BILLERUD

THE LABEL PAPER QUESTION…

C1S or C2S?

Why should I use C1S label paper for my products? Is C2S paper a viable alternative?

Today, more and more label printers are faced with these questions from their brand owner customers. Paper labels are customarily produced using coated one side (C1S) label paper, yet questions often arise when coated two side (C2S) papers for commercial printing are explored as a label paper alternative. This may be due to a number of reasons, including availability, pricing, or simply questioning the status quo. There are differences between C1S and C2S papers, and these differences can significantly impact the processing and performance of labels in their end-use.

For this discussion, C1S labels are defined as labels that are typically printed in sheet form, cut to size, and applied to containers with an automated labeler using wet or hot-melt adhesives. C1S labels are often referred to as cut-and-stack labels, and have become a major labeling format for many food and beverage products sold today. C2S papers are primarily used for commercial printing of materials such as brochures, magazines and promotional pieces.

PRIMARY DIFFERENCES BETWEEN C1S AND C2S PAPERS FALL INTO THREE CATEGORIES:

Design. C2S papers have print-optimized coating on both sides of the sheet. C1S label papers have a print-optimized coating on one side and a reverse-side treatment that is designed for curl stability and adhesive management.

Functionality. The construction of C2S papers results in inherently different paper properties that can impact productivity and fitness for use in label applications.

Manufactured for Specific End Use. C1S label paper is manufactured as a specialty grade, targeting the label market, while C2S papers are manufactured with different and varying end uses in mind.

DESIGN AND FUNCTIONALITY OF ADHESIVE SIDE OF C1S LABELS

Water resistance is a critical attribute of label paper performance. Proper water resistance ensures predictable and controlled penetration of adhesives. It is often assumed that the glossy reverse side of a C2S paper provides adequate “holdout” to control the penetration of adhesives, but this is not always the case.

To understand why this is important, we have to look at why label papers need predictable and controlled adhesive penetration on the non-printed side. In most commercial labeling applications, adhesive is applied to the reverse side of the label, and then the label is transferred to a container that is typically non-permeable, such as a can, jar or bottle. In the time between the adhesive application and when the label is applied, the label needs to behave in a predictable manner and absorb a limited amount of adhesive to build tack and develop a bond with the label, but not so much absorption that it dries the adhesive and reduces its tack.

Three primary issues can result from the label not properly managing the adhesive:

1. Glue may be absorbed into the label too fast, and the glue will not be available for adhesion of the label to the container, leading to flagging (when the edge of a label lifts off the surface after application).
2. With nothing to limit migration of liquid through the label, the adhesive penetrates, creating staining or cockling (wrinkled, puckered or curled appearance) on the printed side. In extreme cases, it may soften the print-side coating and make labels more prone to scuffing or ink rub-off.
3. If the label does not absorb adhesive quickly enough, then "swimming" can occur, where labels slide due to the adhesive's inability to build enough tack to hold the label firmly in place.

ADHESIVE HOLDOUT

Now that we have established the need to limit absorbance of liquids other than inks into the label, we can look at the relative "holdout" provided by the print-optimized coating of C2S paper and the reverse-side coating of a C1S label paper. To do this, we examine two common measurements—Cobb sizing and contact angle.

COBB SIZING

The Cobb sizing test measures how much water can be absorbed by the reverse side of the label. When this test is performed on both products, the glossy coated side of C2S paper allows twice as much water to be absorbed into the label than the reverse side of a C1S label (Figure 1). The difference is not all due to coating—in fact, most of the difference is due to different fiber treatments in C1S versus C2S papers—but it demonstrates that the glossy coating of C2S paper does not provide much benefit with regard to controlling penetration of water-based liquids.

