

A present invention concerns a process in accordance with a pre-characterizing clause of claim 1 and a test chamber in accordance with that of claim 2.

Processes for testing sealing are known in which a container to be tested is subjected to a pressure difference between internal and external pressures as a preliminary condition, and from which a state of sealing of a container is concluded from a magnitude of pressure which is dependent on this pressure difference. Such a process of testing for leaking of containers from fused joins, is known for example from DE-OS 24 47 578. Here, a container is opened and a same pressure is applied internally and, along major wall-sections, also externally, as a result of opening a container, and a testing channel, which is separated from a said volume under pressure, around a fusion-join concerned. Time-related development of pressure in this testing channel is recorded as a measure of a state of sealing of a fusion-join.

From DE-OS 21 15 563, it is known for fusion-joins of containers closed by sheets of material to be tested by piercing a base of a container with a spike and applying pressure inside this container. A state of sealing is deduced by monitoring an internal pressure produced by rupturing walling of a container.

Testing for leaks in containers by observing their internal or external pressures is known generally from an article 'Testing for leaks by measuring pressure-differences' by J. T. Furness, VFI 4/78. Here, sensitivity to pressure change caused by leaking is greater with a decreasing volume in which a pressure relevant to measurement is monitored.

Testing of sealing of rigid containers by recording a volume of gas forced through it into a sealed test-chamber, is known from US-A-3 517 547. Furthermore, in order to increase measuring-sensitivity, a chamber is chosen which is slightly larger than a volume of an object or container to be tested. From US-A-3 177 704 and from JA-A-5 834 337, it is further known for sealing of closed containers to be tested in a test-chamber by setting this test-chamber at negative pressure in relation to an inside of a container to be tested. A process and equipment in accordance with patent US-A-3 177 704 tests rigid pressurized containers and implements increased measuring sensitivity through selection of an intermediate volume, between walling of a test-chamber and an outer surface of a container, which is as small as possible, while equipment in accordance with JP-A-5 834 337 tests containers which are closed by a covering sheet of material, which can be opened and which have deformable sides, through placement of can-shaped containers on base surfaces on supporting means, on a test-chamber.

Here, test-chambers are set at negative pressure in relation to an internal pressure of containers. A test-chamber/container system concerned can be separated from a negative pressure source, thereby producing initial pressure conditions, and a state of sealing of a container can be deduced from pressure-behaviour of an intermediate volume, that is, a volume outside a container, between a test-chamber and a container. Testing-time per container mainly depends on a volume outside of containers, that is, from a difference-volume lying between a test-chamber and a container; duration of a test-cycle concerned lengthens with increase in this difference-volume, since evacuation of this difference-volume needs more time.

Moreover, a leak in a container of a set size and corresponding flow from an inside of a container into an intermediate space, with a set predetermined initial pressure-difference, produces an assessable signal which decreases in intensity with increase in this intermediate or exterior volume in a test-chamber concerned.

From CH-A-395 584, it is known for screen holders to be provided, on a moving plate, for containers to be tested, into which containers can be introduced radially in relation to an axis of a plate concerned. Then test-chamber jackets are turned over axially, over containers, into screen holders and are closed tight onto a moving plate concerned. Danger that, when recording a pressure-difference directed outwards from an inside of a container, sides of packaging containers burst through arching outwards, is prevented in that sides of a chamber are placed so close to sides of a container concerned that these latter can be protected against rupture.

Based on a process and/or a test-chamber of a forementioned type, a present invention is aimed at reduction of duration of a measuring cycle and, with this, simultaneous increase in sensitivity of pressure-measurement.

This is realized by development of an above-mentioned process in accordance with a characterizing clause of claim 1, based on a test-chamber of an above-mentioned type with development in accordance with a characterizing clause of claim 2.

A present invention is therefore based on awareness that, when testing closed containers with at least partly deformable sides, in accordance with a process claimed here, duration of a test-cycle and measuring-sensitivity can be improved by minimizing an above-mentioned intermediate

volume, without sides of a container lying against sides of a test-chamber.

An appropriate evacuation- or pressure-pipe is connected to an outside of a container to apply testing pressure. When testing with negative pressure and taking a minimalized intermediate volume, and therefore a minimalized separation from sides of a chamber, a container concerned is prevented from arching such that, for example, it lies against an opening of a suction pipe, by closure of this opening. In other cases it is generally advisable to prevent a container, in a case of stated testing using negative pressure, from fully or partly lying against sides of a test chamber. As far as is possible, billowing of wall material of a container, leading to its becoming punctured under such additional deformation, should also be prevented.

