ABSTRACT

A depletion device of a bag-in-box container for viscous ink comprises an elongated tube extending into the bag. The tube is preferably cylindrical and has a plurality of holes in its side wall. The holes are arranged in columns so as to define longitudinal ribs in the side wall of the tube. Holes in adjacent columns are offset relative to one another. The depletion device maximizes the amount of ink that can be extracted from the bag by preventing the collapsing bag closing off the depletion device.
DEPLETION DEVICE FOR BAG IN BOX CONTAINING VISCOUS LIQUID

BACKGROUND OF THE INVENTION

[0001] The present invention relates to depletion devices for use with bag-in-box type containers for viscous liquids, in particular inks.

[0002] It is known to use bag-in-box packaging designs to contain viscous liquids such as ink, especially for use in digital duplicators. Such designs offer many benefits in terms of ease of use and protection of the product during transit and storage. Also, it has been possible to achieve designs which enable virtually all the liquid to be depleted from the bag in order to maximize product availability to the user and to minimize issues relating to disposal of the used packaging. When the liquid contained within the bag is viscous, such performance is difficult to achieve. Typically during the process of depletion under suction the difficulty in moving liquid out of the extremities of the bag allows the opposing walls of the bag to close together until a point is reached where the bag orifice becomes blocked and no further liquid can be removed. To avoid this type of failure, which leads to excessive residues of unused liquids, it has been proposed to equip bags with flow directing devices. Typically these are plastic moldings, such as described in GB-A-2 331 065, which prevent opposing walls of the bag from sealing together during the depletion process and also provide channels for the liquid to flow to the bag orifice.

[0003] However a recently developed ink, which has a higher viscosity than those used to date in bag-in-box packaging, was found to have very high residues when used with known depletion devices.

[0004] Accordingly, it is an object of the invention to provide a depletion device that provides improved extraction of a viscous liquid from a bag.

SUMMARY OF THE INVENTION

[0005] The objective of the invention is accomplished by providing a depletion device that allows a viscous liquid to be extracted from a bag which comprises a port that protrudes through an aperture in the bag having a connection means for connection to an extractor and/or a cap, and a hollow, elongate tube extending into the interior of the bag. The interior of the tube in fluid communication with the port and the side wall of the tube has a plurality of through-holes. The total area of the through-holes is greater than 50% of the area of the side wall. Another aspect of the present invention includes a container comprising a bag into which is sealed a depletion device as described above. The bag may be contained in a box and may contain a viscous ink.

DESCRIPTION OF THE DRAWINGS

[0006] The construction designed to carry out the invention will hereinafter be described, together with other features thereof.

[0007] The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

[0008] FIG. 1 is a perspective view of a depletion device according to an embodiment of the invention; FIG. 2 is a first side view of the depletion device of FIG. 1; FIG. 3 is a second side view of the depletion device of FIG. 1; FIG. 4 is an end view of the depletion device of FIG. 1; and FIG. 5 is a cross-sectional view of a bag-in-box type container into which the depletion device of claim 1 has been fitted.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0013] Referring now in more detail to the drawings, the invention will now be described in more detail.

[0014] A depletion device 10, illustrated in FIGS. 1 to 4, is designed to provide improved depletion performance with high viscosity liquids, for example when used with a bag-in-box container such as shown in FIG. 5.

[0015] As illustrated, depletion device 10 is hollow throughout and basically comprises two parts: a connection part 10a and extraction tube 10b. The connection part 10a provides a port which enables connection to an extraction device, such as an ink supply pump in a digital printer, and can also be capped. A thread 18 may be provided to enable a secure connection to the extraction device or cap. A pair of flanges 17 may be provided to securely locate the extraction device in an aperture of a box, as described in co-pending application no GB 0322986.1, filed 1 Oct. 2003, incorporated herein by reference. To enable the depletion device to be sealed into the seam of a bag, a seal portion 16 having a parallelogram cross-section is provided.

