

PE/5-19587/A/CGC 1708

WATER-SOLUBLE BAG ENCLOSING AGRICULTURAL CHEMICAL

The present invention relates to a containerization system and containers which are particularly suitable for storing, packaging and transporting toxic or hazardous products such as agricultural chemicals. In particular, the present invention relates to water-soluble bags enclosing the agricultural chemical in the form of a gel, solid or liquid which is contained within a water-soluble bag made of co-extruded film of at least two separate polyvinyl alcohol layers combined directly after extrusion in the fluid melt state. The film is characterized in that it shows no interface boundaries.

Water-soluble bags containing agricultural chemicals in gel or liquid form have just recently been developed and put into practical use. These water-soluble bags may be thrown into a water tank of a spray system whereupon the bags dissolve and the chemicals contained therein are dispersed into the water supply. Thus, there is no need to dispose of the packaging of the chemicals. U.S. Patent No. 5,080,226 to Hodakowski et al. discloses a water-soluble bag, preferably made of polyvinylalcohol (PVA) film, containing agricultural chemicals in gel form.

Until recently, polyvinylalcohol film was made by a casting process, and then several layers were laminated together to increase strength and reduce pinholes. However, these bags are less than completely satisfactory because the dissolution time of the laminated polyvinylalcohol film is very high. Since the bag does not rapidly dissolve in the water tank, the farmer user must either subject the tank water to vigorous stirring over an extended period of time, or risk tank apparatus clogging by premature application before the bag is thoroughly dissolved.

Additionally, the laminated bags are less than completely satisfactory in that they are susceptible to breakage upon application of pressure.

Recently, however, polyvinylalcohol films have been made by an extrusion process. For example, EP-A-0 347 222 discloses a container system comprising a semi-rigid outer container accommodating a water-soluble bag. The water-soluble bag is disclosed as comprising PVA, polyethylene oxide or methylcellulose. This publication stated that the PVA may be extruded.

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Although single extruded PVA film dissolves quickly, it is also less than completely satisfactory, because the film lacks strength.

Accordingly, an object of the present invention is to provide a water-soluble bag containing agricultural gel, solid or liquid which dissolves rapidly.

Yet another object of the present invention is to provide a water-soluble bag which has sufficient strength to resist breakage and pinhole leaks.

To achieve this object, the water-soluble bag is made of a co-extruded film of at least two separate polyvinyl alcohol layers combined directly after extrusion in the fluid melt state. The film is characterized in that it shows no interface boundaries.

The invention relates to a containerization system for holding and securing agricultural chemical compounds which comprises a water soluble bag made of co-extruded film which completely encloses an agricultural chemical compound, said co-extruded film containing at least two separate polyvinyl alcohol layers combined directly after extrusion in the fluid melt state, and said film also characterized in exhibiting no interface boundaries.

Until recently, all polyvinylalcohol (PVA) films are made by a casting process where the dissolved PVA is poured onto a conveyor-type belt or sheet and then the film is removed or rolled after drying. To add strength and reduce pinholes, several layers of these films are then laminated together with an adhesive applied by spraying or other techniques.

Recently there is developed an extrudible resin process for making PVA film. Contrary to the casting process, the extrudible resin process is an extrusion blown process. This process has several advantages, one of which is that several layers may be simultaneously formed and bonded together without the use of an adhesive.

Applicants have ascertained that, for use in water-soluble bags containing agricultural gels, solids or liquids, these multiple-layer extruded films are advantageous over either laminated cast films which dissolve slowly or single layer extruded films which are susceptible to breakage and pinhole leaks. In particular, applicants have ascertained that the tri-extruded film (three-layered film) is particularly advantageous for use in water-soluble bags containing agricultural gel or liquid.

The co-extruded film has preferably a thickness between 20 and 240 microns, particularly preferably between about 40 and 160 microns and most preferably about 120 microns. The thickness is important for balancing bag stability with rapid dissolution.

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Whereas the layers of laminated film are clearly discernible under a microscope at a magnification factor of 200-fold, the co-extruded film appears as one layer. Nevertheless, the co-extruded film when used in a water soluble bag is stronger than a single-layer extruded film of the same thickness.

