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Description

"Multilayer film with 3-fold coextrusion film".

The invention relates to a multilayer film according to the preamble of claim 1.

From US-A-5,023,120 such a film is known as a packaging material. An aluminium layer is provided for protecting light-sensitive products such as photographic materials from incident light. The packaging produced in this way can be easily torn open by hand and thus enables a safe and quick removal of a product packaged in the film, even in the dark.

Such films are known from practice and are used, for example, to line so-called "big bags".

The dissipative barrier layer is intended firstly to provide reliable product protection, e.g. against odours, air and/or moisture, and secondly to enable the earthing of a packaging material made from the multilayer film. The packaging material can be designed as a flexible container, which can serve as its own container or as an inliner of a "big bag". The dissipative barrier layer is manufactured as an aluminium layer, as aluminium ensures the desired barrier properties and is economical to process.

The plastic layer of reduced electrical resistance on the one hand serves to avoid a contact between the product in the container and the aluminium, and on the other hand to avoid electrostatic charges and associated hazards, for example explosion hazards. As "reduced electrical resistance" it is denoted that the plastic layer has a lower electrical resistance compared to the pure plastic, i.e. it does not have insulating but antistatic or dissipative electrical properties. Accordingly, the reduced electrical resistance of this plastic layer is usually not achieved by a specially selected pure plastic, but by certain admixtures to a plastic material, whereby such admixtures are commercially available.

In the case of plastic layers with reduced electrical resistance, a distinction is made between

- dissipative plastic layers, which have an electrical resistance of at most $10^8\Omega$ over their layer thickness,
- antistatic plastic layers, which have an electrical resistance of between $10^8\Omega$ and $10^{11}\Omega$ over their layer thickness, whereby both of the aforementioned plastic layers are in contrast to

- insulating plastic layers which have an electrical resistance of more than $10^{11}\Omega$ over their layer thickness and accordingly an electrical resistance which is typical for the plastic used or even deliberately increased by admixtures, but in any case not a reduced electrical resistance.

In the following, the plastic layer with reduced electrical resistance is often abbreviated to "dissipative plastic layer" for the sake of linguistic simplification, even if, for example, it is only an "antistatic" but not a " dissipative " plastic layer according to the above definition.

The bonding between the plastic layer of reduced electrical resistance and the aluminium layer is problematic if, as is known and customary in practice, the dissipative plastic layer is made dissipative - or antistatic - by incorporating carbon components. The carbon additives harbour the risk of a poor bonding to the neighbouring layer, so that possibly the aluminium layer can be detached from the dissipative plastic layer under the loads occurring during operation, so that the bond of the overall multilayer film can be interrupted or destroyed in this way, especially in the weld seam area.

From DE 44 31 046 A1 a plastic packaging container with improved electrostatic dissipative property is known, in which the side of the composite film forming the container wall facing the product has a perforation to enable a charge transport of electrical charge to an electrically conductive intermediate layer in the composite film. Such a container is not approved for contact with foodstuffs or pharmaceuticals, as their contact with the electrically conductive, metallic intermediate layer is not permitted.

From DE 92 07 044 U1 a transparent antistatic composite film is known, which is intended, for example, as a solid and hermetically sealed enclosure for electronic components. This packaging material is not intended to be suitable for use with foodstuffs. Antistatic composite films are also known from EP 0 219 315 A2, DE 88 14 712 U1 and EP 0 003 402 A1.

From EP 0 512 364 A1 a three-layer composite film is known, in which the three layers are coextruded. A first outer layer is mechanically loadable. A middle layer is provided as a barrier layer which is oxygen-tight and light-tight. A second outer layer is provided to protect the barrier layer by avoiding contact with the packaged product and also to allow sealing to itself when the package is sealed. Bonding with other layers is not intended in this composite film.

The invention is based on the object of improving a film of this type such that, on the one hand, a reliable bond of all layers is ensured under the loads occurring in operation and, on the other hand, the all-in-all multilayered film can be designed to be harmless in terms of food law and electrostatically, i.e. has a breakdown voltage up to the aluminium layer of no more than 4 kV. Furthermore, the invention is based on the task of specifying a method for producing such a film. Finally, the invention is based on the object of creating a container designated as big bag or FIBC, which is designed to be electrostatic and harmless under food law.

This object is solved by a film having the features of claim 1, as well as by a method according to claim 19 and a container according to claim 20.

