

A PACKING LAMINATE

The present invention relates to a packing laminate comprising a carrier layer of a material imparting stiffness and at least one layer of liquid-tight material.

Edible oil or food products which contain edible oil are usually packed in lacquered sheet metal cans, glass bottles or blow moulded plastic bottles. These types of packages are comparatively expensive to manufacture and to handle, and it is a desirable end to provide a more rational and less cost-demanding packing container for edible oil products. A suitable type of package could be e.g. the parallelepipedic packing container of laminated material which at present is generally used for the packing of other liquid foodstuffs, e.g. milk and fruit juices. These packing containers are manufactured from a packing laminate, comprising layers of paper, plastics and aluminium foil which by means of folding and sealing is converted to a substantially parallelepipedic container body with corner lugs flattened, folded in and sealed to the container body. Attempts to utilize a packing container of this type for the packaging of edible oil were found to give unsatisfactory results, since the plastic layer of polyethylene which covers the inside of the packing laminate, that is to say the side facing the contents, is not suitable for prolonged contact with edible oil or products containing edible oil. As the type of package as such, however, has a number of advantages from the point of view of filling as well as handling and cost, it has been tried to overcome these disadvantages by applying a layer of oil-resistant plastic material to the inside of the laminate. Experiments were carried out with various different types of plastics and in particular the types were tried which are used for the manufacture of the blow moulded plastic bottles mentioned earlier. The type of plastics generally employed for this purpose is a copolymer of ethylene and partially neutralized acrylic acid (EAA) which in the manufacture of blow moulded plastic bottles has proved to be oil-resistant. However, when this type of plastics is applied by extrusion to the inside of a packing laminate,

its properties deteriorate so that the material when it has been in contact with oil for a prolonged period obtains inferior elongation, and cracks appear when the material is stressed, e.g. by folding. This
05 phenomenon is known as stress-cracking and practical experiments have shown that the coefficient of elongation is reduced to below 10% of the normal coefficient of elongation. The difference between EAA in blown and extruded form is due apparently to the
10 processing temperature which is substantially higher (100-150°C higher) on extrusion. A thermal degradation of the plastics material takes place which contributes to increased brittleness. A further cause is to be found in the different degrees of orientation
15 existing in the blown or extruded film respectively. Blown film is oriented during manufacture in longitudinal as well as in transverse direction which results in manifestly better elongation properties than is the case in an extruded film which is only
20 oriented in its longitudinal direction. Consequently, especially folds in the packing container running transversely in relation to the direction of orientation, will invariably cause crack formation with accompanying leakage and absorption of edible oil
25 in the paper layer of the packing laminate, which impair the stiffness of the laminate and give the

packing container a less attractive appearance.

The present invention provides a packing laminate comprising a carrier layer of a material imparting stiffness bearing at least one layer of liquid-tight material which is a plastics layer applied by
05 extrusion comprising a mixture of LLDPE and LDPE.

By mixing LLDPE and LDPE an internal layer may be obtained, the coefficient of elongation of which is not appreciably affected during extrusion of the
10 layer, which means that stress-cracking does not occur even on prolonged contact with edible oil. To assure a good adhesion between the inner layer consisting of LLDPE and LDPE and adjacent layers of usually aluminium foil, use is preferably made of an
15 intermediate adhesion layer which preferably consists of a partially neutralised EAA (ethylene acrylic acid), that is to say a copolymer of ethylene and acrylic acid.

The present invention will now be described in
20 more detail with special reference to the attached schematic drawing which in strong enlargement shows a cross-section through a part of a preferred embodiment of the packing laminate in accordance with the invention.

25 The packing laminate 1 comprises a number of material layers laminated to each other which together

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form a packing laminate of the desired strength and impermeability characteristics. The packing laminate 1 has an external surface 2 and an internal surface 3 which after the packing laminate has been converted to packing containers from the outside and inside respectively of the packing container. It is evident from the figure that the greater part of the thickness of the laminate is taken up by a carrier layer 4 which consists of a material imparting stiffness, e.g. paper or foamed plastics. The carrier layer 4 has an appreciably greater thickness than the remaining layers of the laminate, but the exact thickness may vary depending upon the type and size of the packing container into which the packing laminate is to be converted. In the case of the packing container sizes generally used of 0.2 - 2.0 litres, the paper material chosen for the carrier layer may have a weight per unit area of 120 - 440 g/m². A typical

value in the manufacture of packing laminate for 1 litre containers is 255 g/m^2 . The carrier layer may be impregnated wholly or partly with an oil-repelling agent which, however, belongs to prior art and is not, therefore, described in detail in this patent application.

