(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 June 2018 (28.06.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/116117 A1

(51) International Patent Classification:
B65D 65/46 (2006.01) *B65D 77/04* (2006.01)

(21) International Application Number:
PCT/IB2017/058044

(22) International Filing Date:
18 December 2017 (18.12.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201631043367 19 December 2016 (19.12.2016) IN

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: MOISTURE BARRIER PACKAGE

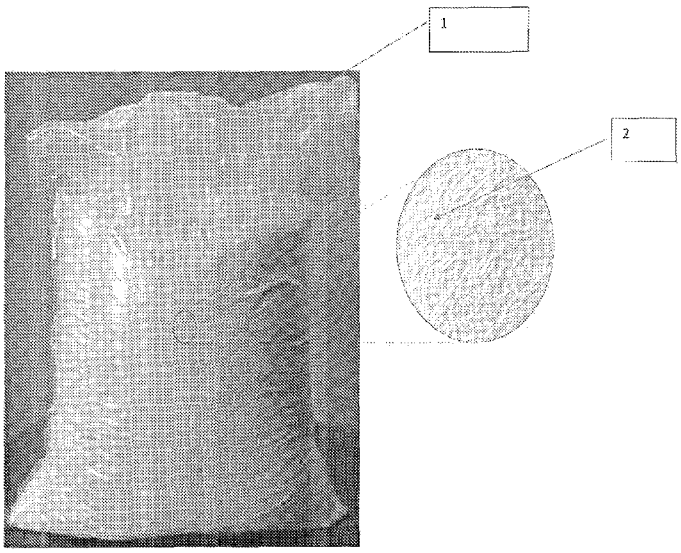

Figure 1

(57) Abstract: A packaged moisture sensitive product and a method for packaging a moisture sensitive product. The packaging comprises a primary package, and a secondary 5 package comprising a composite laminate comprising at least one thermoplastic layer and at least one metallic layer.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

MOISTURE BARRIER PACKAGE

FIELD OF THE INVENTION:

The present invention relates to a moisture barrier package. More particularly, the present invention relates to a moisture barrier package for moisture sensitive agrochemicals.

BACKGROUND AND PRIOR ART:

An essential prerequisite for selecting a packaging for moisture sensitive agrochemicals is to ensure that there is no interaction between the packaging material and the packaged material throughout the shelf life of the product. The conventional formulation types for agrochemicals are wettable powders, water dispersible granules, dusting powders and granules.

Polyethylene is used in agrochemical packaging because of its moisture barrier properties. However, polyethylene alone does not form a sufficient packaging for agrochemicals because of its poor mechanical strength.

Biaxially oriented polyester (PET) has been widely used for packaging of aqueous based products. However, its water vapour transmission rate is higher than that of polyethylene making it unsuitable for packaging moisture sensitive compounds.

US 2015 0274408, published on 1 October 2015, discloses an agriculturally active product including a volume of material including an agriculturally active ingredient (acephate), and a package having a package centroid, an interior region, and a distant portion positioned farthest away from the package centroid, the interior region having an interior region centroid and containing the volume of material, the interior region centroid being spaced apart from the package centroid by an offset distance, the distant portion being spaced apart from the package centroid by a farthest distance, a ratio of the offset distance to the farthest distance being greater than 0.10.

PCT Publication No. WO 1992 017382, published on 15 October 1992, discloses a package containing an agrochemical which package comprises a first sheet of non-planar water soluble or water dispersible material and a second sheet of water soluble or water dispersible material superposed on the first sheet and sealed to it by a continuous closed water soluble or water dispersible seal along a continuous region of the superposed sheets. However, this package suffers from poor mechanical strength and often fails the drop test.

US 5,224,601, published on 6 July 1993, discloses a packaging system containing a pesticidal composition. The packaging system comprises a first sheet of non-planar water soluble or water dispersible material defining a concavity enclosing the pesticidal composition, a second sheet of water soluble or water dispersible material sealed to the first sheet by a continuous closed water soluble or water dispersible heat seal, and a third sheet between the first and second sheets and sealed thereto by a water soluble or water dispersible seal to divide the package into two compartments.

