Emulsion Silicones and Clay Coated Kraft
The building blocks for Specialty Release Papers

Introduction:

Emulsion silicone and clay coated kraft paper is not the typical combination for traditional release liner applications. 100% solids silicone, also known as solventless silicone is usually the silicone system of choice for most applications. Solventless silicone systems offer the formulator a broad range of properties specific to release profiles for adhesive applications. Typically solventless systems cure quickly and provide a stable release platform for the PSA laminate.

Another option for the formulator would be to use a solvent based silicone. Solvent silicones provide some very unique surface and release properties that are difficult to duplicate with other silicone systems. Substrates coated with solvent silicones tend to have a high level of surface slip which assists in maintaining flat profiles of the substrate.

UV cured silicones are also an option for many applications. UV silicones can be beneficial for applications where the laminate is heat sensitive or applications where a typical heat cycle can not be used for curing the silicone.

Emulsion silicones also have a place in the release liner formulator’s toolbox. Traditionally emulsion silicones have been used for on machine applications, where the coating is applied on the paper machine. Emulsion coatings applied on machine tend to both coat the surface of the paper and saturate the paper. These types of products can be used for hygiene applications or for bakery pan liner type of products.

The release liner formulator also has several options available for the choice of substrate. Many high volume applications utilize SCK (super calendared kraft) papers for roll label, tapes or composite type products. For products where a smoother surface, or a more dimensionally stable liner is required, PKC (polycoated kraft) liners are often used. Clay coated kraft papers have also had their traditional place for the release liner formulator. Often times CCK’s are used for applications where a carrier that is heavier and smoother than a SCK base is required. Other areas where CCK is used would be where the economics of the product require a carrier that is lower cost than a traditional PCK.

Emulsion silicones with CCK:

With the varied options available as outlined above, why then would the liner formulator choose to use an emulsion silicone coating with a clay coated kraft to produce a desired release liner? Often times the reason would be that the targeted application requires that the release layer be modified to provide one or both of the following:

1.) A change in a measureable property that can not easily be obtained with traditional silicone/substrate combinations, or
2.) To provide a desired surface that transfers a texture finish and gloss to the applied material.

One example of this would be a product that is often referred to as a “blue liner” used for commercial graphic film applications. The blue liner is a standard 78# clay coated liner, identical in every way to the traditional white or bleached version of the 78# liner. These liners are used for graphic film applications where a colored vinyl film is laminated to the liner and the finished roll is used in cut graphic signage. The value of the blue liner is that it provides a stark contrast to white colored films, making it easier for the technician to weed and separate the cut matrix from the liner. The contrast in color between the blue and the white makes it easier to separate the image.

An emulsion based silicone, being water based, makes it easier to modify the color of the coating. Although this can also be done with other silicones, such as solventless silicones, it is easier in many ways when using an emulsion. The number of water based dye options is greater, and there is less of chance of a negative reaction between the dye and the cure of the silicone coating. This would represent one example where a change in a measurable property, ie color, is required and this change can not easily be obtained with traditional combinations of silicone and paper.

Another example would be casting papers that are used for producing cast PVC films and foams, as well as cast PU foams or films. For casting papers, release of the cast material is important, but also as important is the transfer of the surface gloss and texture to the cast material. Often times the finished surface of the cast material has a targeted gloss and smoothness that is derived primarily from the liner on which it was produced. PVC foams that are used for gasketing applications often require a low gloss surface and a PVC skin layer that is pin hole free to provide optimum sealing properties for the gasket. To achieve this combination of properties, the formulator often uses a combination of a modified silicone coating, working in tandem with the clay coated base to achieve the desired effect. Emulsion silicones make it easier to modify the release layer with other water based additives. Likewise a clay coated kraft base provides the optimum surface on which to build the final product.

Building the liner:

Having established that the combination of emulsion silicones applied to a clay coated kraft can provide some unique features and properties, we can now look at how these products are assembled from the papermaking and coating standpoint. The “general” definition of a clay coated kraft product is a paper that is produced by the kraft pulping process, manufactured on a fine paper machine, and coated with clay either on the papermachine or on an off machine clay coater.

