PRACTICAL ACTION
Technology challenging poverty

PACKAGING MATERIALS FOR FOODS

technical brief

Introduction

This Technical Brief describes the technical properties of different food packaging materials. For more detailed information on packaging using glass containers see Technical Brief: *Packaging foods in glass*, and for methods of filling and sealing containers, see Technical Brief: *Filling and Sealing Packaged Foods.*

Figure 1: Polypropylene drums used as shipping containers for fruit pulp.
Photo: Peter Fellows.

The technical purposes of packaging are:

- To contain foods (to hold the contents and keep them clean and secure without leakage or breakage until they are used).
- To protect foods against a range of hazards during distribution and storage (to provide a barrier to dirt, micro-organisms and other contaminants, and protection against damage caused by insects, birds and rodents, heat, oxidation, and moisture pickup or loss).
- To give convenient handling throughout the production, storage and distribution system, including easy opening, dispensing and re-sealing, and being suitable for easy disposal, recycling or re-use.
- To enable the consumer to identify the food, and give instructions so that the food is stored and used correctly.

The shelf life of a food is the length of time it can be stored before the quality becomes unacceptable, and this includes the time to distribute food to retailers and store it by the consumer. It is important to note that the selection of a packaging material for a particular food depends not only on its technical suitability (i.e. how well the package protects a food for the required shelf life), but also on the availability and cost in a particular area, and any marketing considerations that favour choosing a certain type of package.

Packaging is important because it aids food distribution, and rapid and reliable distribution helps remove local food surpluses, allows consumers more choice in the foods available and helps to reduce malnutrition. Packaging also reduces post harvest losses, which together with giving access to larger markets, allows producers to increase their incomes. Therefore, adequate packaging in developing countries has profound effects on both the pattern of food consumption and the amount of food consumed.

Packaging materials can be grouped into two main types:

1. Shipping containers, which contain and protect the contents during transport and distribution but have no marketing function. Examples include sacks, corrugated fibreboard (cardboard) cartons, shrink-wrapped or stretch-wrapped containers, crates, barrels or drums.
2. Retail containers, which protect and advertise the food for retail sale and home storage. Examples include metal cans, glass or plastic bottles and jars, plastic tubs, pots and trays, collapsible tubes, paperboard cartons and flexible plastic or paper bags, sachets and overwraps.

Frequently more than one type of material is used to package a single product. For example, display cartons may contain multiple packs of food packaged in flexible film. These in turn are placed in corrugated board shipping boxes and loaded onto pallets.

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Types of packaging materials - traditional materials

These materials have been used since the earliest times for domestic storage and local sales of foods. However, with the exception of glazed pottery, they have poor barrier properties and are only used to contain foods and keep them clean. They are also unsuited to the needs of commercial production processes and are considered by many customers to be less attractive than the newer 'industrial' materials described below. A summary of the main types of traditional materials and possible current uses are as follows:

Leaves, vegetable fibres and textiles

Leaves are cheap and readily available, and are used as wrappers for products such as cooked foods that are quickly consumed. Banana or plantain leaves are used for wrapping traditional cheese and fruit confectionery such as guava cheese. Maize leaves are used to wrap corn paste or blocks of brown sugar, and 'Pan' leaves are used for wrapping spices in India. Other examples are green coconut palm, papyrus leaves and bamboo and rattan fibres, which are woven into bags or baskets and used for carrying meat and vegetables in many parts of the world. Palmyra palm leaves are used to weave boxes in which cooked foods are transported, and small banana leaf bags are used to contain coffee beans (Fig. 2) that are a traditional gift in some parts of Africa. Some of these have the potential to be developed as niche packaged products for tourist markets.

Figure 2: Traditional leaf packaging of coffee beans.
Photo: Peter Fellows.

Fibres from kenaf and sisal plants are mainly used for making ropes, cord and string, which can be made into net bags to transport hard fruits. They can also be spun into a yarn that is fine enough to make coarse canvas. Other examples of textile containers are woven jute sacks, which are used to transport a wide variety of bulk foods including grain, flour, sugar and salt. Plant fibre sacks are flexible, lightweight and resistant to tearing, have good durability, and may be chemically treated to prevent them rotting. Their rough surfaces are non-slip, which makes stacking easier compared to synthetic fibre sacks, and they are bio-degradable. Most textile sacks can be re-used several times after washing and they are easily marked to indicate the contents. They are still widely used to transport fresh or dried crops, but they are being replaced as shipping containers by woven polypropylene or multi-walled paper sacks (below). Calico is a closely woven, strong cotton fabric that can be made into bags for flour, grains, legumes, coffee beans and sugar. Methods of filling and sealing sacks and bags are described in Technical Brief: *Filling and Sealing Packaged Foods*. Muslin and cheesecloth are open-mesh, light fabrics used both to strain liquid foods during processing and to wrap foods such as cheeses and processed meats (e.g. smoked ham).