The bag should have a capacity from about 0.1 to 4.0 liters of gel, solid or liquid.

The agricultural chemical compound is preferably a pesticide or a plant protection agent. The compounds may be formulated as for example water-dispersable powders or granules, as emulsifiable liquids or preferably as gels.

The bag may be formed as a twin-bag connecting two bags with a heat sealing boundary, or as a two-chambre bag (bag-on-bag) constructed with PVA film placed between two other films and bound together by heat-sealing, or as a bag in bag system where a little chemical filled PVA bag is placed in a chemical filled greater outer bag.

The following examples are presented for illustrative purposes only, and are not intended in any way to limit the scope of the invention.

Example 1:

Two water soluble bags, each containing 610 grams of gel product, are shock tested in a Lansmont® vertical free fall shock machine. The first bag is made of a 3.0 ml mono-extruded PVA film, whereas the second bag is made of a 3.0 ml tri-extruded PVA film. The first mono-extruded bag exhibits a velocity change of 125 inches per second, whereas the second tri-extruded bag exhibits a velocity change of 210 inches per second.

Example 2:

Two water soluble bags, each containing 610 grams of gel product, are drop tested in a Lansmont® vertical free fall shock machine. The first bag is made of a 3.0 ml mono-extruded PVA film, whereas the second bag is made of a 3.0 ml tri-extruded PVA film. The first mono-extruded bag exhibits a critical drop height of 48 inches, whereas the second tri-extruded bag exhibits a critical drop height of over 48 inches (beyond the measuring capacity of the machine).

Example 3:

In multiple trials, three water soluble bags, each containing 204 grams of gel product, are compressed in an Instron® Test System Model 4200 machine. The first bag is made of 3.0 ml laminated PVA film, the second bag is made of a 3.0 ml mono-extruded PVA film, and

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the third bag is made of a 3.0 ml tri-extruded PVA film. After averaging the trials, the first laminated film bags exhibit breakage at an average of 300 lbs, the mono-extruded bags exhibit breakage at an average of 325 lbs, and the tri-extruded bags exhibit breakage at an average of 528 lbs.

Although the present invention has been described above in connection with a preferred embodiment thereof, various changes and modifications will become apparent to those of ordinary skill in the art. Therefore, such changes and modifications are intended to be within the true spirit and scope of the present invention as defined by the appended claims.

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Example 3:

In multiple trials, three water soluble bags, each containing 204 grams of gel product, are compressed in an Instron® Test System Model 4200 machine. The first bag is made of 3.0 ml laminated PVA film, the second bag is made of a 3.0 ml mono-extruded PVA film, and the third bag is made of a 3.0 ml tri-extruded PVA film. After averaging the trials, the first laminated film bags exhibit breakage at an average of 300 lbs, the mono-extruded bags exhibit breakage at an average of 325 lbs, and the tri-extruded bags exhibit breakage at an average of 528 lbs.

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WHAT IS CLAIMED IS:

1. A containerization system for holding and securing agricultural chemical compounds which comprises a water soluble bag made of co-extruded film which completely encloses an agricultural chemical compound, said co-extruded film containing at least two separate polyvinyl alcohol layers combined directly after extrusion in the fluid melt state, and said film also characterized in exhibiting no interface boundaries.
2. The containerization system of claim 1, wherein the agricultural chemical compound is a pesticide or a plant protection agent.
3. The containerization system of claim 1, wherein the co-extruded polyvinylalcohol film has a thickness between about 20 and 240-microns.
4. The containerization system of claim 3, wherein the film has a thickness between about 40 and 160 microns.
5. The containerization system of claim 4, wherein the film has a thickness of about 120 microns.
6. The containerization system of claim 1, wherein the bag has a capacity of between about 0.1 and 4.0 liters.
7. The containerization system of claim 1, wherein the co-extruded film is a tri-extruded film.
8. The containerization system of claim 1, wherein the agricultural chemical compound is in the form of a gel.

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