CA 2 285 202, published on 2 September 1999, discloses a system and method provided for storing an active ingredient such as a pesticide or other type of agricultural chemical in a water soluble package. The active ingredient is incorporated in a storage formulation including a hydrophilic, non-aqueous solvent which is capable of dissolving the active ingredient but not the water soluble package.

Acephate, O, S-dimethyl acetylphosphoraamidothioate, is an insecticide that is vulnerable to environmental moisture or moisture derived from the packaging material. Therefore, moisture resistant packaging of acephate or formulations containing acephate has been a long felt need in the art. The FAO specifications for packing acephate stipulate that acephate must not contain more than 2 g/kg of water, as measured by MT. 30, CIPAC F, p.91. The specification further stipulates that typically the water content should be about 1.5 g/kg. It further states that as

acephate technical is hygroscopic, care must be taken to package it in moisture-proof containers and store in dry locations.

The present invention provides an effective moisture barrier packaging system for acephate and for acephate containing agrochemical products.

OBJECTS OF THE INVENTION:

Therefore, an object of the present invention is to provide a moisture barrier packaging system for moisture sensitive agrochemicals.

Another object of the present invention is to provide a package for moisture sensitive agrochemicals that ensures no interaction between the packaging material and the packaged material throughout the shelf life of the product.

Another object of the present invention is to provide a moisture barrier package for acephate or acephate containing agrochemical products.

The present invention described hereinafter meets at least one, and preferably more than one, of the above mentioned objects of the invention.

SUMMARY OF THE INVENTION:

A packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid; polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum;

cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivatives;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer;

(ii) at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

(iii) at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural

rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

A method of packing a moisture sensitive product, said method comprising:

(a) placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid; polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum; cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivatives;

(b) placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene,

polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer; and

(ii) at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

(iii) at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

DETAILED DESCRIPTION OF THE INVENTION:

Surprisingly, the present inventors have now found that the combination of at least one water soluble polymer layer, at least one first thermoplastic layer, at least one metallic layer and at least one second thermoplastic layer provides surprising mechanical strength to a package intended for a moisture sensitive agrochemical product along with providing the requisite moisture resistance to the packaged agrochemical. More surprisingly, it was found that the increased mechanical strength and the moisture resistance were prejudiced when any one of the water

soluble polymer layer, or any of the thermoplastic layers or the metallic layer was absent from the packaging. It was unexpected that the described layers, in combination, provided surprising benefits to a packaged agrochemical product that was otherwise very sensitive to environmental moisture exposure.

Therefore, in an aspect, the present invention provides a packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid; polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum; cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivatives;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

(I) at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide,

polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer;

(II) at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

(III) at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

In another aspect, the present invention also provides a method of packing a moisture sensitive product, said method comprising:

(a) placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch

made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid; polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum; cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivatives;

(b) placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

(I) at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6,

polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer;

(II) at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

(III) at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

Both of these aspects may have several embodiments depending on the preferential selection of the water soluble polymer or either of the thermoplastic layers or of the metallic layer. These embodiments described hereinafter are non-limiting and are only intended to be the exemplary embodiments of the present invention.

Therefore, in an embodiment, the present invention provides a packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of polyvinyl alcohol;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of polyethylene terephthalate;

(ii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

(iii) at least one second layer of polyethylene terephthalate.

In another embodiment, the present invention also provides a method of packing a moisture sensitive product, said method comprising:

(a) placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch made of polyvinyl alcohol;

(b) placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of polyethylene terephthalate;

(ii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

(iii) at least one second layer of polyethylene terephthalate.

In another embodiment, the present invention provides a packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of polyvinyl alcohol;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of polyethylene terephthalate;

(ii) at least another second layer of polyethylene terephthalate;

(iii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

(iv) at least one layer of low density polyethylene.

In a preferred embodiment, the seconday package is a trilaminated layer comprising 12 micron polyethylene terephthalate, followed by another layer of 12 micron polyethylene terephthalate, a 8 micron aluminium foil/layer, followed by a 100 micron low density polyethylene layer.

