotation of the lid will open the container in the conventional manner so that the contents can be accessed and the container resealed by reapplication of the lid. The activation process cannot be reversed. The activation process by rotation of the parts is a one-way operation and results in the irreversible chemical activation by the digester liquid entering the tray. It is desirable to be able to lock the activation state. This can be achieved by shaping the end of the groove 24 to capture the peg and prevent it moving backwards as shown in Figure 3. Activation can also be insured by the interlocking created by the popping up process of the base 40. Other methods of

achieving activation could be used. Irreversible mechanical activation may be desirable because reversal could allow the fluid to come out of contact with the gel to create unreliable results. In other arrangements where the absorption of the fluid into the gel is sufficient to ensure irreversible activation (that is the chemical reaction is permanent) the rotation mechanism can be made reversible, in order to neutralise the positive pressure in the cap resulting from the initial activation compression. This makes it easier to feel the bumps once liquefied, because it is less 'bulgy'. Accordingly the physical mechanism may be reversible; but the activation chemical reaction between the activator and the gel is irreversible.

- [26] As time passes, the digester liquid is absorbed by the gel and begins the temperature dependent decay process which will eventually force the gel to liquefy. When the gel is liquefied, a user touching the film 66 will be able to feel the tactile pattern moulded into the base of the tray. When the gel is solid and the contents of the container are still fresh, the user will feel a smooth surface. Accordingly, the device 2 allows the user to detect when the decay process has proceeded sufficiently far for the gel to liquefy. By appropriate choice of gel and digester liquid, the decay process in the gel can be made to mimic the anticipated freshness of the contents of the container.
- [27] The film 66 is sealed to the upper part of the lid. Ultrasonic welding can be used. Other methods of creating a seal over the sponge could be employed. The two parts of the lid can be injection moulded plastics. Other forms of fabrication such as vacuum casting could be used. The overall height of the lid can be made to match the overall height of a conventional lid so that this type of lid can be simply used in the packaging process in like for like replacement of conventional screw top lids or caps.
- [28] Preferably the outer side of the wall of the upper part 4 is knurled as shown in Figure 7 to facilitate gripping of the part to initiate rotation.

## Second embodiment

- [29] The second embodiment is illustrated in Figures 4 to 8 and like parts are indicated by like reference numerals. The general principle of the second embodiment is as previously described. In this embodiment the digester fluid is contained in a sponge

60 which fills the reservoir 38. The sponge may be made of cellulose or other suitably absorbent material. The type of material used needs to be able to store the required amount of digester liquid and expel substantially all of it when compressed. As shown in Figure 4, there are two concentric ribs 20 which support the base 40 of the reservoir in this embodiment in order to create greater force on the sponge 60.

- [30] On activation of the device the side wall of the reservoir is popped up into an inverted position as shown in Figure 5 to apply uniform pressure to the sponge and cause the digester fluid to flow around and over the edges of the tray and onto the gel 64. The inversion of the flexible base 40 squeezes the digester liquid out of the sponge, around and over the sides of the tray and onto the top of the gel layer as diagrammatically illustrated in Figure 5, where the digester liquid is shown as a layer 70 sitting on top of the gel.
- [31] The tray 62 could also have perforations in its base to allow entry of the digester fluid squeezed out of the sponge.
- [32] It will be appreciated that this embodiment with a sponge in the reservoir could be combined with the first embodiment, with the base of the tray provided with a valve sealed channel as in the first embodiment in order to deliver the digester fluid into a cloth lined base of the tray on activation.
- [33] The method of operation of the second embodiment is as previously described.