Retention of form is ensured by a test chamber, with a screen insert, in accordance with a present invention, even if this is only so in set areas along walling of a chamber concerned, in order to prevent suction of container sides onto a suction pipe, or along a whole inside of a chamber and/or sides, in order to take up a container concerned.

By developing a test-chamber as stated in claim 3, a simplest possible form of a test-chamber concerned is realized, and a container, once it has been inserted and tested, after opening of a lid member, can be directly removed. A problem, when developing a hollow space of a test chamber concerned so that it is similar in form to that of a container, in order to minimize volume of a container concerned, that parts of sides of hollow space could get caught such that a container could no longer be directly removed from this test-chamber, is thereby removed in a simple way.

It is furthermore proposed, as stated in claim 4, that a sleeve base encloses a thrusting piston which can be piloted into a sleeve interior, such that, after sealing of a container has been tested, and after removal of a lid member, a tested container can be passed out through lifting of a thrusting piston concerned.

For essentially truncated cone-shaped containers, such as those used to contain yoghurt, it is further proposed, as stated in claim 5, that a sleeve be developed essentially truncated cone-shaped.

A test-chamber concerned can favourably be spatially designed as stated in claim 7, whereby its opening is on top. In this way, containers to be tested can be inserted into a test-chamber under gravity, and can be passed out, after testing, aided by a thrusting piston and, in particular, when testing pot-shaped containers such as those used for yoghurt, which are closed by a sheet of foil, loading of a seal-join between cover foil and pot corresponding to a normal state of such a container is ensured. This sealing-join can scarcely be reliably tested for sealing after a product contained has flowed downwards, with containers concerned in an upside-down position.

In order to be able to easily remove soiling of a test-chamber by contents of containers, it is proposed that a drainage pipe, for a rinsing agent, which can be closed tight, open into a chamber concerned, as stated in claim 8, whereby this test-chamber can be directly rinsed. Rinsing occurs manually, or a feed pipe, with a terminally positioned jet-nozzle, which can be closed tight, can be provided on a closing cover for example, so that a test-chamber can be rinsed as required. When providing a test-chamber with a drainage pipe, for a rinsing agent, which is to be closed

tight, a movable part which is present in any case, namely a thrusting piston, can be used to open and tightly close this pipe, as stated in claim 9.

This development is preferably realized as stated in claim 10 such that a sealing piston includes a piston disk and a pipe through which a side of a said piston disk, which faces away from an inside of a sleeve, is opened or closed tight, whereby a forementioned drainage pipe for a rinsing agent is opened when a container which has just been tested is thrust out, and when this piston is withdrawn, and in a position for testing of sealing, this drainage-pipe is closed tight.

A number of such test chambers are excellently suited to being combined in an arrangement in accordance with claim 11, for carrying out in-line testing of containers, in production, after these have been closed. Because of short duration of a testing cycle with a test-chamber in accordance with a present invention, all containers of a production line can be tested for sealing, bringing with it significant advantages in relation to random sampling.

Such an arrangement, in accordance with a present invention, of several test-chambers in accordance with a present invention, is preferably developed as a carousel.

A test-chamber in accordance with a present invention, and therefore also an arrangement of several such test-chambers, is especially suited to testing filled and closed plastic beakers, such as yoghurt pots.

A present invention is explained below in connection with diagrams.

These figures are as follows:

Fig. 1 a diagrammatic representation of a test-chamber of a known type and its use in testing sealing of closed, filled containers with a cross-sectional area which tapers in a direction along an axis of a container concerned,

fig. 2 a diagrammatic representation, analogous to that of fig. 1, of a test-chamber in accordance with a present invention,

fig. 3 a diagrammatic longitudinal section through a preferred design variation of a test-chamber in accordance with a present invention for testing sealing of beaker-type containers such as yoghurt pots.

Fig. 1 shows a diagrammatic representation of a test-chamber 1 of a known type which is used, also in a known way, for testing sealing of closed containers 3 which, seen in a direction of a container axis A, have tapering cross-sectional areas F_3 . Containers 3 concerned are filled with a product 5 and are closed by a covering sheet of foil 7, for example, which is connected at its periphery to a container 3, by adhesion or fusion for example. Such containers can, for example, be plastic beakers which are closed by aluminium foil 7.

For testing of sealing, these containers 3 are introduced into a test-chamber 1 which is then closed by a closing cover 11 and seals 13. An intermediate volume V_2 is established between a container 3 and a test-chamber comprising a closing cover 11 and a sleeve 15, a said intermediate volume being set to a test pressure p_2 which is different from a pressure inside a said container 3.