In another embodiment, the present invention also provides a method of packing a moisture sensitive product, said method comprising:

(a) placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch made of polyvinyl alcohol;

(b) placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one first layer of polyethylene terephthalate;

(ii) at least another second layer of polyethylene terephthalate;

(iii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

(iv) at least one layer of low density polyethylene.

In a preferred embodiment, the seconday package is a trilaminated layer comprising 12 micron polyethylene terephthalate, followed by another layer of 12 micron polyethylene terephthalate, a 8 micron aluminium foil/layer, followed by a 100 micron low density polyethylene layer.

In another embodiment, the seconday package is a trilaminated layer comprising 12 micron polyethylene terephthalate, a 20 micron aluminium foil/layer, followed by a 85 micron low density polyethylene layer.

Thus, in another embodiment, the present invention provides a packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of polyvinyl alcohol;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one layer of polyethylene terephthalate;

(ii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

(iii) at least one layer of low density polyethylene.

In another embodiment, the present invention also provides a method of packing a moisture sensitive product, said method comprising:

(a) placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch made of polyvinyl alcohol;

(b) placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

(i) at least one layer of polyethylene terephthalate;
(ii) at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and
(iii) at least one layer of low density polyethylene.

In an embodiment, the moisture sensitive agrochemical product is a phosphoramidothioate insecticide selected from the group consisting of acephate, chloramine phosphorus, isocarbophos, isofenphos, isofenphos-methyl, methamidophos, phosglycin and propetamphos.

In another embodiment, the moisture sensitive agrochemical product is acephate or a formulation comprising the same.

In an embodiment, the moisture sensitive agrochemical product is acephate 97% dry flowable formulation.

Thus, a moisture resistant packaging for 10 kg acephate 97% dry flowable formulation was prepared. A description of the preferred embodiments follows hereinafter, which is not to be considered as limiting.

In an embodiment, the water soluble polymer layer is a water soluble pouch made up of polyvinyl alcohol.

In an embodiment, the water soluble pouch is sealed on a plurality of sides, preferably sealed on two or three sides.

In an exemplary embodiment, the water soluble layer is selected with the following specifications, which were selected for packaging a 10 kg sample of acephate 97% DF formulation. These specifications are exemplary and are not to be construed as limiting the present invention.

S No.	Parameter	Unit	Exemplified selection
1	Height of pouch (± 2mm)	mm	700
2	Width of pouch(± 2mm)	mm	460
3	Total thickness (min)	µ	52-58
4	GSM of Film (major)	g/mt^2	60-70
5	Tensile Strength (Min)	N/mm^2	34
6	Elongation (Min)	%	290
7	Sealing Area	mm	4- 5
8	Moisture @ 50% RH, 23°C(Max.)	%	5
9	Dissolution Time at 30 °C	S	180
10	Drop Test	-	Pouch should pass drop test from 1.0 meter height consist of 2 drops

In an embodiment, the secondary packaging layer is a 4-layer composite layer comprising the following layers:

Printed PET (12 µ) // PET (12 µ) // Al foil (9 µ) // LDPE (100 µ)

In an exemplary embodiment, the secondary packaging is selected with the following specifications, which were selected for packaging a 10 kg sample of acephate 97% DF formulation. These specifications are exemplary and are not to be construed as limiting the scope of the invention in any manner.

S No.	Parameter	Unit	Exemplified selection
1	Height of pouch or Repeated length (± 2mm)	mm	670
2	Over all Width of laminate (± 2mm)	mm	1055
3	Dimension of pouch After forming(major)		305 X 210 X 670
4	Laminate GSM (±5%)	g/mt^2	157
5	Heat Seal Strength	kg/15 mm	3.5
6	Bond Strength(Min.)	g/15m m	150
7	Total thickness (min)	micron	133
8	Coefficient of friction(major)		0.25-0.3
9	Workmanship (major)		Pouch should be properly sealed, without any weak sealing at closed end. The sealing and cutting should be proper. Pouch should not have any pinholes or cuts in foil as well as pouch. There shall be no delamination in the pouch.

10	Sealing width at all 4 corner (Included in size) (major)	mm	10.0

The process for preparing such composite laminates is not particularly limiting, and these laminates may be prepared as per the conventional processes known in the art. For example, such laminates may be prepared by compression moulding, extrusion coating, extrusion lamination, tandem extrusion lamination, chemical vapour deposition etc. Such processes are commonly known in the art and are used for preparing the multi-layer laminates of the invention.