Wood

Wooden containers protect foods against crushing, have good stacking characteristics and a good weight-to-strength ratio. Wooden boxes, trays and crates have traditionally been used as shipping containers for a wide variety of solid foods including fruits, vegetables and bakery products. Wooden tea chests are produced more cheaply than other containers in tea-producing countries and are still widely used. However, in most applications, plastic containers have a lower cost, are more easily cleaned for reuse, do not risk contaminating foods with splinters, and they have largely replaced wooden containers in most applications. Small wooden boxes are used to pack tea or spices for tourist markets in some countries. Wooden barrels have been traditionally used as shipping containers for a wide range of liquid foods, including cooking oils, wine, beer and juices. They continue to be used for some wines and spirits because flavour compounds from the wood improve the quality of the products, but in other applications have been replaced by aluminium, coated steel or plastic barrels.

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Leather
Leather containers made from camel, pig or kid goat hides have traditionally been used as flexible, lightweight, non-breakable containers for water, milk and wine. Manioc flour and solidified sugar were also packed in leather cases and pouches, but the use of leather has now ceased for most commercial food applications.

Earthenware
Pottery is still used domestically for storage of liquid and solid foods such as yoghurt, beer, dried foods, honey, etc. Corks, wooden lids, wax or plastic stoppers, or combinations of these are used to seal the pots. If they are glazed and well sealed, they prevent oxygen, moisture and light from entering the food and they are therefore suitable for storing oils and wines. They also restrict contamination by micro-organisms, insects and rodents. Unglazed earthenware bowls or pots are porous and the evaporating moisture makes them suitable for products that need cooling. They are still used for local sales of curd or yoghurt in parts of Asia.

Glass or plastic containers have largely replaced pottery because of its high weight, fragility, variability in volume when hand-made, and the difficulty of adequately cleaning pottery containers for re-use.

Types of packaging materials - industrial materials

These materials have been developed over the last 200-300 years and are the main types of packaging used by small-scale food processors. The availability of glass, metal or plastic containers varies considerably in different countries, and this, together with the relative cost of different materials, determines their uptake by local processing industries. Where these materials have to be imported, large minimum order sizes can be a significant constraint on the development of a processing sector.

Metal containers
There are two basic types of metal cans: those that are sealed using a ‘double seam’ and are used to make canned foods (see Technical Brief: *Canning of Foods*); and those that have push-on lids or screw-caps that are used to pack dried foods (e.g. milk or coffee powder, dried yeast) or cooking oils respectively. Double-seamed cans are made from tinplated steel or aluminium and are lined with specific lacquers for different types of food. Cans have a number of advantages over other types of container: when sealed with a double-seam they provide total protection of the contents; they are tamperproof; and they can be made in a wide range of shapes and sizes. However, the high cost of metal and the high manufacturing costs make cans expensive compared to other containers. They are heavier than plastic containers and therefore have higher transport costs. There are few can-making factories in developing countries and small-scale food processors generally do not use metal cans because of these disadvantages and/or lack of availability. Larger (200 litre) metal drums are widely used as shipping containers for oils, juices and other liquid foods, although cheaper plastic drums are steadily replacing them.

Other types of metal containers include aluminium foil cups and trays, laminated foil pouches as alternatives to cans or jars, collapsible aluminium tubes for pastes, and aluminium barrels. The advantages of aluminium are that it is impermeable to moisture, odours, light and micro-organisms, and is an excellent barrier to gases. It as a good weight: strength ratio and a high quality surface for decorating or printing.

