

THE ABC'S OF FOLDING CARTON SUBSTRATES



The type of paper substrate used to construct a folding carton greatly influences the structural integrity, graphics quality, cost and other characteristics of the finished packaging. This article explains the main paper substrates used in folding carton packaging, as well as their characteristics and primary uses.

A paper substrate is the raw material used to make folding carton packaging. There are two types of substrates used in folding cartons: *paperboard* and *small flute corrugate*.

Paperboard is a general term describing heavier-weight grades of paper (at least .01 inches thick) made from cellulose, or wood, fibers. The most common substrate used in the production of folding cartons, paperboard is also used in making boxes, shipping containers, construction materials and other consumer and industrial products.

Small flute corrugate consists of a fluted, or wavy, layer of paper and one or more thin layers of paperboard. The fluting is smaller than what is found in corrugated shipping boxes,

resulting in a sheet with less strength and greater flexibility than standard corrugated board but still greater strength than paperboard. However, small flute corrugate is generally more expensive than paperboard. As a result, small flute corrugate is often used in high-end packaging in which rigidity and strength are required.

Next we discuss the different factors that influence the characteristics of first paperboard and then small flute corrugate.

FACTORS INFLUENCING PAPERBOARD CHARACTERISTICS

A number of factors influence the characteristics of paperboard, including virgin vs. recycled material content, the process used to produce the paper pulp, the type of wood used, whether or not paper fibers have been bleached, caliper and grain direction.

Virgin vs. recycled material content.

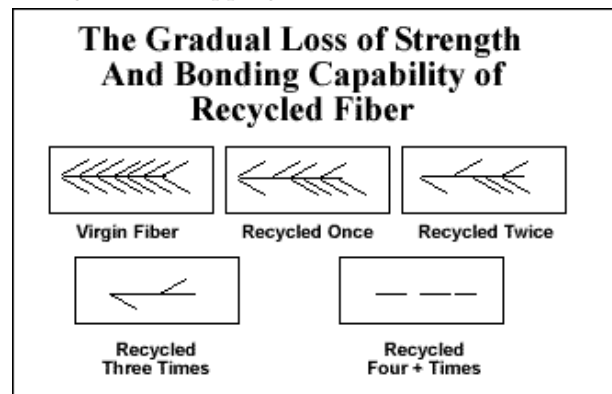
Each time a fiber is recycled it is shortened and, potentially, contaminated. As a result, recycled fibers have less strength and less stiffness (in the cross direction) than virgin fibers. In addition, recycling results

in degradation of the bonding capabilities of fibers, which can impact gluability.

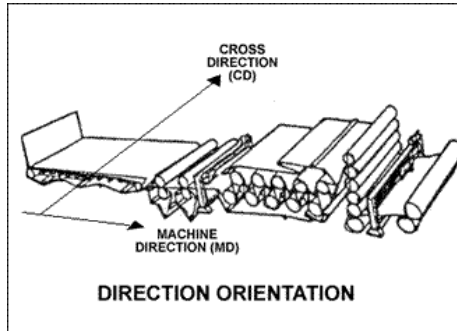
Pulping Process. There are two primary pulping processes: chemical and mechanical. Chemical pulping results in shorter paper fibers than mechanical pulping. As a result, chemical pulping of a given wood type will provide a smoother, higher-quality printing surface than mechanical pulping of the same type of wood. However, the longer fibers produced by the mechanical pulping process are stronger and more durable than fibers from a chemical pulping process, all other factors being held constant.

Wood type. The relative softness or hardness of the wood used in a pulp also affects a paper substrate's printing surface and strength. Softer woods, such as pine, have longer fibers that produce stronger, more durable substrates than those produced from hard wood fibers. However, the shorter fibers from hard woods, such as oak, produce smoother printing surfaces.

Bleaching. Bleaching is used to remove color from wood pulp. As a result, bleached fiber provides a clean, white appearance throughout the sheet for high quality printing. However, the bleaching process degrades and weakens wood fibers, having some effect on the strength of a substrate. The bleaching process also adds cost to the production of a paper substrate.



Caliper and grain direction. The thickness, or caliper, of paperboard is measured in thousandths of an inch, commonly referred to as "points." Most paperboard is between 10 points and 40 points. Paperboard also has a "grain direction" and "cross direction." The grain direction is the direction in which paperboard is machined at the mill; the cross direction is 90 degrees to the grain direction.



are what allows it to be converted on folding carton equipment.

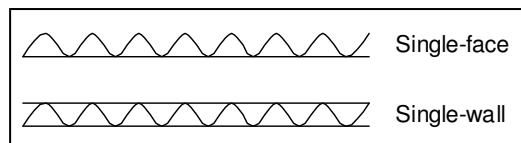
Single-face vs. single-wall construction. Small flute corrugate is generally constructed in one of two ways. In single-face corrugated board, there is a paper liner on only one side of the fluting. In single-wall corrugated board, the fluting is sandwiched between layers of paper liner. Which type of small flute board is used depends on the printing method used by a folding carton manufacturer.