In an embodiment, a plurality of such secondary packages, each of said secondary packages comprising acephate 97% DF placed inside the primary package, were disposed within a tertiary packing, which comprises printed cartons.

In an embodiment, the printed carton is laminated with BOPP film for additional moisture resistance.

In a preferred embodiment, the printed carton is laminated with 10 µ BOPP film.

In an embodiment, the printed carton is provided with at least one die cut handle provided for easy handling.

In an embodiment, a plurality of such printed cartons are placed within a shipper packaging.

In an embodiment, the moisture sensitive material which are capable of being packed within the packaging method of the present invention includes, but is not limited to, acephate; combination of acephate and buprofezin; and combination of acephate and imidacloprid and compositions comprising the same.

Fig. 1 demonstrates a water soluble pouch (1) made up of polyvinyl alcohol. The water soluble pouch (1) has been used for packaging a 10 kg sample (2) of acephate 97% DF formulation.

Fig. 2 demonstrates a secondary packaging layer (3) according to an exemplary embodiment of the present invention. The secondary packaging layer (3) includes a 3-layer composite layer comprising PET (4), Al foil (5) and LDPE (6).

Example 1

The tri-laminated pouch PET (24 µ) // Al foil (9 µ) // LDPE (100 µ) along with the primary packaging layer of PVA was used to pack acephate 97% DF formulation. The package containing acephate 97% DF was then subjected to AHS study at 54°C.

Sr. No.	*TESTS*	*REQUIREMENTS*	RESULTS			
			Ambient	7 days	14 days	28 days
1	Description	The material shall be in the form of white to off-white granules, free from any visible extraneous matter.	Complies	Complies	Complies	Complies
2	Acephate content % w/w	97.0 ± 2.5 (94.5 To 99.5)	97.39	97.08	96.51	95.47
3	pH (1 % Aq.Solution)	3.5 To 6.5	5.51	5.25	4.88	4.19
4	Water insoluble % w/w	1.0 Max.	0.19	0.19	0.18	0.20
5	Wet Sieve % w/w Passing through 75 µ test sieve	99.0 Min.	99.92	99.92	99.91	99.90

6	Solubility in 1% Aq.sol^{n}	Should be clear solution	Complies	Complies	Complies	Complies
7	Moisture Content % w/w	Record	0.18	0.19	0.21	0.26
Degraded Acephate content in %------->			-	0.32	0.90	1.97

It was thus found that the packaged sample complied with the specifications up to 28 days in AHS study. AHS study is normally conducted for 14 days at an elevated temperature of 54°C, which according to standard guidelines, provides adequate data in certain circumstances to allow the regulatory authorities to make a regulatory finding regarding the stability of the product and the effect of the formulation on the product packaging.

Comparative Example 2:

The tri-laminated pouch PET (24 µ) // Al foil (9 µ) // LDPE (100 µ) along with the primary packaging layer of PVA was used to pack Acephate 97% DF formulation available from UPL Ltd. In the comparative sample, the tri-laminate pouch was replaced with a laminate comprising polyethylene/EVOH layer without a metallic layer.

Sr No	Parameters	Requirements	Initial Results	After 28 days	
				PE/EVOH	High Barrier Film Pouch
1	Description	The material shall be in the form of white to off white free flowing	Complies	Complies	Complies

		granules free from extraneous matter.			
2	Assay of Acephate	97.0% Min.	97.32	96.5	96.9
3	PH (1% Aq. Soln)	3.5 to 4.5	4.42	3.60	3.44
4	Material insoluble in water	1.0 Max	0.22	0.24	0.24
5	Wet Sieve Test thru 75 micron Sieve (200 BSS)	99.0 Min	99.91	99.9	99.91
6	Moisture Content	--	0.19	0.21	0.20

It was found that there was 0.84% reduction in the percentage active ingredient of acephate in the PE/EvOH (Ethylene Vinyl Alcohol) pouch, whereas only about 0.43% degradation in acephate content in the tri-laminated pouch of the invention. The PE/EvOH pouch, without the metallic layer, also led to highly corrosive smell generated in the pouch.