Glass
Glass bottles and jars have some of the advantages of metal cans: they are impervious to micro-organisms, pests, moisture, oxygen and odours; they do not react foods or have chemicals that migrate into foods; they can be heat processed; they are recyclable, and (with new lids) they are re-useable; they are rigid, to allow stacking without damage; and unlike metal cans, they are transparent to display the contents. The main disadvantages of glass are: the higher weight than most other types of packaging, which incurs higher transport costs; containers are easily broken, especially when transported over rough roads; they have

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more variable dimensions than metal or plastic containers; and there are potentially serious hazards from glass splinters or fragments that can contaminate foods (see Technical Brief: *Packaging Foods in Glass*). Glass containers are still widely used for foods such as juices, wines, beers, pickles/chutneys and jams (Fig 3.), especially in countries that have a glass-making factory, but their disadvantages and the high cost for imported containers in other places mean that they are steadily being replaced by plastic containers.

Figure 3: Glass jars used by a small-scale jam maker.
Photo: Peter Fellows.

Paper and cardboard

Paper and boards are made from wood pulp and additives are mixed into the pulp to give particular properties to the packaging, including:

- Fillers such as china clay, to increase the brightness of paper and improve surface smoothness and printability.
- Binders, including starches, vegetable gums, and synthetic resins to improve the strength.
- Resin or wax sizing agents to reduce penetration by water or printing inks.
- Pigments to colour the paper and other chemicals to assist in the manufacturing process.

Different types of paper are used to wrap foods: 'sulphate' paper is strong and used for single- or multi-walled paper sacks for flour, sugar, fruits and vegetables; 'Sulphite' paper is lighter and weaker and is used for grocery bags and sweet wrappers, as an inner liner for plastic biscuit wrappers and laminated with plastic films. Greaseproof paper is sulphite paper made resistant to oils and fats, and used to wrap meat and dairy products. 'Glassine' is a greaseproof sulphite paper that is given a high gloss to make it resistant to water when dry, but it loses its resistance once it becomes wet. Tissue paper is a soft paper used for example to protect fruits against dust and bruising. Papers are also treated with wax to provide a moisture barrier and allow the paper to be heat sealed. Wax coatings are easily damaged and the wax is therefore laminated between layers of paper and/or polyethylene when used for bread wrappers and inner liners for cereal cartons.

'Paperboard' is a term that includes boxboard, chipboard and corrugated or solid fibreboards. Typically, paperboard has the following structure:

1. A top layer of white material to give surface strength and printability.
2. Middle layers of grey/brown lower grade material.
3. An under-layer of white material to stop the colour of the middle layer showing through.
4. A back layer if strength or printability are required.

All layers are glued together with adhesive.

White board is suitable for contact with foods and is often coated with wax or laminated with plastic to make it heat sealable. It is used for ice cream, chocolate and frozen food cartons. Chipboard is made from recycled paper and is used for example as the outer cartons for tea or cereals but not in contact with foods. It may be lined with white board to improve the appearance and strength. Other types include moulded paperboard trays for eggs, fruit, meat or fish or for egg cartons.

Small paperboard tubs or cans are used for snackfoods, confectionery, nuts, salt, cocoa powder and spices. Larger drums are used as a cheaper alternative to metal drums for powders and other dry foods and, when lined with polyethylene, for cooking fats. They are lightweight, resist compression and may be made water resistant for outside storage. Other products that are handled in lined drums include fruit and vegetable products, peanut butter and sauces.

Corrugated board resists impact, abrasion and compression damage, and is therefore used for shipping containers. Smaller more numerous corrugations give rigidity, whereas larger corrugations or double- and triple-wall corrugated material provides cushioning and resists impact damage. Corrugated cartons are used as shipping containers for bottled, canned or

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plastic-packaged foods. Wet foods may be packed by lining the corrugated board with polyethylene or a laminate of wax-coated greaseproof paper and polyethylene, and used for chilled bulk meat, dairy products and frozen foods.

Flexible plastic films

In general, flexible plastic films have relatively low cost and good barrier properties against moisture and gases; they are heat sealable to prevent leakage of contents; they add little weight to the product and they fit closely to the shape of the food, thereby wasting little space during storage and distribution; they have wet and dry strength, and they are easy to handle and convenient for the manufacturer, retailer and consumer. The main disadvantages are that (except cellulose) they are produced from non-renewable oil reserves and are not biodegradable. Concern over the environmental effects of non-biodegradable oil-based plastic packaging materials has increased research into the development of 'bioplastics' that are derived from renewable sources, and are biodegradable. However, these materials are not yet available commercially in developing countries.

