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RAN 4090/217A closure for a reagent container

The invention relates to a closure for a reagent container for use in an analysis system in which an automatic pipetting device is used for transferring small quantities of reagent from the reagent container to reaction cells.

The invention also relates to a closure device containing a closure of the aforementioned kind.

In hitherto-known analysis systems, e.g. for clinical chemical analysis of biological specimens, open reagent containers are used. An automatic pipetting device takes a small amount of a liquid reagent from the container and supplies it to a reaction cell. The capacity of a conventional reagent container is sufficient for a relatively large number (of the order of 200 to 1000) of such pipetting operations.

The use of open reagent containers has the following disadvantages:

- The laboratory staff have to take each new reagent container out of its packaging, remove the closure and insert the open reagent container into the analysis system in place of an empty reagent container. Often a number of different reagents are needed at different times in the same analysis system. The use of open reagent containers therefore puts the laboratory staff to considerable trouble.

- When open reagent containers are used in rooms with relatively dry air, some of the reagent solution is lost through evaporation and consequently the concentration of the reagent increases with time. When open reagent containers are used in rooms with relatively moist air, on the other hand, the volume of the reagent solution increases and thus its concentration decreases with time. When open reagent containers are used, there is also exchange of gas with the ambient air, which ages or changes the reagent. All the aforementioned changes in the reagent, particularly in the concentration thereof, reduce the accuracy of the resulting analysis.

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The object of the invention therefore is to provide a closure of the initially-mentioned kind for obviating the aforementioned disadvantages.

According to the invention, the problem is solved by a closure characterized in that

- a) it is formed in one piece from a plastic and
- b) it has a cylindrical side wall and an annular top wall adjacent the side wall and merging into a conical wall which extends inwards from the inner circle of the top wall and ends in a perforatable tip situated on the axis of symmetry of the cylindrical wall.

The main advantages of the closure according to the invention are as follows:

- For the purpose of pipetting a reagent from the container into the reaction cells, the pipetting needle can be inserted through the closure into the reagent container, it is therefore unnecessary to remove the closure in order to use the container in an analysis system.

- In each pipetting process, the conical inwardly extending wall in the central part of the closure guides the pipetting needle through the same place in the closure, i.e. through a small slot in the perforated tip of the conical wall. This ensures that even after a large number of pipetting operations (e.g. 200 to 1000) through the same closure, there is no danger to the closure and no resulting blockage of the pipetting needle (by fragments of the closure).

- Apart from small venting slots, which are open only when the pipetting needle is inserted, the reagent container equipped with the closure according to the invention remains substantially sealed during its entire period of use in the analysis system. This effect of the closure according to the invention is obtained more particularly as a result of its conical wall, which has a shape and length so as to prevent evaporation of the reagent solution and exchange of gas with the ambient air. In addition, the closure surrounds and resiliently abuts the pipetting needle at the place of penetration. As a result, the needle is wiped when inserted and pulled out, thus largely preventing contamination by different reagents.

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As a result of the aforementioned advantages, by means of the closure according to the invention the treatment of the reagent container in the analysis system can be made automatic, i.e. the laboratory staff can be relieved from the hitherto necessary manual activity and the reliability of treatment can also be increased.

The closure according to the invention is preferably a screw cap. This is a simple method of ensuring a efficient seal on the reagent container.

A preferred embodiment of the closure according to the invention is characterized in that the conical wall has a first part adjacent the top wall and co-operating with the axis of symmetry of the cylindrical side wall to form a first angle, and a second part which forms the tip of the conical wall and co-operates with the axis of symmetry of the cylindrical side wall to form a second angle which is greater than the first angle, and the first angle is preferably between 5° and 30° and the second angle is between 20° and 60° . In a particularly preferred embodiment the first angle is about 10° and the second angle is about 30° . By this means the conical wall of the closure in optimum manner serves a double purpose as a guide for inserting the pipetting needle and as an important part of the closure for tightly sealing the container.

Preferably, access to the conical wall of the closure according to the invention can be sealed by a metal sealing foil. As a result the closure has sufficient sealing-tightness for storing freeze-dried or granulated reagents for a prolonged period.

A preferred embodiment of the closure according to the invention is characterized in that, adjacent to the top wall, it has a cylindrical wall which is concentric with the side wall and extends inwards and lies between the side wall and the conical wall. This embodiment has the advantage of providing sufficient sealing-tightness for storing reagents in liquid form for a prolonged time. In this embodiment of the closure an additional sealing ring between the closure and the container is therefore not required in the case of liquid reagents.