Comparative Example 3

The acephate + imidacloprid formulation Lancer Gold®, available from UPL Ltd, was tested for storage stability in a comparative high barrier film pouch made of 100 micron low density polyethylene. Thus, the test package was absent of the water soluble polymeric pouch, the thermoplastic layer and the metallized layer. The storage stability of the formulation was tested after AHS storage i.e. after 28 days at 54^{O}C.

S No.	Parameters	Requirements	T=0 day	T=28 days
			High barrier film pouch (100 mic LDPE)	
1	Description	White/off-white free flowing powder	Complies	
2	Acephate assay	50.0 ± 5 %	51.6	50.1
3	Imidacloprid assay	1.80 ± 5 %	2.11	1.40
4	pH (2% aq. Soln.)	3.0 to 6.0	5.44	3.24
5	Water content	1.5 Max	0.35	0.77
6	Wettability	120 Max	72	76
7	Wet sieve test (75 micron, 200 BSS)	99.0 Min	99.7	99.62

Thus, it was found that in the absence of the secondary package and the water soluble polymer of the present invention, acephate content of Lancer Gold ® degraded by 2.90% after 28 days, and the imidacloprid content degraded by 33.5% when packed in high barrier film pouch of 100 micron LDPE. A highly corrosive smell was also generated in the pouch. A packaging method and the packaged product according to the present invention was required to pack acephate or acephate containing formulation.

While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples

herein. The invention should therefore not be limited by the above described embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention.

CLAIMS

1. A packaged moisture sensitive product, said packaged product comprising:

(a) at least one moisture sensitive product;

(b) at least one primary package containing said moisture sensitive product, said primary package being a water soluble pouch made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid; polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum; cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivatives;

(c) at least one secondary package capable of holding said primary package and being made of a composite laminate having a plurality of layers, said layers being selected from:

at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate,

polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer;

at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

2. The packaged product as claimed in claim 1, wherein:

said primary package is a water soluble pouch made of polyvinyl alcohol;

said secondary package is a composite laminate having a plurality of layers, said layers being:

at least one first layer of polyethylene terephthalate;

at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and

at least one second layer of polyethylene terephthalate.

3. The packaged product as claimed in claim 1, wherein:
said primary package is a water soluble pouch made of polyvinyl alcohol;
said secondary package is a composite laminate having a plurality of layers, said layers being:
at least one first layer of polyethylene terephthalate;
at least another second layer of polyethylene terephthalate;
at least one aluminium layer disposed between polyethylene terephthalate layers or deposited on at least one of said polyethylene terephthalate layer; and
at least one layer of low density polyethylene.

4. The packged product as claimed in claim 3, wherein the moisture sensitive agrochemical product is a phosphoramidothioate insecticide selected from the group consisting of acephate, chloramine phosphorus, isocarbophos, isofenphos, isofenphos-methyl, methamidophos, phosglycin and propetamphos or a formulation thereof.

5. The packaged product as claimed in claim 4, wherein the moisture sensitive agrochemical product is acephate or a formulation thereof.

6. The packaged product as claimed in claim 5, wherein the moisture sensitive agrochemical product is acephate 97% dry flowable formulation or acephate 50% + imidacloprid 1.8% SP formulation.

7. A method of packing a moisture sensitive product, said method comprising:
placing said moisture sensitive product within a first primary package, said primary package being a water soluble pouch made of a water soluble polymer selected from polyethylene glycol or a block copolymer comprising polyethylene glycol selected from copolymers with polypropylene oxide, copolymers with polyethylene butylene, and copolymers with polycaprolactone; polyvinylpyrrolidone; polyvinyl alcohol; polyacrylic acid;

polyacrylamides; N-(2-hydroxypropyl) methacrylamide; divinyl ether-maleic anhydride; polyoxazoline; polyphosphates; polyphosphazenes; xanthan gums; pectins; chitosan derivatives; dextran; carrageenan; guar gum; cellulose ethers selected from hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, and sodium carboxy-methyl cellulose; and starch or starch derivative;