On both sides of the carrier layer 4 comparatively thin layers 5,6 of a liquid-tight, thermoplastics material, e.g. polyethylene, are present. The polyethylene layer 5 on the outside 2 of the packing laminate imparts a smooth and liquid-tight exterior to the packing laminate which, moreover, makes possible a sealing of the laminate with the help of heat and pressure, a so-called thermo-sealing. This external layer of thermoplastics consists of LDPE (Low Density Polyethylene) which has a weight of coating of $12 - 30 \text{ g/m}^2$. When the packing laminate is to be converted to packing containers with a volume of 1 litre, generally a weight of coating of 20 g/m^2 is used.

The thermoplastic layer 6 applied to the opposite side of the carrier layer 4 also consists of LDPE with a similar weight of coating. Like the layer 5, the layer 6 is applied to the carrier layer 4 by means of extrusion which means that the layers 5,6 are applied to the carrier layer 4 in liquid state and penetrate into the surface layer of the latter so that the seal between the layers 5 and 6 respectively and the carrier layer 4 is very good. The main task of the layer 6 is to make possible the application of a metal foil layer 7 which in most cases consists of aluminium foil of a thickness of $5 - 18 \mu$, preferably 7μ (corresponding to a weight of coating of 19 g/m^2). The layer 7 serves as a barrier layer which prevents light as well as oxygen from reaching the contents, which is advantageous since the contents are thus given better keeping quality. It is not desirable, however, for the contents to come into direct contact with the metal foil layer and this is coated, therefore, in general with a further layer which in the packaging of milk, fruit juice and other beverages usually consists of polyethylene. However, polyethylene is not oil-resistant and the packing laminate in accordance with the invention, therefore, comprises an inner layer of two types of

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plastics mixed with one other, namely LLDPE (linear low density polyethylene) and LDPE (low density polyethylene). An inner layer of this type, however, has comparatively poor adhesive properties and so as to improve these, an intermediate adhesion layer 9 is made use of which joins the inner layer 8 to the metal foil and preferably consists of partially neutralized EAA (ethylene acrylic acid), that is to say a copolymer of ethylene and acrylic acid. The inner layer 8 of mixed LLDPE and LDPE has a weight of coating of preferably 30 g/m^2 . In the manufacture of packing containers of smaller volume (0.2 litres) the weight of coating may be reduced a little further, but approx. 20 g/m^2 has proved to be a lower limit so as to avoid crack formation or other types of leaks. The intermediate adhesion layer 9 has a coating weight of preferably 15 g/m^2 , but very low coating weights may be used and even a weight as low as 1 g/m^2 has proved to give satisfactory results. It is important, though, that the combined thickness of the inner layer and the adhesion layer amounts to at least 30 g/m^2 , since otherwise, in unfavourable circumstances (mechanical damages etc.) the edible oil may come into contact with the metal foil layer 7.

The manufacture of the packing laminate in accordance with the invention takes place substantially in a conventional manner, in that the carrier layer by means of extrusion is coated successively with the different surface layers. The aluminium foil is applied from a roll, the polyethylene layer 6 serving as a binder. The adhesion layer 9 and the inner layer 8 can be applied each separately directly after one another or through coextrusion.

The conversion of the laminate to individual packing containers may also be done in a conventional manner, e.g. by supplying the packing laminate in form of a roll to a packaging machine, wherein it is converted to a tube which is filled with contents and sealed off by means of repeated transverse seals so that cushion-shaped, filled packing containers are produced. The cushion-shaped packing containers are then form-processed to parallelepipedic shape in that their corner lugs are flattened, folded down and sealed to the outside of the packing container.