In other words, the invention proposes not to bond the antistatic or dissipative plastic layer directly to the barrier or aluminium layer, for example using a coupling agent, but to provide an additional layer in between. This additional layer can be bonded to the aluminium layer in a manner known per se, for example using a coupling agent or in an extrusion process. In the extrusion process, shortly before the aluminium layer, which is produced as a flat film, comes into contact with the film, which is first produced as a tube and then cut open and spread out flat, and which has the additional layer, a liquid polymer such as PE is sprayed on, which enables – as in the case of coupling agents – a good bonding of the aluminium layer with the additional layer.

The additional layer is, according to the proposal, in turn reliably bonded to the dissipative plastic layer in that both said additional layer and a layer provided on the other side of the dissipative plastic layer are produced together with the dissipative plastic layer itself as a three-layer coextruded film. The coextrusion of these three layers results in a welding or fusion of the individual layers while still in a liquid state, so that this enables reliable anchoring of the first-mentioned additional layer, which is oriented towards the aluminium layer, to the conductive plastic layer, which is otherwise difficult to laminate or bond.

In other words:

- Due to the fact that the dissipative plastic layer has a high proportion of additives that improve the dissipative property, such as carbon, it is normally difficult to bond it to other layers of a multilayer film, e.g. to the dissipative barrier layer, which consists of aluminium.

- Although the proportion of these additives can be reduced in order to better bond the dissipative plastic layer with the dissipative barrier layer, this results detrimentally in a higher breakdown voltage of the film.
- Although - as a first alternative - the layer thickness of the entire film can be reduced in order to reduce the breakdown voltage, in that the dissipative plastic layer forms an outer layer of the film and is not separated from a product to be packaged by an additional separating layer, this film is then not approved for contact with foodstuffs or pharmaceuticals, as their contact with the additives that improve the dissipative property must be avoided.
- Although – as a second alternative - for reducing the breakdown voltage, it can be provided to perforate the dissipative plastic layer such that a transport of electrical charges to the dissipative barrier layer is facilitated, also in this case, too, such a film is not approved for contact with foodstuffs or pharmaceuticals, as their contact with the dissipative barrier layer, which is made of aluminium, is to be avoided.

According to the proposal, this problem of conflicting objectives in the development of a packaging film is solved by providing the dissipative plastic layer, which is poorly bondable in itself, with two outer layers by means of a coextrusion process, one of which enables good bonding with other layers and the other of which forms a separating layer towards the product that is harmless under food law. Surprisingly, during coextrusion, even dissipative plastic layers having a high proportion of additives that improve the dissipative property can be reliably bonded to other layers.

In that the bonding of the three layers to form an overall film is done by coextrusion and that coupling agents between the three layers can be waived, the breakdown voltage of this three-layer coextruded film is kept particularly low, so that despite the use of a comparatively large number of layers, a multilayer film can be created which easily meets the requirements placed on an electrostatically dissipative multilayer film.

If it is mentioned in the aforementioned DE 44 31 046 A1 that a coextruded film can also be used for the inner layer provided there, this merely reflects a common practice in practice of using existing equipment as economically as possible in terms of production technology: namely, if an existing production plant has a coextruder, films are also produced as coextruded films whose several layers consist of identical material. This type of film production is more economical than providing an additional mono-extruder for such cases. In any case, DE 44 31 046 A1 does not give any hint towards producing the coextruded film from several layers of different materials, and in particular not of designing the coextruded film by selecting the materials of the individual layers within the coextruded film in favour of a reduced electrical resistance. Rather, the perforations in the inner layer, i.e. in the entire coextruded film, are proposed for this purpose, which are intended to enable a charge transport of electrical charge to the electrically conductive intermediate layer in the composite film. Due to these perforations, the inner layer according to DE 44 31 046 A1 does not have to contain any material which has a reduced electrical resistance and which may be poorly bondable to adjacent layers, so that no problem arises as to how the inner layer can be bonded to other layers of the composite film.

Furthermore, according to the invention, it is envisaged to ensure the integrity of the comparatively thin aluminium layer by providing it, on the side facing away from the coextruded film, with a low-stretch plastic layer which allows tensile forces to be absorbed without cracks appearing in the aluminium layer.

Advantageously, a PET film can form the low-stretch plastic layer, since PET, on the one hand, can be bonded to the aluminium layer without any problems in a manner known per se and, and on the other hand, enables the absorption of high tensile forces with only low elongation.

Alternatively, the low-stretch plastic layer can be made of oriented polypropylene (OPP), although both PET and OPP are only exemplary materials that have proven themselves in practical tests.