According to the invention, the aforementioned problem is also solved by a closure device characterized in that it contains the following components:



- a) a closure made in one piece from a plastic and having a cylindrical side wall and an annular top wall adjacent the side wall and merging into a conical wall which extends inwards from the inner circle of the top wall and ends in a perforatable tip lying on the axis of symmetry of the cylindrical wall, and
- b) a plug which is insertable as a seal between the closure and the container and has a central orifice which is adapted to the shape of the outer surface of the conical wall of the closure so that when the container is sealed by the plug and the closure, the outer surface of the conical wall abuts in sealing-tight manner against the inner wall of the orifice through the closure.

Since this closure device contains a closure according to the invention, it provides all the advantages described hereinbefore with reference to the closure. The plug provided in the closure means according to the invention increases the sealing-tightness, which is particularly advantageous for containers holding reagents in granulated form. Preferably all the previously-mentioned embodiments of the closure according to the invention can be used in the closure device according to the invention, except for that embodiment of the closure according to the invention which has a second cylindrical wall.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a view, partly in section, of a first embodiment of a closure 11 according to the invention;

Fig. 2 is a partial plan view of the closure 11 in Fig. 1;

Fig. 3 is a cross-section of a plug 21 adapted to co-operate with the closure 11 in Fig. 1 to form a closure device according to the invention;

Fig. 4 is a view, partly in cross-section, of a closure device according to the invention;

Fig. 5 is a view, partly in cross-section, of the closure device as per Fig. 1 and a spike 17 inserted therein;

Fig. 6 is a view, partly in cross-section, of the closure device in Fig. 4 after removal of the spike 17 shown in Fig. 5;

Fig. 7 is a plan view of the closure device in Fig. 6;



Fig. 8 is a view, likewise in cross-section, of the closure device in Fig. 4 and a pipetting needle 26 inserted therein, and

Fig. 9 is a view, partly in cross-section, of a second embodiment of a closure 31 according to the invention.

A first embodiment of a closure 11 according to the invention will now be described with reference Figs. 1 and 2. The closure 11 is made in one piece from a plastic. It has a cylindrical side wall 13 and an annular top wall 14 adjacent the side wall and merging into a conical wall 15 which extends inwards from the inner circle of the top wall and ends in a perforatable tip 16 lying on the axis of symmetry of the cylindrical wall.

Preferably the closure 11 is a screw cap having a side wall 13 formed with an internal thread 19 which matches an outer thread in the neck of the reagent container (not shown) which is to be sealed by the closure.

The conical wall 15 has a first part adjacent the top wall 14 and co-operating with the axis of symmetry of the cylindrical side wall 13 to form a first angle which is preferably about 10° but can be between 5° and 30° .

The conical wall 15 has a second part which forms the tip 16 of the conical wall and co-operates with the axis of symmetry of the cylindrical side wall 13 to form a second angle which is greater than the first angle. The second angle is preferably 30° , but can be between 20° and 60° .

Access to the conical wall 15 is preferably sealed by a metal sealing foil 28. An embodiment thereof is shown in Fig. 4.

Fig. 3 shows a cross-section through a plug 21 which, in co-operation with the closure 11 in Fig. 1, is adapted to form a closure device according to the invention as in Fig. 4, for providing a particularly good seal.

As Fig. 4 shows, the closure device comprises the previously-described closure 11 and the plug 21, which is insertable as a seal between the closure 11 and the container. The plug 21 has a central orifice 22 which is shaped to match the outer surface of the conical wall 15 of the closure so that when the container is sealed by the plug 21 and closure 11, the outer



surface of the conical wall 15 bears in sealing-tight manner against the inner wall of the orifice 22 through the plug 21.

All the embodiments of the closure 11 described with reference to Figs. 1 - 4 hereinbefore are suitable for constructing the closure device which has likewise been described.

The use of the closure 11 will be described hereinafter with reference to Figs. 5 - 8.

The tip 16 of the conical wall 15 in Fig. 1 is perforated by the tip of a spike 17, which has cutting fins 18, 19. The sharp bottom edges of the fins 18, 19 cut venting slots in the bottom part of the conical wall 15. After the spike 17 has been removed, the conical wall 15 remains in the state shown in Figs. 6 and 7. A Y-shaped slot 23 is left at the perforated tip of wall 15, and the bottom part of the wall now has venting slots 24 and 25.

As shown in Fig. 8, a pipetting needle can now be introduced through the Y-shaped slot at the tip of the conical wall 15 into the reagent container, e.g. in order to remove a given volume of liquid reagent therefrom.

