For Success in Reducing Core Thickness, Adhesive Choice Plays a Critical Role.
The ongoing movement toward thinner disposable hygiene products means producers must take a completely different approach to core design. As core fluff is decreased or eliminated, the role of the adhesive becomes increasingly essential to core integrity; and selection of the right adhesive is paramount to achieving desired performance.

SMART SOLUTIONS FOR THE DISPOSABLE HYGIENE PRODUCTS INDUSTRY
EXECUTIVE OVERVIEW

In mature markets, diapers and feminine disposable hygiene products have reached the market saturation level. Since consumers in these markets expect reliable absorption and no leakage from their disposable hygiene products, their purchase decisions are now based on other differentiating factors, like scent and softness, as well as thickness. Thinner products, with less bulk, waste and store shelf space requirements, carry a great deal of appeal for consumers and retailers. But, as the demand grows for thinner diapers and pads with less pulp, maintaining the integrity of the absorbent core while reducing fluff percentage becomes more challenging.

As fluff pulp is reduced, the task of holding the wet core in place rests largely with the adhesive. But the same adhesive choice, amount and application used when the superabsorbent polymer (SAP) and fluff ratio is 50/50 will not perform as effectively when the SAP/fluff ratio is changed to 70/30 or even a more disparate ratio.

In fact, there is no single, global product for all core designs and performance measures. Nor is this even possible given the ever-changing myriad of design variations, substrates and test parameters. That’s why a holistic approach – one that takes into consideration all of the issues involved in a product’s make-up or system – is necessary to create an adhesive solution based on the final core design that will optimize core integrity performance.

The purpose of this paper is to share our insights about the trend toward reduced core thickness and how adhesive choice effects success.

HIGHLIGHTS

Supported by the thought leadership of Bostik’s Global Nonwoven Business Unit, this white paper offers ideas for best practices in reducing core thickness while preserving core integrity. Insights include:

1. As core fluff is reduced, the role of every component – but particularly the role of the adhesive – changes. For core integrity performance, the adhesive selection is dependent on final core design.

2. How? Take a holistic approach, including expert adhesive selection based on design and performance requirements, and confirmed with proven test methods.

3. The key challenges? Numerous, but solutions are becoming available.

4. Many cores on the market today contain about half fluff and half SAP. Reducing the amount of fluff to 30% or 40% will make a noticeably thinner product. With the current core-forming systems in use today, it’s possible that a ratio of 70% SAP to 30% fluff can be reached. Machine suppliers are also offering new systems that achieve an 80% SAP to 20% fluff ratio. But, an SAP ratio of more than 80% cannot be achieved with the technology that is currently available to the broader market. Increasing the SAP ratio above that 80% mark requires overcoming that technology gap – the same gap that currently inhibiting the creation of entirely fluff free cores.

The Challenges of “Thin”

WHAT IS THIN?

In many of the disposable hygiene industry, the goal is to produce a thinner diaper that looks like underwear. To achieve this, the disposable product requires a non-bulky, or thin core. To some, “thin core” means reduced core fluff. To others, “thin core” equates to fluff free.

When the amount of fluff is reduced in the core, SAP is increased. It’s important to note that a key function of fluff is to keep the SAP in place. So, removing fluff minimizes the ability to control SAP positioning in the core and to control SAP gel blocking, basically changing the entire absorbent system of a diaper. It also may change the overall shape and dimensions of the diaper, which will impact fit. When changing the core, alterations in the stretch engine or elastic leg (both key adhesively bonded applications) may be required.

THE CORE AS A SYSTEM.

The core of a diaper is a dynamic, complex composite of many individual components that must work together as a system in order to function properly. As you can see from this graphic of a diaper core, each component has specific tasks to fulfill in order for the core to enable the diaper to achieve its main goal: keep the wearer feeling dry and comfortable.

As with any dynamic system, when one component is altered, it can impact the performance of each of the other components. For optimal overall performance, producers and suppliers must look at the core system in a holistic manner. The absorbent core – that blend of SAP and fluff in the middle of the diaper – is only one aspect of what performs the absorption function in the diaper.