[0016] Extraction tube 10b is hollow and elongate, so as to extend a substantial way into the container to be depleted. The tube is preferably cylindrical but oval or polygonal cross-sections may also be used. To maximize depletion, the side walls of the tube 10b are as open as possible; the end 15 may also be open. In the present embodiment, the open area is maximized by forming the tube as an open cage 11 of longitudinal and circumferential ribs 12, 13 so as to leave through-holes 14. The longitudinal ribs 11 can be seen as dividing the through-holes 14 into columns. The circumferential ribs 13 are positioned so that through-holes 14a in one column are offset from the through-holes 14b in the adjacent column. This means that there are no continuous ribs extending around the entire circumference of the tube 10a (except at the ends). Substantially the whole area through which ink will be depleted is therefore provided with through-holes into the interior of the tube 10a.

[0017] The dimensions of the depletion device will depend on the exact application to which it is to be put, but a device for a 1000 cc bag-in-box container may have an overall length of about 180 mm, whilst the tube 10a may have a diameter of about 13 mm, with longitudinal ribs 11 having a width of about 1.5 mm. The circumferential ribs 13 may have a width d1 of about 2 mm and the through-holes 14a a width d2 of about 6 mm. The total open area of the tube 13a is about 63% of the total surface area of the tube.

[0018] Experiments (see below) have shown that the depletion device described above has improved performance.
compared to a prior art design. The improved performance is believed to derive from the following features, acting alone or in combination:

1. The tubular form of the part extending into the container.

2. The provision of drainage holes covering the total surface area of the tube where liquid depletion is required to take place. Preferably more than 40 holes are provided and most preferably more than 70.

3. Maximization of the open area of the tube whilst retaining sufficient rigidity and strength of the tube. The open area is preferably more than 50 or 60% of the total area of the tube and in a preferred embodiment is between 60 and 65% of the total area.

4. The hole pattern being such that these occupy longitudinal sections of the drainage tube but where holes in neighboring longitudinal sections are offset so that there are no continuous ribs around the tube circumference.

5. Minimisation of the width of the longitudinal ribs, e.g. to less than 30% of the circumference of the tube, preferably to between 20 and 25%.

Experimental results demonstrate that depletion devices according to the invention enable greater depletion of viscous liquids from bag-in-box containers than known devices. It is believed that the improved performance of the present invention arises because the device counteracts the tendency of the bag film to collapse on the surface of the flow directing device and by maximizing the opportunities for residual ink to be depleted when this occurs. Important factors are seen to be:

1. Tube form maximizes surface area of flow directing device.
2. Large open area maximizes opportunities for ink to drain in areas where there is no film contact.
3. The stepped hole pattern creates an irregularity in available drainage channels which increases the chances of the depletion device not becoming blocked by bag film collapsing on to it during depletion.
4. In providing an optimum design for a given application, consideration must be given to the selection of hole size and tube diameter. Generally larger holes are favored but consideration must be given to the strength and rigidity of the fitment. Also excessively large holes may exacerbate depletion problems by bag film being sucked into the drainage tube during the depletion process. In selecting tube diameter there are two opposing requirements. Larger diameters equate to larger surface areas for the drainage tube and this is known to favor the depletion process. However the volume of liquid within the tube represents an inevitable residue within the pack. From this consideration smaller diameters are favored. It is therefore necessary to conduct experiments in order to achieve the optimum design for a particular application.

**EXAMPLES**

Ink samples of varying viscosity were filled into 1000 cc bag-in-box cartridges of identical design except that one group had a flow directing device according to the above described embodiment and a second group had a fitment according to GB-A-2 331 065. The cartridges were allowed to equilibrate overnight in a test environment with a temperature of 10°C. For each ink and fitment variation ink depletion performance was assessed by carrying out printing tests using a Pixport JP5500 digital duplicator (Ricoh Company of Japan). Printing was continued until an ‘out of ink’ signal was given by the printing machine. At this point the cartridge was weighed and the ink residue was calculated by subtracting the average weight for the cartridge packaging. A ‘Pass’ result was recorded when all 10 cartridges within a test group achieved a residue of 5% or less. Results are tabulated below to confirm the superior performance of the present invention.