Fig. 9 shows another embodiment of a closure 31 according to the invention which by itself, i.e. without an additional plug such as the plug 21 in Fig. 4, provides sufficient sealing-tightness for storing a liquid reagent in a container. As before, the closure 31 is made in one piece from a plastic. It has a cylindrical side wall 33 and an annular wall 34 adjacent the side wall and merging into a conical wall 35. The wall 35 extends inwards from the inner circle of the top wall 34 and ends in a perforatable tip 36 lying on the axis of symmetry of the cylindrical wall 33. The plug axis of symmetry of the cylindrical wall 33. The plug 31 also has a cylindrical wall 37 adjacent the top wall 34, the wall being concentric with the side wall 33, extending inwards and lying between the side wall 33 and the conical wall 35.

The use of the closure 11 described with reference to Figs. 5 - 8 also applies to the closure 31 in Fig. 9.

The closure 11 or 31 is made by injection moulding, e.g. from LD-PE (low density polyethylene). The closure is given a suitable colour, e.g. white.

The plug 21 is made e.g. of bromobutyl rubber.



The sealing foil 28 is e.g. a sandwich foil, i.e. a laminated structure comprising a layer of polyethylene terephthalate (PETP) having a thickness of 12 micrometres, an aluminium layer having a thickness of 12 micrometres and a layer of polyethylene (PE) having a thickness of 100 micrometres.

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Claims

1. A closure (11) for a reagent container (12) for use in an analysis system in which an automatic pipetting device is used for transferring small quantities of reagent from the reagent container to reaction cells, this closure being characterized in that

- a) it is formed in one piece from a plastic and
- b) it has a cylindrical side wall (13) and an annular top wall (14) adjacent the side wall and merging into a conical wall (15) which extends inwards from the inner circle of the top wall and ends in a perforatable tip (16) situated on the axis of symmetry of the cylindrical wall.

2. A closure according to claim 1, characterized in that it is a screw cap.

3. A closure according to claim 1, characterized in that the conical wall (15) has a first part adjacent the top wall (14) and co-operating with the axis of symmetry of the cylindrical side wall (13) to form a first angle, and a second part which forms the tip (16) of the conical wall and co-operates with the axis of symmetry of the cylindrical side wall (13) to form a second angle which is greater than the first angle.

4. A closure according to claim 3, characterized in that the first angle is between 5° and 30° and the second angle is between 20° and 60° .

5. A closure according to claim 4, characterized in that the first angle is about 10° and the second angle is about 30° .

6. A closure according to claim 1, characterized in that access to the conical wall (15) is sealed by a metal sealing foil (28).

7. A closure according to claim 1, characterized in that it has a cylindrical wall (37) adjacent the top wall (34), the lip being concentric with the side wall (13) and extending inwards and lying between the side wall (33) and the conical wall (35).

8. A closure device for a reagent container of use in an analysis system in which an automatic pipetting device is used for transferring small quantities of reagent from the reagent



container to reaction cells, this closure device being characterized in that it contains the following components:

a) a closure (11) made in one piece from a plastic and having a cylindrical side wall (13) and an annular top wall (14) adjacent the side wall and merging into a conical wall (15) which extends inwards from the inner circle of the top wall (14) and ends in a perforatable tip (16) lying on the axis of symmetry of the cylindrical wall (13), and

b) a plug (21) which is insertable as a seal between the closure (11) and the container and has a central orifice (22) which is adapted to the shape of the outer surface of the conical wall (15) of the closure so that when the container is sealed by the plug (21) and the closure (11), the outer surface of the conical wall (15) abuts in sealing-tight manner against the inner wall of the orifice (22) through the closure (21).

9. A closure device according to claim 8, characterized in that the closure (11) is a screw cap.

10. A closure device according to claim 8, characterized in that the conical wall (15) of the closure (11) has a first part adjacent the top wall (14) and co-operating with the axis of symmetry of the cylindrical side wall (13) to form a first angle, and a second part which forms the tip (16) of the conical wall and co-operates with the axis of symmetry of the cylindrical side wall (13) to form a second angle which is greater than the first angle.

11. A closure device according to claim 10, characterized in that the first angle is between 5° and 30° and the second angle is between 20° and 60° .

12. A closure device according to claim 11, characterized in that the first angle is about 10° and the second angle is about 30° .

13. A closure device according to claim 8, characterized in that access to the conical wall (15) is sealed by a metal sealing foil (28).

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