placing said primary package in a secondary package capable of holding said moisture sensitive agrochemical product contained within said primary package, said secondary package being made of a composite laminate having a plurality of layers, said layers being selected from:

at least one first layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer;

at least one metallic layer disposed between said thermoplastic polymer layers or deposited on at least one of said thermoplastic polymer layer; and

at least one second layer of a thermoplastic polymer, said thermoplastic polymer being selected from polyamideimide, polyethersulphone, polyetherimide, polyarylate, polysulphone, polyarylate, polysulphone, polyamide, polymethylmethacrylate, polyvinyl chloride, acrylonitrile

butadiene styrene, polystyrene, polyetheretherketone, polytetrafluoroethylene, polyamide 6-6, polyamide 11, polyphenylene sulphide, polyethylene terephthalate, polyoxymethylene, polypropylene, high density polyethylene, low density polyethylene, polypropylene, polystyrene, polymethylmethacrylate, polyvinyl chloride, natural rubber, polydimethyl siloxane, polyoxymethylene, polycarbonate, polyetheretherketone, nylon 6, polyphenylene sulphide, polyethersulphone, polyetherimide, and liquid crystal polymer.

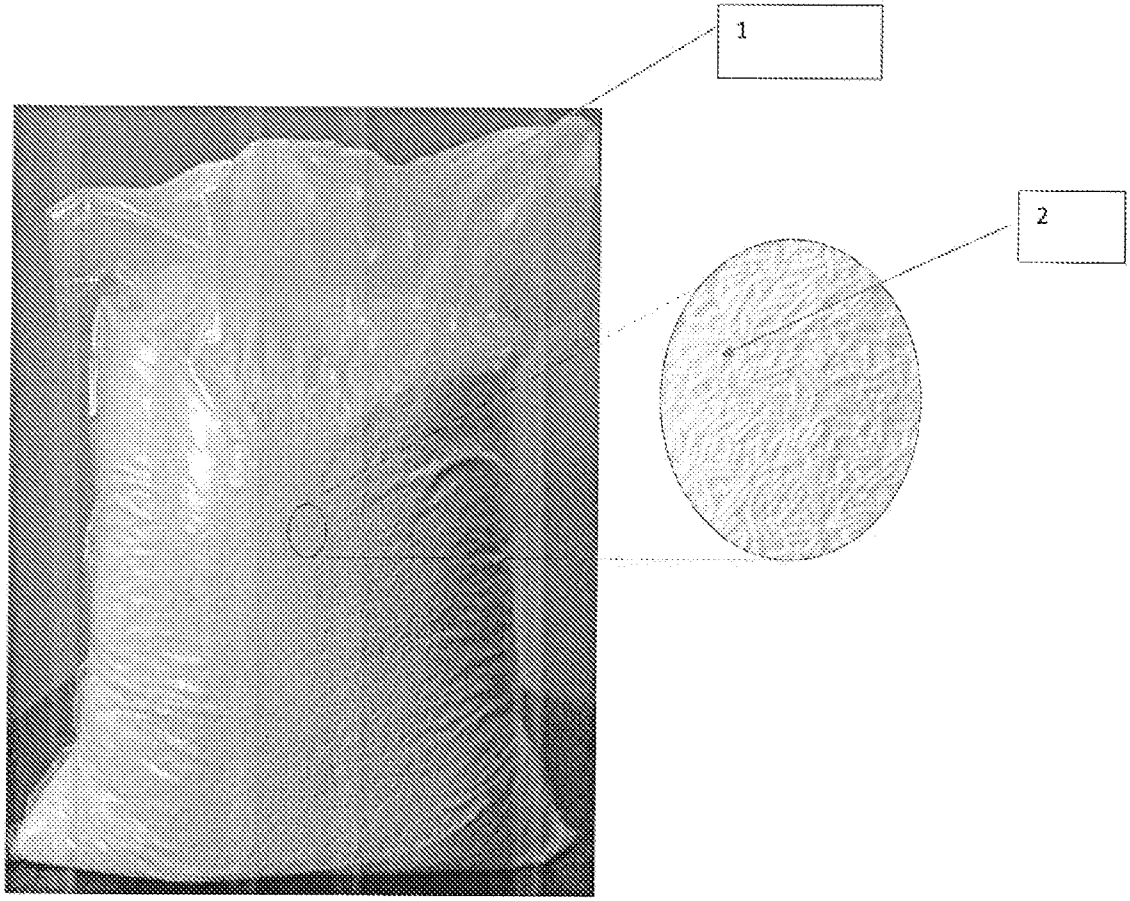

Figure 1

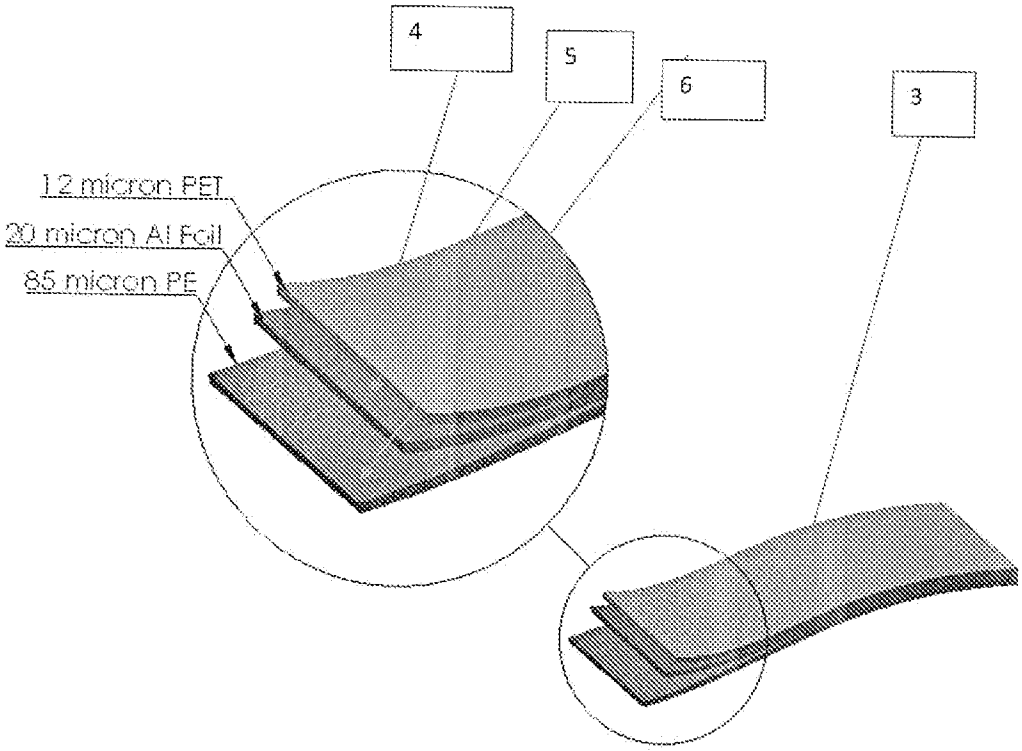

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2017/058044

A. CLASSIFICATION OF SUBJECT MATTER

B65D 65/46 (2006.01) B65D 77/04 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIPAP/EPODOC, STN CAPLUS. Search terms: water soluble, polyvinyl alcohol, PVOH, pouch, sachet, inner, metallised, aluminium, foil, laminate, pesticide, insecticide, agrochemical, agrichemical, acephate, B65D65/46, B65D77/04, UPL, Shroff and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2018	15 February 2018
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Andrew Matthews AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832693

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	**PCT/IB2017/058044**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4119604 A (WYSONG) 10 October 1978 See whole of the document but particularly the Abstract, column 9 line 27-31 and line 45-67.	1-7
X	US 20040031717 A1 (EDWARDS et al) 19 February 2004 See whole of the document but particularly the Abstract, [0044], [0054] and Example 1.	1-7
X	US 5827586 A (YAMASHITA et al) 27 October 1998 See whole of the document but particularly the Abstract, column 2 line 54-65, column 3 line 7-37 and line 48-53.	1-7
X	JP H05339106 A (SANKYO CO.) 21 December 1993 See whole of the document but particularly the Abstract, [0012], [0026], and [0034].	1-7

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2017/058044**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2017/058044**

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/IB2017/058044**

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Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.