By making use of a combination of LLDPE and LDPE for the inner layer 8 an inner layer is obtained which resists the effect of the oil even during prolonged contact, and any appreciable reduction in the stretching ability of the inner layer could not 5 be observed in practical experiments. The mixing ratio between LLDPE and LDPE can be varied, but experiments and tests have shown that an admixture of LLDPE of approx. 85% by weight of the total weight (LLDPE+LDPE) of the layer provides a material layer of substantially the same elongation properties in transverse as well as 10 in longitudinal direction which is of decisive importance in order to prevent crack formation when the finished laminate is folded during its conversion to packing containers.

If the admixture of LLDPE is reduced to between 50 and 85% by weight improved extrusion properties are obtained, that is to say 15 the extrusion can be carried out at a faster rate without the thickness of layer or the uniformity being negatively affected. This has to be paid for though in part by poorer elongation properties of the finished layer, and if the admixture is reduced to below approx. 50% the transverse elongation properties of the layer 20 are worsened to such an extent that it becomes unsuitable for use in the packaging of oil or oil-containing products.

In corresponding manner there is an upper limit to the admixture of LLDPE at approx. 90% by weight. Above this limit on contact with oil the longitudinal properties are impaired and the material 25 no longer can be used with such contents.

An important factor regarding the possibilities of extruding the material is also the so-called melt-index of the material which can be varied to a certain extent depending upon the mixing ratio between LLDPE and LDPE together with the melt index of these two 30 types of material making up the mixture. Thus preferably an LDPE of a melt index in the range of 5.5 - 8 g/10 min (dg/min) is chosen which together with an LLDPE of a melt index of approx. 3.7g/10 min gives the mixture a melt index of at least 3.5 g/10 min. The melt index of the mixture ought to be between 3.5 and 7.0 g/10 min, 35 which represents an easy-flowing mixture of good extrudability.

A typical laminate in accordance with the invention which

is used for the manufacture of packing containers of a volume of 1 litre (TETRA BRIK[®]) comprises the following layers (starting from the outside of the laminate):

	LDPE	12 g/m ²
5	Paper	225 g/m ²
	LDPE	25 g/m ²
	Al foil	7 μ
	EAA	8 g/m ²
	LLDPE+LDPE	27 g/m ²

- 10 This material in practice proved to have excellent properties for the packaging of oil, and the oil-resistance of the inner layer permits storage over a long period without any stress-cracking or other defects arising.



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CLAIMS

1. A packing laminate comprising a carrier layer of a material imparting stiffness bearing at least one layer of liquid-tight material which is a plastics layer applied by extrusion comprising a mixture of LLDPE and LDPE.
2. A packing laminate in accordance with Claim 1, wherein the said plastics layer is joined to an adjacent layer in the laminate by means of an adhesion layer.
3. A packing laminate in accordance with Claim 2 wherein the adhesion layer joins the said plastics layer to a layer of aluminium foil.
4. A packing laminate in accordance with Claim 2 or Claim 3 wherein the adhesion layer consists of partially neutralised EAA.
5. A packing laminate in accordance with any one of Claims 1 to 4, wherein the LLDPE content of the said plastics layer is between 50 and 90% of the total weight of the mixture.
6. A packing laminate in accordance with Claim 5, wherein the said LLDPE content is 85% by weight.
7. A packing laminate in accordance with any one of Claims 1 to 6, wherein the said plastics layer has a coating weight at least 20g/m².
8. A packing laminate as claimed in Claim 7,



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wherein the coating weight of the said plastics layer is about 30g/m².

9. A packing laminate in accordance with Claim 2 or any one of Claims 3 to 8 when dependent on Claim 2,
05 wherein the adhesion layer has a coating weight of 1 to 15g/m²

10. A packing laminate in accordance with Claim 2 or any one of Claims 3 to 9 when dependent on Claim 2, wherein the adhesion layer and the said plastics layer
10 have a combined coating weight of at least 30g/m².

11. A packing laminate in accordance with any one of Claims 1 to 10, comprising the following material layers from the inside outwards: LLDPE+LDPE, EAA, Al-foil, LDPE, paper and LDPE.

15 12. A packing laminate substantially as described herein with reference to the accompanying drawing.

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