As shown by fig. 1, this is achieved via a pressure application pipe 17 with a volume 19. After pressure has been applied to an intermediate volume V_z , a valve 19 is closed and build-up of a pressure p_z of an intermediate volume V_z is recorded by means of a pressure sensor 21 which is preferably developed as a sensor of pressure difference and has a reference pressure p_z supplied to it, together with a pressure of an intermediate volume p_z . A pressure, which is lower than that of an inside of a container concerned, is applied, as a test pressure to an intermediate volume, whereby there is a climb in pressure in an intermediate volume V_z after closure of a valve 19, if a container concerned is leaking, after closure of a valve 19, as a result of onset of pressure equalization. For application of a test pressure p_z to an intermediate volume V_z , a volume of gas has to be extracted from an intermediate volume V_z , this volume to be removed being greater with increase in size of a said intermediate volume V_z .

A volume of gas to be moved to produce a testing pressure p_z , with a set extraction of a suction organ (not shown) connected to a pipe 17, acts directly on a duration of time which is necessary for application of testing pressure: with decrease in size of an intermediate volume V_z , time needed to apply pressure to it also decreases.

Furthermore, with a set amount of leaking, with a set test pressure p_z and therefore a set pressure difference of an intermediate volume V_z and an inside of a container concerned, a gas volume flowing through a leak per unit time is also given, whereby a pressure-change in an intermediate volume V_z , recorded in connection with a leak, is greater with time for a smaller intermediate volume V_z .

In order to optimally take these relationships into account, a test-chamber is designed as shown in fig. 2, such that a smallest possible intermediate volume is defined between a said test-chamber and a container to be tested introduced into it. A test chamber 31 in accordance with a present invention, shown in fig. 2, includes a single-sided, open sleeve 35 with an opening 34, whereby cross-sectional areas F_{35} , seen from an opening 34, taper downwards. Tapering of cross-sectional area F_{35} along an axis A_{35} thereby favourably corresponds to tapering of a cross-sectional area F_3 of a container 3 to be introduced into a test-chamber 31, and tested, such that sides of a container 3 and an inside of a test-chamber 31, with an inserted container 3, lie substantially equidistantly from each other. An intermediate volume V_z thereby has a minimum value.

A closing cover 33 is also provided on a test-chamber 31 in accordance with a present invention, which is closed tight by a said closing cover 33 by means of seals 37, shown diagrammatically, after insertion of a container 3 to be tested into this test-chamber 31. Application of a test-pressure and recording of pressure behaviour in an intermediate volume V_z occurs as explained in connection with fig. 1.

Fig. 3 diagrammatically shows a favoured design variation of a test-chamber in accordance with a present invention. It is developed, by way of example, to test sealing of essentially truncated cone-shaped containers 3, such as those to be used for yoghurt, for example.

A container 3, with a cover sheet 7, to be tested is shown by a dashed line. A test-chamber in accordance with a present invention includes a sleeve 39, which is formed corresponding to an outer form of a container. A cross-sectional F_{39} area

of a sleeve 39, tapers essentially conically in a direction of a central axis A, from a sleeve opening 41 towards a base 43 of a sleeve 39, and defines a hollow space which is, geometrically, essentially similar to a body of a container 3 such that, when a container to be tested is inserted, there is a substantially constant separation between its sides and sides of a sleeve 39. In an area of an opening 41 of a sleeve 39, there is preferably a circular positioning groove for such containers, normally provided for a projecting rim provided with fusing of a cover sheet (not shown).

A test-chamber concerned furthermore includes a closing cover 45, which can be driven onto or away from a sleeve 39 as shown by a double arrow, for closing a said test-chamber tight by means of seals 43.

A sliding piston 47, which is axially driven, is disposed on a base of a sleeve 39, this piston being withdrawn in a position shown when a container 3 is inserted and is tested, and then, after opening of a closing cover 45, is pushed forwards to force out a container which has just been tested.

A drainage pipe 49, for a rinsing agent, opens on a side of a piston 47 facing away from an inside of a test-chamber, this pipe, when a piston 47 is withdrawn, being closed by means of sealing members 51, as shown. This provides a possibility, after removal of a tested container 3, of rinsing a product which has leaked into a test-chamber concerned during testing of sealing, after forward movement of a piston 47, whereby a rinsing agent flows out of a drainage pipe 49 for it which is then opened. To rinse a test-chamber concerned, a feed pipe (not shown), with a jet nozzle, for a rinsing agent, can at all events be provided on a closing cover 45.

A test-chamber concerned, particularly for use with containers which are closed by means of a cover sheet of foil 7, such as those for yoghurt etc, are preferably spatially arranged so that their opening 41 lies on top. This prevents a contained product from falling onto a cover sheet 7 which would adversely effect testing of sealing of connection sealing, a fusion-join for example, between a cover sheet 7 and sides of a container.