COBB WATER ABSORPTION

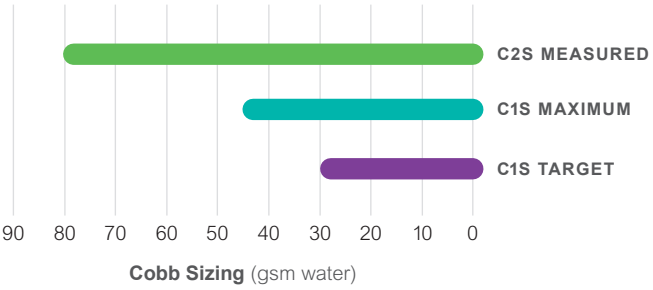


FIGURE 1: Comparison of Cobb water absorbance—C1S vs C2S paper

CONTACT ANGLE

Contact angle can also be measured on the surface exposed to the adhesive to tell more about how the coating surface interacts with adhesive. Figure 2 shows that the reverse side of C1S label paper is less prone to absorbing liquid, while the glossy coating on C2S paper actually is more "spongelike" in its absorption of liquid as soon as it hits the surface.

C2S paper features a fine pore structure within the glossy coating, setting up a capillary network that literally pulls liquid into the paper. On the other hand, the fibers on the backside of C1S label papers have larger pores than the coating, and they are treated with sizing agents that interrupt the capillary network to inhibit absorption, so the capillary forces are much less apparent than in C2S papers. This combination of a coating prone to fast capillary absorption, and a fiber matrix with no resistance to water absorption can result in undesirable results during labeling. While the fiber matrix could be treated to reduce its tendency to absorb water, the reverse-side coating layer in C2S would still provide the fine pore structure that is responsible for faster absorption at the coating surface.

High-speed photography of a water droplet contacting the surface of paper

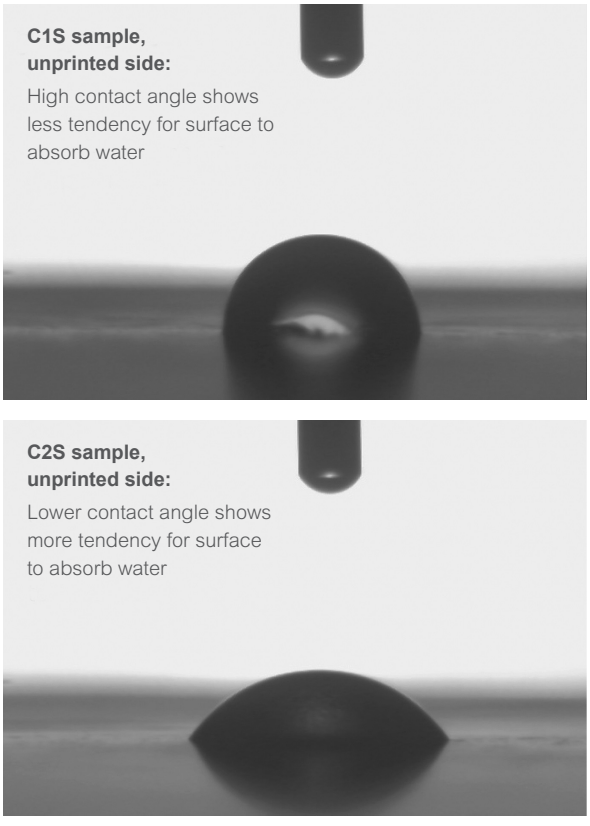
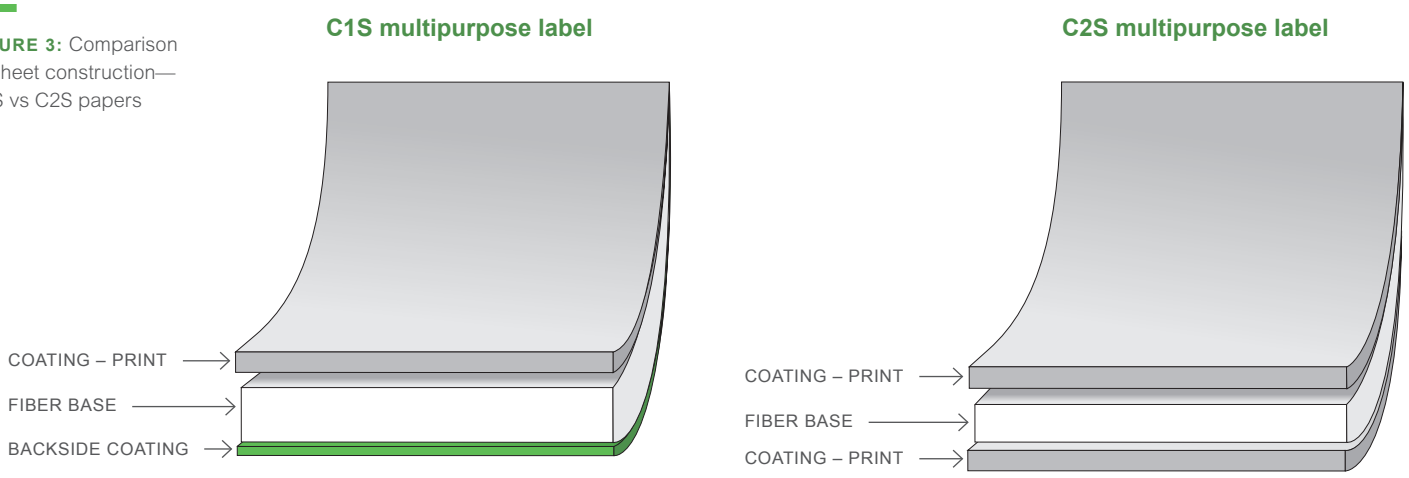