There is a very wide choice of plastic films made from different types of plastic polymer. Each can have ranges of mechanical, optical, thermal and moisture/gas barrier properties. These are produced by variations in film thickness and the amount and type of additives that are used in their production. Some films (e.g. polyester, polyethylene, polypropylene) can be 'oriented' by stretching the material to align the molecules in either one direction (uniaxial orientation) or two (biaxial orientation) to increase their strength, clarity, flexibility and moisture/gas barrier properties. There are thus a very large number of plastic films and small-scale processors should obtain professional advice when selecting a material to ensure that it is suitable for the intended product and shelf life. Typically, the information required includes: type of plastic polymer(s) required; thickness/strength; moisture and gas permeability; heat seal temperature; printability on one or both sides; and suitability for use on the intended filling machinery (see also Technical Brief: *Filling and Sealing Packaged Foods*).

A summary of the main different types of flexible plastic films is as follows:

Cellulose

Plain cellulose is a glossy transparent film that is odourless, tasteless and biodegradable (within approximately 100 days). It is tough and puncture resistant, although it tears easily. It has dead-folding properties that make it suitable for twist-wrapping (e.g. sugar confectionery). However, it is not heat sealable and the dimensions and permeability of the film vary with changes in humidity. It is used for foods that do not require a complete moisture or gas barrier, including fresh bread and some types of sugar confectionery. Cellulose acetate is a clear, glossy transparent, sparkling film that is permeable to water vapour, odours and gases and is mainly used as a window material for paperboard cartons.

Figure 4: Milk packaged in flexible film.
Photo: Peter Fellows

Polyethylene (or polythene)

Low-density polyethylene (LDPE) is heat sealable, inert, odour free and shrinks when heated. It is a good moisture barrier but is relatively permeable to oxygen and is a poor odour barrier. It is less expensive than most films and is therefore widely used for bags, for coating papers or boards and as a component in laminates. LDPE is also used for shrink- or stretch-wrapping (see Technical Brief: *Filling and Sealing Packaged Foods*). Stretch-wrapping uses thinner LDPE (25 - 38 μm) than shrink-wrapping (45 - 75 μm), or alternatively, linear low-density polyethylene is used at thicknesses of 17 - 24 μm. The cling properties of both films are adjusted to increase adhesion between layers of the film and to reduce adhesion between adjacent packages.

High-density polyethylene (HDPE) is stronger, thicker, less flexible and more brittle than LDPE and a better barrier to gases and moisture. Sacks made from HDPE have high tear

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and puncture resistance and have good seal strength. They are waterproof and chemically resistant and are increasingly used instead of paper or sisal sacks.

Polypropylene
Polypropylene is a clear glossy film with a high strength and puncture resistance. It has a moderate barrier to moisture, gases and odours, which is not affected by changes in humidity. It stretches, although less than polyethylene. It is used in similar applications to LDPE. Oriented polypropylene is a clear glossy film with good optical properties and a high tensile strength and puncture resistance. It has moderate permeability to gases and odours and a higher barrier to water vapour, which is not affected by changes in humidity. It is widely used to pack biscuits, snackfoods and dried foods.

Other films
Polyvinylidene chloride is very strong and is therefore used in thin films. It has a high barrier to gas and water vapour and is heat shrinkable and heat sealable. However, it has a brown tint which limits its use in some applications. Polyamides (or Nylons) are clear, strong films over a wide temperature range (from – 60 to 200°C) that have low permeability to gases and are greaseproof. However, the films are expensive to produce, require high temperatures to heat seal, and the permeability changes at different storage humidities. They are used with other polymers to make them heat sealable at lower temperatures and to improve the barrier properties, and are used to pack meats and cheeses.

Coated films
Films are coated with other polymers or aluminium to improve their barrier properties or to impart heat sealability. For example a nitrocellulose coating on both sides of cellulose film improves the barrier to oxygen, moisture and odours, and enables the film to be heat sealed when broad seals are used. Packs made from cellulose that has a coating of vinyl acetate are tough, stretchable and permeable to air, smoke and moisture. They are used for packaging meats before smoking and cooking. A thin coating of aluminium (termed 'metallisation') produces a very good barrier to oils, gases, moisture, odours and light. This metallised film is less expensive and more flexible than plastic/aluminium foil laminates. The properties of selected coated films are shown in Table 1.