A fine paper machine is a machine that utilizes moderate refining of the fibers and produces a finished web by the fourdrinier process. By contrast and SCK type papermachine highly refines the fibers. This results in very slowly drainage of the water from the web and requires an elongated wet end of the papermachine to accommodate the process. An SCK type paper inherently has less porosity than a fine paper due to the heavy refining of the fibers. Diagram 1 below illustrates the difference between the two types of processes. The fine paper has more voids, or valleys between the individual fibers. The SCK paper shows greater overlap of the fibers with fewer void areas.
Diagram 1.

In order to achieve the final properties required for the release liner application, a primer coat or “groundcoat” must be applied to the fine paper to help minimize the voids in the surface of the fiber mat, and to provide a smoother overall surface on which the release layer can be applied. A by-product of filling in these void areas, is that the overall porosity of the paper decreases, allowing for better holdout of the applied clay coating, and the subsequent release coating.

A typical clay coating consists of the following components. Clay, which is the primary component can comprise up to 75-85% of the coating depending on the desired properties. Typically there are two types of clay used for release liners, differentiated by particle shape. Round clays, in the shape of little rocks help to fill in the void areas around the paper fibers. Flat clays are also useful in improving the smoothness and density of the paper. Most times a combination of the two types of clays are used.

A second component in the coating would be a binder. A binder can be either natural, like starch, or a synthetic material like styrene-butadiene. The function of the binder is to “bind” the clay to the paper fiber, and also help fill in the void areas. This further reduces porosity and improves the smoothness of the paper. Typical binder levels in a coating would range from 10-30%.

Finally, there are often other minor additives in a clay coating. These include thickeners, flow modifiers, pH control additives and others. The function of these additives is primarily to improve the coating properties of the clay coating to allow it to be applied in an effective manner on the equipment.

Diagram 2 below shows the difference between a non coated fine paper, and the same paper with an application of clay. Typical application rates would be roughly between 5 -15# of dry coating, per ream of paper. The ream size for most liners is 3000 square feet.
Diagram 2.

The top two photos show the uncoated fine paper. The bottom two photos illustrate the difference in the surface after an application of 5-15#/ream of clay coating. The clay coating fills in the void areas and improves the smoothness of the surface of the paper.

After the primer coat, the top layer or release coating can be applied. A typical application rate of the release layer would be between 0.5 and 3.0#/ream, depending upon the composition of the coating and the required surface properties of the finished paper. In addition to providing release characteristics to the coated paper, the release coating also defines the functional surface of the liner. This is critical in many casting paper applications. The surface provides the transferred image and
texture to the cast material. In many ways the release layer builds on the surface properties provided by the clay layer to produce the desired finished product.

Diagram 3 below shows the transformation of a casting paper from fine paper, through the primer coating phase, to the finished product. In each step the surface is modified and transformed to produce the desired and targeted gloss and texture.

Diagram 3.
The change in surface can be clearly seen in the above SEM (scanning electron microscopy) photographs. The change in properties can also be measured through typical testing methods. Table 1 below outlines the change in gloss and surface smoothness that occurs with the application of the clay coating and release coating layer. Surface smoothness is measured by Parker Print Surf or PPS. The device measures the rate of air flow over the surface of the paper where the lower the number, the smoother the surface of the paper. Gloss is measured by angle of reflected light. In this case the higher number indicates a higher gloss product. The data below is for the 78# Blue liner.

Table 1.

<table>
<thead>
<tr>
<th>Sample</th>
<th>PPS Smoothness</th>
<th>Gloss</th>
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<tbody>
<tr>
<td>Fine paper Rawstock</td>
<td>6.62</td>
<td>7.4</td>
</tr>
<tr>
<td>Clay Coated Base</td>
<td>2.41</td>
<td>38.4</td>
</tr>
<tr>
<td>Release coated product</td>
<td>1.08</td>
<td>73.5</td>
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</tbody>
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Summary:

To summarize, in the release coating marketplace, the combination of CCK base paper with an emulsion silicone release layer is not often considered when thinking of traditional release liner applications. However, if you need to customize the surface, or impart a desired transfer gloss or texture on a cast product, then this combination allows for a wide variety of finishes. Clay coated kraft paper allows the paper manufacture to build a surface structure by designing the appropriate clay coating. Emulsion silicones allow for further customization because of their compatibility with a variety of water based additives. The combination offers a wide range of unique surface properties and textures for a number of specialty release applications.