<table>
<thead>
<tr>
<th>Depletion Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ink Viscosity*</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>11.80 Pa·s</td>
</tr>
<tr>
<td>14.40 Pa·s</td>
</tr>
<tr>
<td>19.30 Pa·s</td>
</tr>
</tbody>
</table>

*Viscosity measured at 23°C using a Bohlin CS10 rheometer (Bohlin Instruments Ltd, Gloucestershire, England) equipped with a 25 mm cone (2° angle) applying a Casson model.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

**What is claimed is:**

1. A depletion device to allow a viscous liquid to be extracted from a bag, the device comprising:

   a port for protruding through an aperture in the bag having connection means for connection to an extractor;

   a hollow elongated tube for extending into the interior of the bag, said tube having a hollow interior in fluid communication with said port defined by a tube side wall; and

   a plurality of through-holes formed in said side wall, the total area of the through-holes being greater than 50% of the area of the side wall.

2. A device according to claim 1 wherein the tube is cylindrical.

3. A device according to claim 1 wherein total area of the through-holes is greater than 60% of the area of the side wall.

4. A device according to claim 1 wherein total area of the through-holes is in the range of from 55 to 65% of the area of the side wall.

5. A device according to claim 1 wherein the through-holes are arranged in columns separated by a plurality of longitudinal ribs.

6. A device according to claim 5 wherein through-holes in one column are offset longitudinally relative to through-holes in an adjacent column.

7. A device according to claim 6 wherein there are no continuous ribs between through-holes that extend around the complete circumference of the tube.
8. A device according to claim 5 wherein the total width of said ribs is less than 30% of the circumference of said tube.

9. A device according to claim 5 wherein the total width of said ribs is in the range of 20 to 25% of the circumference of said tube.

10. A device according to claim 1 wherein the through-holes are disposed across substantially the whole area of the tube.

11. A device according to claim 1 wherein there are 40 or more through-holes.

12. A device according to claim 1 wherein there are 70 or more through-holes.

13. A device according to claim 1 wherein the end of the tube farthest from the port is open.

14. A device according to claim 1 further comprising a bag attachment portion between the port and the tube, said attachment portion including a sealing portion shaped so as to be sealable into the seam of a bag.

15. A device according to claim 14 wherein the sealing portion is substantially a parallelogram in cross-section.

16. A container comprising a bag into which is sealed a depletion device according to claim 1.

17. A container according to claim 16 further comprising a box surrounding the bag and wherein the port of the depletion device protrudes form an aperture in said box.

18. A container according to claim 16 wherein said bag contains a viscous liquid.

19. A container according to claim 18 wherein said viscous liquid has a viscosity of greater than 12 Pa-s measured at 23°C using a Bohlin CS10 rheometer equipped with a 25 mm cone (2° angle) applying a Casson model.

20. A container according to claim 18 wherein said viscous liquid is an ink.

21. A depletion device to allow a viscous liquid to be extracted from a bag, the device comprising:

a port for connection to a liquid extractor; and

a hollow elongated tube for extending into an interior of the bag having a side wall defining a hollow interior;

a plurality of through-holes formed in said side wall arranged in columns to define longitudinal ribs and circumferential ribs in said sidewall; and

holes in adjacent columns being offset relative to each other to prevent a collapsing bag from closing off the elongated tube as liquid is depleted from the bag.

22. A device according to claim 21 wherein total area of the through-holes is in the range of from 50 to 65% of the area of the side wall.

23. A device according to claim 21 wherein there are no continuous circumferential ribs between through-holes that extend around the complete circumference of the tube.

24. A device according to claim 23 wherein the total width of said circumferential ribs is in the range of 20 to 25% of the circumference of said tube.