Table 1: Properties of selected packaging materials

Film	Coating	Barrier to		Strength	Clarity	Thickness (µm)
		Moisture	Air/odours			
Cellulose	PvDC	*	***	*	***	21-40
	Aluminium	***	***	*	***	19-42
	Nitro-cellulose	***	***	*	-	21-42
LDPE	-	**	*	**	*	25-200
HDPE	-	***	**	***	*	350-1000
Polypropylene	-	***	***	***	***	20-40
	PvDC	***	***	***	***	18-34
	Aluminium	***	***	***	-	20-30
Polyester	-	**	**	***	**	12-23
	-	***	***	***	-	20-30

* = low, ** = medium, *** = high. PvDC = polyvinylidene chloride, LPDE = low density polyethylene, HDPE = High density polyethylene.
Thicker films of each type have better barrier properties than thinner films.

Laminated films
Lamination (bonding together) of two or more films improves the appearance, barrier

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properties or mechanical strength of a package. Some examples of laminated films are shown in Table 2.

Table 2: Selected laminated films used for food packaging

Laminated film	**Typical food applications**
Polyvinylidene chloride coated polypropylene (2 layers)	Crisps, snackfoods, confectionery, ice cream, biscuits, chocolate
Polyvinylidene chloride coated polypropylene-polyethylene	Bakery products, cheeses, confectionery, dried fruit, frozen vegetables
Cellulose-polyethylene-cellulose	Pies, crusty bread, bacon, coffee, cooked meats, cheeses
Cellulose acetate-paper-foil-polyethylene	Dried soups
Metallised polyester-polyethylene	Coffee, dried milk
Polyethylene-aluminium-paper	Dried soup, dried vegetables, chocolate

Coextruded films

Coextrusion is the simultaneous extrusion of two or more layers of different polymers to make a film. Coextruded films have three main advantages over other types of film: they have very high barrier properties, similar to laminates but produced at a lower cost; they are thinner than laminates and are therefore easier to use on filling equipment; and the layers do not separate.

There are three main groups of polymers that are coextruded:

- Low-density and high-density polyethylene, and polypropylene.
- Polystyrene and acrylonitrile-butadiene-styrene.
- Polyvinyl chloride.

Typically a three-layer coextrusion has an outside layer that has a high gloss and printability, a middle bulk layer which provides stiffness and strength, and an inner layer which is suitable for heat sealing. They are used, for example, for confectionery, snackfoods, cereals and dried foods. Thicker coextrusions (75 - 3000 µm) are formed into pots, tubs or trays (Table 3).

Table 3: Selected applications of coextruded plastic films

Coextruded film	**Typical food applications**
High impact polystyrene-PET	Margarine, butter tubs
Polystyrene- polystyrene-PvDC- polystyrene	Juice and milk bottles
Polystyrene- polystyrene-PvDC-polyethylene	Tubs for butter, cheese, margarine, bottles for coffee, mayonnaise, sauces.

Rigid and semi-rigid plastic containers

There is a wide range of plastic bottles, pots, jars, trays and tubs made from single or coextruded plastics that are increasingly used for processed foods, when they are available in developing countries. The main advantages, compared with glass and metal, are as follows:

- Lower weight, resulting in savings of up to 40% in transport and distribution costs. Cups, tubs and trays are tapered (a wider rim than base) for more compact stacking for transport and storage.
- Lower production costs using less energy.
- Tough, unbreakable and easy to seal.
- Very good barrier properties.
- Precisely moulded into a wider range of shapes than glass or metal containers.
- Can be coloured for consumer appeal and to give UV-light protection to foods.

However, they are not re-usable, are less rigid than glass or metal for stacking and cannot be heated to the same high temperatures as glass and metal. They are used for example as:

- Cups or tubs for margarine, processed meats, cheese, spreads, yoghurt, peanut butter, dried foods or ice cream and desserts (high-nitrile resin copolymers or high-impact polystyrene and acrylonitrile butadiene styrene).

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- Trays for meat products and chocolates, tubs for margarine or jams, and (polyvinyl chloride) - good oil resistance and low gas permeability.
- Bottles and jars for fruit juices, squashes and juice concentrates, vinegar, cooking oil, milk, wine, syrup and, and as drums for salt and bulk fruit juices (HDPE, polyvinyl chloride).
- Bottles for carbonated drinks (polyethylene terephthalate (PET) - PET is a very strong transparent glossy film that is a good moisture and gas barrier. It is biaxially oriented to develop the strength for use in carbonated drinks bottles.
- Squeezable bottles and pots for mustard, mayonnaise, jams, tomato ketchup and other sauces (polypropylene coextruded with ethylene vinyl alcohol).
- Trays for chocolates, eggs, or soft fruit.
- Foam cartons or trays for eggs, fresh fruits and takeaway meals (polystyrene).