FIGURE 2: Comparison of Contact Angle—C1S vs C2S Paper
Source: Biron Research Center

FIGURE 3: Comparison of sheet construction—C1S vs C2S papers



Both tests were performed using pure water to demonstrate behavior with water-based adhesives. However, these results could not be used to predict behavior of non-aqueous materials such as hot-melt adhesives. From an adhesive management perspective, there may be situations in which a C2S paper may perform acceptably with hot melt adhesive. In these situations, there are a number of other factors to consider and a more in-depth assessment is required.

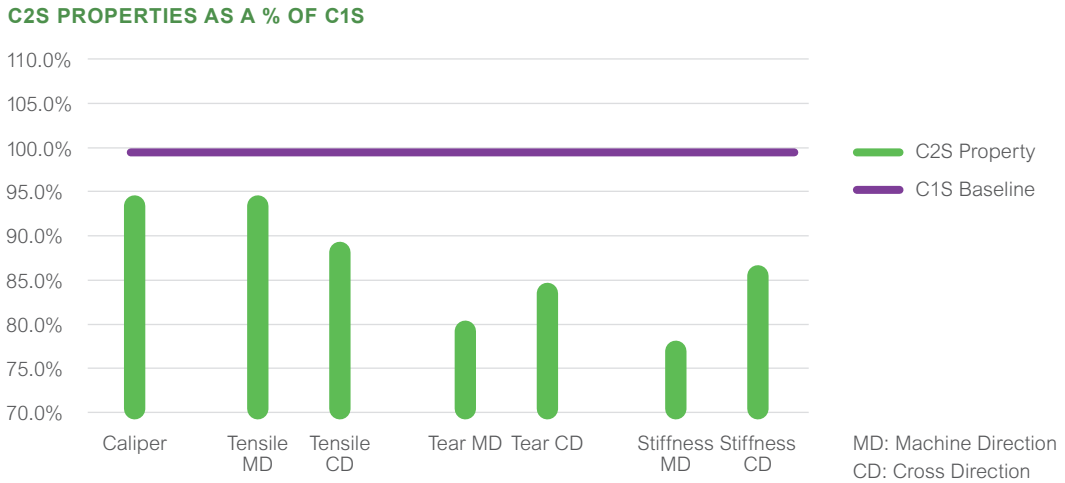
CONSEQUENTIAL DIFFERENCES INHERENT TO C1S AND C2S PAPERS

Fiber or Coating? At equal basis weight, the weight of the coating on the reverse side of C2S paper is replaced with fiber in C1S paper. For typical label papers, there will be 15% – 30% more fiber in a C1S label paper when compared to the same weight C2S paper.