Advantageously, the aluminium layer can be bonded to the coextruded film by means of a coupling agent. This bonding technique known per se represents an operationally reliable bonding of the aluminium layer to the coextrusion film and is made possible in that the additional layer mentioned at the beginning is provided in the coextrusion film between the dissipative plastic layer and the aluminium layer, so that a reliable bonding to the aluminium layer is made possible, which would not lead to sufficient mechanical stability of the composite film if a coupling agent were used between the aluminium layer and directly the dissipative plastic layer.

Advantageously, the additional layer mentioned at the beginning can be made antistatically. In this way, an unacceptably high breakdown voltage of the multilayer film is avoided, even if the coupling agent of the aluminium layer and the aforementioned additional layer is provided, does not have good dissipative values. In addition, the aforementioned additional layer can be designed as thin as possible, for example not exceeding a layer thickness of 10 µm, so that also in this way a breakdown voltage as low as possible up to the aluminium foil is made possible.

The antistatic design of the aforementioned additional layer can be achieved in particular in that a permanent antistatic additive is added to the plastic forming this layer, whereby this layer is advantageously formed from polyethylene, which enables problem-free bonding to the aluminium layer by means of coupling agent.

The layer of the three-layer coextruded film provided on the opposite side of the dissipative plastic layer, i.e. on the side facing away from the aluminium layer, can advantageously be made of polyethylene. Here, the use of the purest possible polyethylene is particularly advantageous, which, firstly, is harmless under food law and so that, secondly, costly additives can be dispensed with and, furthermore, due to the material properties of the pure polyethylene, excellent weldability of the film is given when, for example, two sections of the same film or two films of the same type with their respective PE surface are directed towards each other and welded, resulting in excellent weld seam strength.

The aforementioned multilayer film can in particular serve to build up the wall of a packaging container, for example the big bags mentioned at the beginning, whereby advantageously the multilayer film can serve to produce an inliner of such a packaging container. The outer cover of such packaging containers can consist of a tear-resistant fabric in a manner known per se.

Using the example of a flexible packaging container, the proposed film structure is explained in more detail below, with terms such as "inner" and "outer" being used on the basis that they refer to layers or plies of the composite film directed towards the interior of the container and towards the exterior of the container, respectively.

For example, an outwardly directed low-stretch layer of the composite film may have a layer thickness of about 12 µm and be made of polyester (PET) or of oriented polypropylene (OPP).

As the next inward-facing layer of the multilayer film, the already mentioned aluminium is provided.

The thickness of the barrier layer, when using an aluminium layer, can be for example about 9 – 12 µm.

As next component the multilayer film has a coextruded film, which is bonded to the aluminium layer by means of a coupling agent. Next to the aluminium layer, within the three-layer coextruded film, a very thin plastic layer is provided, which has a layer thickness of, for example, about 8 µm and which consists of a plastic, for example a polyethylene, in particular, for example, an LDPE, which can be easily bonded to the aluminium layer, wherein a permanently antistatic additive, which is commercially available in practice, is mixed with this layer.

The middle layer of the coextruded film consists of a, for example, about 60 µm thick polyethylene film, for example an LDPE, whereby this is made antistatic or dissipative by a high carbon content of, for example, 60% or 65% carbon.

The last, and located furthest inwards in the container, layer of the three-layer coextruded film and thus of the entire five-layer composite film consists of a polyethylene that is harmless under food law, for example in particular an LDPE, and has a layer thickness of about 13 µm. This layer thickness enables reliable welding of the multilayer film and a breakdown voltage that is below 4 kV. This innermost layer is preferably free of perforations, depressions or the like on its inner side facing the product, so that it is excluded in a hygienically advantageous manner that either a very fine, e.g. dust-like product can come into contact with container material from which it should actually be separated by the innermost layer, or that residues of this product can become stuck in the perforations or depressions.

The two outer layers of the overall three-layer coextrusion film can also be interchanged, in which case, however, the layer facing furthest inwards, i.e. towards the product, contains the antistatic additive and must be provided in a comparatively greater layer thickness in order to ensure sufficient weld seam strength. In contrast, the proposed layer structure or the proposed layer arrangement of the three-layer coextrusion film is economically more advantageous.

The outermost low-stretch layer, for example the aforementioned PET layer, is advantageously dimensioned smaller at two opposite edges of the film than the overall dimension of the film in that the aluminium layer and the other layers of the composite film project beyond the width of the low-stretch plastic layer there. In this way, the aluminium layer is exposed in the area of the outer edges of the composite film, for example in a width of about 10 mm, so that it can be easily earthed or electrically conductively connected to an outer fabric of a big bag, so that the packaging container as a whole can be easily earthed.