Packaging suppliers

A comprehensive list of worldwide packaging suppliers and support institutions is provided by Packaging International at www.packaging-int.com/companies/ Agents for packaging companies in the capital city are the best source of information on what is available locally and the relative costs of different materials. Orders cannot be placed directly with packaging manufacturers, but their websites have technical information on the range of products that they produce, for example:

Figure 5: Plastic bottles used for fruit squashes. Photo: Peter Fellows.

- Polypropylene, company information from Total Petrochemicals, available at www.totalpetrochemicalsusa.com/brochures/PP_castandblown_film.pdf
- Tinplate and tin free steel cans, company information from JFE Steel Corporation, available at www.jfe-steel.co.jp/en/products/sheets/catalog/b1e-006.pdf
- Visypak food packaging, company information from Visy available at http://www.visy.com.au/uploads/steel_can_process.pdf
- Types of glass, company information from British Glass, available at www.britglass.org.uk/aboutglass/typesofglass.html#1

References

- *Packaging Foods in Glass*, Practical Action Technical Brief
- *Filling and Sealing Packaged Foods*, Practical Action Technical Brief
- *Canning of Foods*, Practical Action Technical Brief

Further Reading

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- *Small-scale Food Processing: A Guide to Appropriate Equipment*, Fellows, P. and Hampton, A., IT Publishing/CTA, 1992.
- *The Packaging Regulations - implications for business*, Powell, J. and Steele, A., Chandos Publishing, Witney, Oxon., UK. 1999

Support Institutions

Further information can be obtained about local costs and availability of different types of packaging materials from the following institutions:

- Asian Packaging Federation, c/o Sri Lanka Institute of Packaging, 290, D.R. Wijewardena Mawatha, Colombo 10, Sri Lanka, E-mail: slip@sltnet.lk
- Indian Institute of Packaging, E-2, MIDC Area, Chakala, PO Box 9432, Andheri (East), Mumbai Maharashtra 400093, India, Tel: +91 22 821 9803, Fax: +91 22 837 5302, E-mail: enquiry-iip@iip-in.com, Website: www.iip-in.com
- Institute of Packaging (South Africa), P.O. Box 145, Pinegowrie, South Africa, 2123, Tel: +27 11 913 3880, Fax: +27 11 913 2418, E-mail: info@ipsaeducation.org.za, Website: www.ipsaeducation.org.za
- Institute of Packaging (UK), Willoughby House, Broad Street, Stamford, Lincolnshire, PE9 1PB, UK., Tel: +44 1780 759200, Fax: +44 1780 759220, E-mail: iop@pi2.org.uk, Website: www.pi2.org.uk.
- Institute of Packaging Ghana, PO Box 2234, Tema, Ghana, Tel: +233 20 81906867, E-mail: iopghana@yahoo.com, Website: www.iopg.org
- Institute of Packaging Kenya, P.O. Box 27543, Nyayo, Nairobi, Kenya, Tel: +254 2 340447, Fax: +254 2 21 9755, E-mail: sam_moturi@eankenya.com,
- Instituto Peruano de Envase y Embalaje (IPENBAL), Av. Las Palmeras 375, Lima 1 Casilla, Peru, 1806, Tel: +51 14 704485, Fax: +51 14 400891.
- Packaging Industries Association of Bangladesh, 68 Dilkusha Commercial Area, GPO Box 535, Dhaka, Bangladesh, 1000, Tel: +880 2 2372701, Fax: +880 2 833279.
- Union Latino Americana Del Embalage (ULADE), Avda. Jujuy 425, Buenos Aires, C1083AAE, Argentina, Tel: +54 1149570350, Fax: +54 1149561368, E-mail: iaenvase@infovia.com.ar, Website: www.packaging.com.ar.
- World Packaging Organisation, c/o STFI-Packforsk, Box 5604, S-114 86 Stockholm, Sweden, Fax: +46 8 4115518, Email: info@stfi.se, Website: http://www.packaging-technology.com/wpo/
- Zimbabwe Association of Packaging, 17 Coventry Road, Workington, Harare, Zimbabwe, Tel: +263 4 753 800, Fax: +263 4 882 020.

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