The extra fiber in the C1S label paper contributes strength, caliper, and stiffness that is not provided by the coating layer on the reverse side of C2S papers (Figure 4.) The improved physical properties found in C1S label paper translate into higher productivity on press through higher press speeds, less misfeeds, and easier handling of the paper on both ends of the press.

Asymmetrical Design. C1S label papers have a rougher surface on the back side. Although it would seem that the smooth "slippery" surfaces of C2S papers would provide a lower coefficient of friction and allow sheets or labels to feed more easily, we find that the opposite is true in practice. The rougher reverse side of C1S papers creates a smoothness differential between the print side and the reverse side and that helps separate the labels when they are being fed into a high-speed press or a high-speed labeler. One theory on this behavior is that the smooth surfaces of C2S paper act like two sheets of glass that tend to stick together—because there is no pressure relief, a vacuum forms between them when they are pulled apart; on the other hand, C1S label papers do not make that level of intimate contact, so they are less prone to sheet separation issues during the labeling process.

FIGURE 4: Comparison of physical properties—C1S and C2S paper at equal basis weight





MANUFACTURED FOR SPECIFIC END USE

A final and major factor is that C1S label papers are designed and manufactured specifically for label printing and labeling markets, and great care is taken to focus on that intended end use. From procurement to final inspection, when C1S is being produced, all eyes are on the goal of producing a label that will run consistently at the printer and labeler. To accomplish this, raw material changes are infrequent and qualifications are held to a very high standard, since there is no way to thoroughly test every application and end use for the product.

Consistency and reliability are given priority over cost cutting or evaluating unproven technology.

Inspections during and after manufacturing are held to a high standard, knowing that the label printer and labeler are counting on the labels to run consistently and reliably on high-speed printing and labeling equipment.

In contrast, when C2S paper for commercial printing is being manufactured, the focus is on a different goal—to ensure that the product is suitable for two-side printing and binding into magazines and brochures. The standards set for C2S paper are not necessarily lower, but are more reflective of the intended end-use. There are numerous tiers of C2S papers available, ranging from digital and inkjet papers to sheetfed offset or web offset, at differing levels of brightness, gloss, smoothness, and moisture level. Each variation has unique properties and varying quality expectations, so there is no "typical" C2S printing paper. Also, we are able to thoroughly evaluate and confirm suitability for these end uses, so raw material and equipment changes do occur more frequently in C2S papers in order to compete in these markets.

C1S LABEL PAPER: A CLEAR ADVANTAGE

The advantages associated with increased fiber content and controlled water absorption provide compelling reasons for labels to be produced using C1S label paper; however, the overlooked reality that C1S label papers are produced specifically for the label markets is every bit as essential to consider when choosing a label stock. Just as a good mechanic or an accomplished chef selects the proper tools and materials to satisfy their customers, C1S label paper provides the label manufacturer with the right tools to fully and consistently satisfy their customers' needs.

ABOUT THE AUTHOR

Jim Shultz is a Product Development Engineer for the specialty papers product area. Jim has accumulated a wealth of experience in label papers during his 24 years in research, product development, and product management functions, earning two US and one European patent on C1S paper innovations. In addition, he has extensive experience developing and scaling up inkjet and other emerging technologies on high-speed paper machines. Jim is a graduate of the SUNY College of Environmental Science and Forestry with a BS in paper science engineering, and has an MBA from Frostburg State University.

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