A test-chamber in accordance with fig. 3 includes, as diagrammatically shown, pressure-feed and recording pipes or organs as explained in connection with figs. 1 and 2.

For testing sealing of containers such as those for yoghurt, cream etc, in line with production, that is after filling of a container and its closure, whereby each container is tested, several test-chambers as diagrammatically shown in fig. 3 for example are combined to form testing equipment, favourably on a horizontal turntable device (not shown) rotating about a vertical axis, so that all containers are subjected to testing of sealing in a test-chamber in accordance with a present invention, before filled and closed containers are stored for subsequent despatch.

In order additionally to prevent areas of sides of containers from lying against inner surfaces of a test-chamber concerned, in cases of testing of containers, as claimed here, with flexible sides, under negative pressure, a screen insert (not shown) which is in accordance with a present invention is inserted into a test-chamber concerned, for example as a conical sieve tube which is open underneath and into which a container to be tested is inserted. Using such a screen prevents sides of a container from lying air-tight against sides of a test-chamber concerned, when negative pressure is applied. Where necessary, further pressure

connections can be provided that also ensure pressure equalization with an intermediate volume V_z created above a cover sheet 7, when placing an opening part with a sheet of foil 7, of a container 3, onto a correspondingly formed circular shoulder in an area 41 of an opening of a test-chamber.



patent claims

1. Process for reducing duration of a test-cycle and for raising pressure-sensitivity in non-destructive testing of a closed container (3), in which, as an initial state in a container (3) to be tested, which has an at least partly deformable casing, is subjected in a test chamber to a pressure difference between internal pressure and predetermined external pressure which is lower than the internal pressure and the sealing of the container is considered on a basis of the time-bahaviour of the external pressure, characterized in that arching towards the outside of the deformable casing as a result of the pressure difference is prevented and it therefore becomes possible to design a minimal intermediate space between the test chamber wall and the container casing.
2. Test chamber for non-destructive testing of sealing of a container (3) with at least a partly deformable casing and an outer cross-sectional area (F_{3s}) which is reduced in an axial direction (A_{3s}) of a said container, whereby a said test chamber concerned has a hollow zone (35), which can be closed, for uptake of a said container (3), to which an evacuation device (17, 19) for producing a pressure difference between an inside of a said container and an outer space formed between walling of a hollow zone and a said container, is connected, for a starting state, and a device (21) for measuring a pressure-intensity (P_z which depends on a pressure difference and



sealing of a said container and furthermore a hollow zone of a said testing chamber is at least substantially geometrically similar to a form of a container (3) to be tested, characterized in that a filtering screen inset is provided in a said chamber to support a deformable part of the container and the distance of the walling of the hollow zone from a filtering screen inset is identical to or less than arching of supported parts of casing without the provided filtering screen inset.

3. Test chamber in according to claim 2, characterized in that a chamber (31) includes mechanical-sleeve (35, 39), which is closed on one side, an open cross-sectional area (F_{35} , F_{39}) decreases in a direction (A) away from a base of said sleeve, and a cover (33, 45) is provided for sealed closure of said sleeve.
4. Test chamber according to claim 3, characterized in that, on the base of the sleeve, there is a push-piston (47) which is piloted into the inside of the sleeve.
5. Test chamber according to claim 3 or claim 4, for substantially truncated-cone-shaped containers, characterized in that a said mechanical-sleeve concerned is substantially truncated-cone-shaped.
6. Test chamber according to any one of claims 3 to 5, with a container to be tested, characterized in that walling on a side of the sleeve runs at a substantially constant distance from casing of the container.
7. Test chamber according to any one of claims 3 to 6, characterized in that the test chamber is disposed such that its opening faces upwards.



8. Test chamber according to any one of claims 3 to 7, characterized in that a sealing closable channel (49) for a rinsing agent which opens into the hollow zone.
9. Test chamber according to claim 8, characterized in that the channel can be opened and closed by means of a piston (47) which preferably acts as well as a container-arching piston acts.
10. Test chamber in according to claim 3, characterized in that a base of a hollow zone concerned surrounds a disc of a piston and a channel (49) is opened or sealably closed by means of a side of the piston facing away from the hollow zone concerned.
11. Arrangement with a number of test chambers, according to any one of claims 2 to 10, for in-line testing of containers from relevant production, after said containers have been closed.
12. Arrangement according to claim 11, characterized in that, test chambers are disposed on a carousel.
13. Use of a test chamber according to any one of claims 3 to 10 or an arrangement according to one of claims 11 and 12, for testing filled and closed plastic beakers such as those produced to contain yoghurts.