An embodiment example of the invention is explained in more detail below with reference to the purely schematic representation:

Fig. 1 shows altogether a schematic cross-section through the individual layers of a in total five-layer film, whereby for the sake of clarity the individual layers are shown separately from one another and additional materials such as coupling agents are not shown.

The entire multilayer film is marked 1. It has a low-stretch plastic layer 2 made of PET with a layer thickness of 12 µm, which is dimensioned smaller than all the layers of film 1 illustrated below.

The low-stretch plastic layer 2 is bonded to an aluminium layer 3 of 9 µm thickness illustrated below it, for example by means of a coupling agent or during extrusion process, and this aluminium layer 3 is bonded to a three-layer coextrusion film 4, for example also by means of a coupling agent or during extrusion process.

The coextrusion film 4 consists of a central antistatic or dissipative polyethylene film 5 with a layer thickness of 59 µm and a layer 6 of LDPE, which is enriched with a permanent antistatic additive, facing the aluminium layer 3.

The innermost layer 7 facing the product has a layer thickness of 13 µm and is made of a polyethylene that is harmless to foodstuffs, namely LDPE. This layer is in contact with the contents of the packaging material which is later made from the multilayer film 1.

Patentkrav

1. Beholder, betegnet som bigbag eller FIBC, med antistatiske egenskaber, hvorved beholderens væg omfatter en flerlagsfolie (1) med et dissipativt barrierelag, som er dannet af en metalfolie, navnlig et aluminiumslag (3),
og med et kunststoflag (5) med reduceret elektrisk resistans, og som danner det midterste lag i en koekstruderet folie (4), som består af tre koekstruderede lag, og
med et lav-strækbart kunststoflag (2), der er tilvejebragt på den side af barrierelaget, som vender bort fra koekstruderingsfolien (4),
kendetegnet ved, at
barrierelaget er forbundet med koekstruderingsfolien (4), kunststoflaget (5) med reduceret elektrisk resistans indeholder indlejrede kulstof-bestanddele med et kulstofindhold på 30 % til 80 %,

- at det er konfigureret til at være dissipativt **ved, at** det har en elektrisk resistans på højst 10^8 Ω over dets lagtykkelse,
- eller at det er konfigureret til at være antistatisk **ved, at** det har en elektrisk resistans, som er mellem 10^8 Ω og 10^{11} Ω over dets lagtykkelse.

2. Beholder ifølge krav 1,
kendetegnet ved, at
et lag af polyester (PET) danner det lav-strækbare kunststoflag (2).

3. Beholder ifølge krav 1 eller 2,
kendetegnet ved, at
barrierelaget er forbundet til koekstruderingsfolien (4) ved hjælp af et hæftemiddel.

4. Beholder ifølge krav 1 eller 2,
kendetegnet ved, at
barrierelaget ved ekstruderingsprocessen er forbundet med koekstruderingsfolien (4).

5. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
laget (6) af koekstruderingsfolie (4), der grænser op til barrierelaget, er dannet som antistatisk.

6. Beholder ifølge krav 5,
kendetegnet ved, at
laget (6), som grænser op til barrierelaget, er dannet af et kunststof, hvortil der er tilsat et permanent antistatisk additiv.

7. Beholder ifølge krav 6,
kendetegnet ved, at
laget (6), som grænser op til barrierelaget, er dannet af polyethylen (PE).

8. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
laget (6), der grænser op til barrierelaget, har en lagtykkelse, som højst er 10 µm.

9. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
det bort fra barrierelaget vendende, ydre lag af koekstruderingsfolien (4) er dannet af polyethylen.

10. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
flerlagsfolien (1) danner en inliner i beholderen.

11. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
kunststoflaget (5), som har reduceret elektrisk resistans, indeholder polyethylen som kunststof.

12. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
det lav-strækbare kunststoflag på to modsat liggende kanter af folien (1) er dimensioneret som smallere end totalbredden af folien (1), således at det dissipative barrierelag på disse kanter rager ud over bredden af det lav-strækbare kunststoflag (2).

13. Beholder ifølge krav 12,
kendetegnet ved, at
det lav-strækbare kunststoflag på folien (1) på hver kant er dimensioneret som cirka 10 mm smallere end folien (1).

14. Beholder ifølge et af de foregående krav,
kendetegnet ved, at
folien (1) danner beholderens væg.

FIG.1