

PAPER BASED RELEASE LINERS

John Theisen
Senior Product Development Engineer
Expera Specialty Solutions
Rhineland, WI

Abstract:

An overview of paper based release liners is provided explaining the differences in product attributes including strengths and weaknesses of each type of liner. A market breakdown showing the relative share of paper versus filmic release structures and general differences between the two are summarized. The sustainability aspects of cellulosic wood fiber based release liners are presented as well as the subtle differences between bleached and unbleached (natural) fiber. Paper based release liners are subcategorized in to machine glazed (MG), machine finished (MF), machine calendered (MC), supercalendered kraft (SCK), glassine, clay coated, and poly coated kraft (PCK). These classifications are discussed in detail in terms of features and end use benefits.

Wikipedia defines a release liner as a paper or plastic based carrier web material, which is coated on one or two sides with a release agent, which provides a release effect against any type of a sticky material such as an adhesive or mastic. Release liners are available in different colors, with or without printing under the low surface energy coating or on the backside of the liner. Another way of describing a release liner is that it is an adhesive delivery system and an integral part of a pressure sensitive tape.

According to Alexander Watson & Associates there were 4,994 million square meters of total release liners used in tapes in 2013. If one assumes a nominal average of 60#/ 3000 ft² basis weight (98gsm) this represents over 500,000 ton of liner substrate per annum. Glassine and calendered kraft comprise the largest share of release liner substrates in pressure sensitive tapes with 38% of the market share. This is followed by polyolefin coated paper at 24%. Polyolefin coated paper is also referred to as poly coated kraft or PCK. Films comprise 21% of the market breakdown. Clay coated papers were 11% and 6% were other papers.

The focus of this topic is on paper based release liners but first I would like to review some of the attributes between film and paper. If one considers the differences, strengths, and weaknesses between film and paper then one should be able to identify what type of substrate is best suited for the intended application from both process ability as well as end use performance requirements.

Films provide a physical barrier and are practically impenetrable to silicone release coatings, moisture, and air. While this can be beneficial for silicone hold out it can also be detrimental for remoisturizing and out gassing. Paper has a surface treatment for hold out and the cellulosic structure can be permeable and breathable.

Films are also very durable when exposed to the environment and are difficult to tear, while one is able to tear paper. For instance it is easier to rip off a piece of paper tape than a film tape.

There are thermal differences between films and paper as well. At elevated temperatures, films have a tendency to stretch under tension and dependent on the chemical structure they can be heat sealable. At warm to moderately hot temperatures paper is relatively heat resistant and responds like an insulator. Granted, paper can burn and hold a flame at lower temperatures than most films. It is also important to note that the strength of paper is primarily derived from hydrogen bonding. Therefore under long exposure to heat paper will dry out and become weak and brittle.

Films also have better hygro stability than paper. Film will not expand or shrink when exposed to water. And films are more transparent than paper unless an opacifier is added to the polymer.

Paper has some unique properties that in general most films do not provide. Paper provides stiffness this is important when a level of rigidity is required for the application. Paper also provides a tactile sensation for the receptors on skin and can provide a differential feel between both sides of the substrate.

A key difference between paper and film is the sustainability aspect of paper. Paper is derived from cellulosic wood fiber. Wood fiber comes from trees and trees are a renewable resource, a natural resource that replaces itself. In contrast most films are derived from petroleum feed stock.

The sustainability of the forest products industry is documented and validated in a variety of ways. Two sustainability methods pertinent to paper based release liners are forest and chain of custody certifications. Forest certification is the process whereby forestland is audited by an independent party and is found to conform to acceptable standards of sustainable forest management and procurement. Chain-of-custody certification is the act of tracking and recording the possession and transfer of fiber from its point of origin in the forest through harvesting, processing, manufacturing, wholesaling, and retailing.

Most people think of paper as a white sheet. But wood is not white. The whiteness comes from chemically bleaching natural fiber. Natural fiber is also referred to as unbleached in our industry. Bleached papers are the dominant liners in the pressure sensitive tape market. Historically, (I believe) that is because at one time they were cleaner and had less foreign objects and debris (FOD). Today, this is a perception. In reality we have not identified a difference in release performance or FOD between bleached and natural fibers, only difference is appearance. For example, a 3.2 Mil Bleached and 3.2 Mil Natural SCK liner produced on the same paper machine, supercalendered on same supercalender, and silicone coated on same five roll coater with same low platinum solventless silicone coating and equal coat weights had equal release and cure. The release for both liners was between 28 – 30 g force. Cure measured by atomic absorption < 1.0% silicone extractables for both liners.

The following photographs qualitatively show there is no difference in FOD between bleached and natural liner. These are photographs of an applicator sponge wipe from a five roll solventless silicone coater. The sponges were in contact with the applicator roll for the same area of liner for each respective photograph.

PHOTO 1

PHOTO 2

So, what if 5000 tons of bleached liner was replaced with 5000 tons of natural liner? According to the Environmental Paper Network, a coalition of over 100 non-profit organizations working toward the sustainable production and consumption of pulp and paper, there would be a significant reduction in wood use, net energy, greenhouse gases, wastewater, and solid waste. A Paper Calculator can be used to quantify these reductions and is publicly available at 444.papercalculator.org.