FACTORS INFLUENCING SMALL FLUTE CORRUGATE CHARACTERISTICS

The primary factors that determine the characteristics of small flute corrugated board are the profile, or height, of the flute and whether it is single-face or single-wall board

Flute profile. The flute profile of a corrugated board is designated by letter. A, B, C flutes are found in standard corrugated board, which is widely used in brown shipping boxes. A, B, and C flutes are typically 2.0 to 4.8 millimeters in height. E, F, G, N, and O flute are found in small flute corrugated boards. The profile of these flutes ranges from 0.3 to 1.8 millimeters.

The flute profile greatly influences the strength, stiffness, creasing and folding qualities of a corrugated board. In general, corrugated boards with smaller flute profiles have less vertical compression strength, less stiffness and greater flexibility than boards with larger flute profiles. The greater flexibility and superior creasing and folding qualities of small corrugate (relative to standard corrugate)



In the *litho-laminating* printing method, single-face corrugated board is used as an input. In this method, a folding carton manufacturer prints onto a thin paperboard (10 to 12 points), which is then laminated onto the single-face small flute corrugate. The application of the printed paperboard creates a single-wall corrugated board with printing on one side. This board is converted into the end packaging product.

In the *direct offset* method, a folding carton manufacturer prints directly onto the corrugated substrate. This method requires a single-wall corrugated substrate as an input into the process.

These factors result in a variety of substrate options from which manufacturers and users of folding cartons can choose. We next discuss the different types and uses of the major substrates available for folding cartons.

TYPES AND USES OF SUBSTRATES

There are four main types of substrates used in folding cartons:

- 1) Unbleached Kraft Paperboard
- 2) Bleached Kraft Paperboard
- 3) Recycled Paperboard
- 4) Small flute corrugate

We discuss the characteristics and uses of each below.

Unbleached Kraft Paperboard—often referred to as Solid Unbleached Sulfate—is the most commonly used substrate for folding cartons. It is produced from at least 80% virgin-unbleached wood pulp and is coated with a thin layer of kaolin clay and titanium dioxide to improve color, smoothness and printing receptivity. Unbleached Kraft can also be treated with a moisture barrier for use in liquid and food packaging.

The use of unbleached, usually softwood pulp results in good tear resistance and the greatest stiffness and strength in relation to basis weight of the paperboard substrates. Thus, Unbleached Kraft often allows for the use of a lower caliper paperboard relative to other substrates. It also has cost advantages over bleached virgin paperboard.

Unbleached Kraft is used in many folding carton applications,

especially when strength and durability are paramount. Typical uses are consumer electronics packaging, beverage carriers, dry food packaging, hardware packaging, and packaging for powdered detergents and soaps.

Bleached Kraft—often called solid bleached sulfate (SBS)—is the highest quality and most expensive paperboard substrate. It is produced from bleached virgin wood pulp that is produced with a chemical pulping process. Most Bleached Kraft paperboard grades are clay-coated to enhance the smoothness and receptivity of the printing surface. Like Unbleached Kraft, SBS can be treated with a moisture barrier for use in liquid and food packaging.

Bleached cellulose pulp has high whiteness, brightness and light stability. Thus, Bleached Kraft is white throughout the sheet and is ideal for packaging requiring high impact graphics. The softness and flexibility of bleached virgin pulp provides superior creasing, embossing, and cutting properties with low dust generation, allowing for a wide scope of structural designs. However, the bleaching process also adds cost and reduces stiffness. Bleached Kraft paperboard has the highest purity and provides food products with the best odor taste and taint protection.

SBS is typically used in high-end packaging, where the impact and quality of the printed image are essential. It is also used in food packaging to ensure taste protection. Common uses are health and beauty packaging, pharmaceutical packaging, and frozen foods.

Recycled paperboard is produced from recovered paper collected from paper manufacturing and converting plants and post consumer sources. It represents the single largest market for recovered paper in the United States.

Recycled paperboard is a multiply substrate with six to nine plies. Due to the degradation of fibers during the recycling process, virgin fibers are usually added to increase strength. Nevertheless, recycled substrates generally have lower stiffness per unit weight and inferior printing surfaces to virgin substrates. However, recycled paperboards have cost advantages, which make them an economical alternative for many folding carton applications.

There are four main grades of recycled paperboard:

- Clay Coated News Back (CCNB) is brown or gray, depending on the type of fiber used, and clay coated on one side
- Clay Coated Light Back (CCLB) is light gray with a clay coating on one side
- Clay Coated Kraft Back (CCKB) is brown and clay coated on one side
- Bending Chip (BC) is brown and not coated.

Recycled substrates are used in many folding cartons applications, including hardware packaging, auto parts packaging, overnight envelopes, and partitions.

Small Flute Corrugate is a multiply substrate in which small flute corrugated medium is sandwiched between thin layers of paperboard. The addition of

the corrugated medium increases stiffness and strength but also adds cost to the converting process.

Small flute corrugate is generally used in high-end packaging in which strength and stiffness are essential. It can also be used to provide large windows in packaging while maintaining structural integrity. Typical uses include small appliance packaging, overnight shipping boxes, beverage carriers, club store boxes, sporting goods packaging, and toy packaging.

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