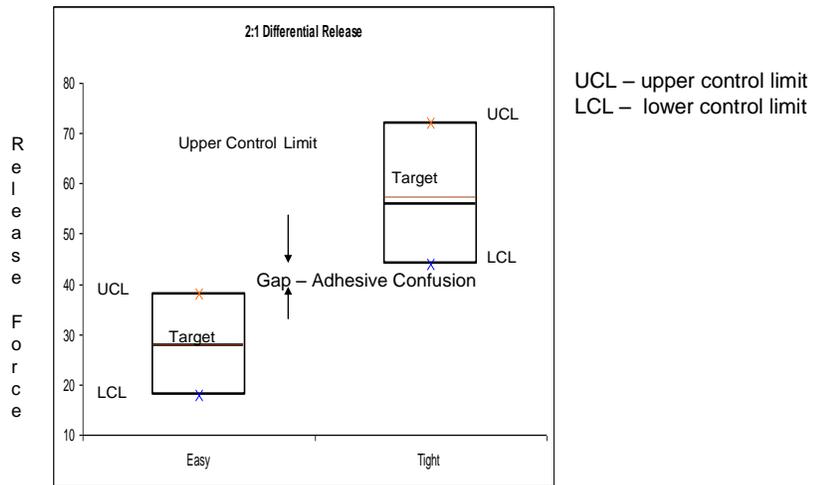
Paper release liners can be bleached white, unbleached natural, or a variety of colors such as Havana, honey, blue etc. Regardless of the color they are subcategorized as glassine and supercalendered kraft (SCK), poly coated paper (PCK), clay coated paper (CCK), and other papers including machine finished (MF), machine glazed (MG), and machine calendered (MC).

Release liners are specialty papers that are highly engineered and highly specified for fitness of use in the intended application. Consequently there are literally hundreds if not thousands of unique grades of paper that fall into these categorizes. Thus there are probably exceptions to the advantages and limitations listed.

Supercalendered kraft (SCK) papers are the primary substrate used in pressure sensitive tapes and are mostly in the 60 to 80#/ 3000 ft² (98 – 130 gsm) basis weight range. These substrates are readily available and provide good strength for tapes. An advantage of SCK is that they provide controlled differential release.

In applications that have a low differential release there is a narrow gap between the lower release control limit of the tight side and the upper release control limit of the easy side (Fig. 1). The silicone release coatings are designed to maintain the differential release and are optimized via the three “C’s” of silicone coating – chemistry, cure, and coverage. However, a consistent robust liner also impacts this interaction to minimize potential adhesive confusion where the adhesive may not release from the intended side of the substrate.

Adhesive Confusion on 2:1 Differential Release Liner



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Fig. 1: Differential Release

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Glassines provide an ideal base for applying silicone release coatings but due to the inherent high density and corresponding low yield the cost is prohibitive in many of the higher basis weight tapes. They can be difficult to handle in converting and winding processes due to dishing and telescoping in roll form when silicone coated two sides. However, with tension control and experience this can be overcome. If smoothness and a clear adhesive look are desired glassines can meet this need.

Polycoated papers (PCK) are very durable and widely used in the construction industry where the tape is exposed to the environment. When a high resistance to tearing is required PCK are the tape of choice. A couple limitations of PCK are they may run slower than paper in some coating operations due to process temperatures and they may impede out gassing in foam sealant applications.

Clay coated papers (CCK) provide good dimensional stability due to being less reactive to moisture and temperature than other papers and as a class provide a good value proposition. However their strength to weight ratio is lower than SCK.

Machine finished, machine glazed, and machine calendered comprise the smallest set of papers in the pressure sensitive tape market. They tend to be lower basis weight and are an inexpensive base substrate. They are used in applications that do not require a great deal of strength like a tab or tag.

Table 2 lists some of the descriptive properties of commercial SCK, glassine, PCK, CCK, and MC liners. Unfortunately, it is not realistic to make direct comparisons against all liner categories at equivalent

basis weight. But the data can be used to identify what type of substrate may be best suited for an intended application. Examples from Table 2 show SCK has high tensile strength. Glassines have high density, high gloss, and low tear. PCK has high bulk. Clay coated kraft has high opacity. Machine calendered liners have lower density/ higher bulk.

Table 2: Descriptive properties of liner categories

Liner Type	units	SCK	Glassine	PCK	CCK	MC
Basis Weight	lbs./ 3000 ft ²	60	37.2	83	76	25
Caliper	Mil	3.5	2.08	5.8	4.5	1.9
Apparent Density	BW/ Caliper Sec./w100 cc	17.1	17.9	14.3	16.9	13.1
Porosity	(oil)	30000	90000		16000	30000
MD Tensile	lbs./in.	54	44	48	53	24
CD Tear	grams	77	33	90	105	27
Smoothness	PPS	2.2	1.8		2.6	
Smoothness	Sheffield	130	70		110	95
Gloss	% at 75 deg.	42	60		40	
Opacity	%	77	51		86	50

Summary

Paper based release liners are the dominant substrate in pressure sensitive tape market. Supercalendered kraft (SCK) liners are robust structures that are ideally suited for many of the demanding tape applications. As the industry continues to strive for sustainable raw materials natural SCK papers will become more prevalent in the tape market.