To achieve thinner cores, a producer is likely to think first of changing the ratio of SAP and fluff (reducing fluff). With a holistic approach, the next step is to assess how that change will affect all the other components that contribute to the absorption distribution layer: the core wrap, Acquisition Distribution Layer (ADL), topsheet material, adhesives, etc.

FLUFF VS. SAP

<table>
<thead>
<tr>
<th>FLUFF vs. SAP</th>
<th>SAP:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composed of cellulose from trees</td>
<td>Petroleum-derived polymer</td>
</tr>
<tr>
<td>Quickly absorbs by capillary action</td>
<td>Slowly absorbs via ion attraction</td>
</tr>
<tr>
<td>Absorption capacity: Some absorption capacity</td>
<td>Absorption capacity: High absorption capacity</td>
</tr>
<tr>
<td>Releases liquid immediately upon pressure</td>
<td>Retains liquids under pressure</td>
</tr>
<tr>
<td>Variable fiber lengths</td>
<td>Variable cross link densities</td>
</tr>
<tr>
<td>Various chemical treatments</td>
<td>Influences gel modulus/absorptive capacity</td>
</tr>
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Both materials are hygroscopic and often supplied with a moisture content specification. The actual moisture content at the time of conversion is strongly influenced by the environment in which these two components are stored.
ADAPTABILITY IS A KEY FUNCTION.

While suppliers of layer materials, films and nonwovens for backsheets and topsheets are making strides in adapting their products to meet the demand for thinner cores and diapers, adhesives are also undergoing innovative changes that enable disposable hygiene product producers to more effectively use these emerging material innovations.

Adhesives may perform a number of functions in the core area, as shown in the graphic below. If a core wrap is used, adhesives can be added to seal the wrap and prevent SAP migration. They can also be used to bond the layers of the core: ADL to core; core to backsheets. The extent of adhesive use also depends on geographical location. Typically in North America, a construction adhesive is used for all bonding within a diaper or pad. Elsewhere — in Latin America and Asia, in particular — a separate core adhesive is more commonly used. It’s also typical in these regions to have a “simpler core structure” and no core wrap, probably not even an ADL. In that case, manufacturers expect adhesives to play an even larger role.

While some adhesives may not contribute directly to core or absorption — such as wetness indicators and elastic attachment adhesives — they do impact and contribute to the entire system. The system cannot work well, with good fit and liquid containment, without the reliable performance of adhesives throughout the product.

MANAGING CORE INTEGRITY.

The level of core integrity is generally gauged by how well the core performs when the SAP fluff pad is wet (see diagram above). But as we take a more holistic approach, we want to move beyond considering that core integrity is important only when the fluff is wet. We also need to learn how the core behaves when the wearer is moving because the core needs to remain in one piece. Cracking and shifting allow leakage. Even if the core cracks or shifts while dry, the SAP powder may gather in one region instead of spreading evenly within the crotch section, so it won’t be able to perform properly when wet.

The trend toward thinner cores places even more emphasis on the importance of the way the SAP and fluff are wrapped. As part of a holistic approach, it’s important that the pocket wrap is properly designed so that the adhesive thoroughly seals the edges to prevent leakage. Because this is a complicated application for an adhesive, it’s essential that the adhesive is developed and selected for the specific substrates being used, as well as for the level of required performance. There is no one adhesive that will handle the job for every type of substrate and for a performance level ranging from good to excellent.

MANUAL CORE SHAKING TEST METHODS

CORE CRACKING
Quantitative test: analyzes diapers (often using a Hardy Integrity Tester). After insult, the core is dropped until cracking is observed.

TENNIS BALL IN DRYER
Qualitative test: after insult, diaper is placed in a dryer with tennis balls and observed for cracking after 10 minutes.

CORE SHAKING
Qualitative analysis: after insult, diaper is shaken on a machine until cracking is seen. Manual Core Shaking.

VISUAL CHECK FOR SAP/FLUFF REMAINS
Qualitative analysis: after insult, ADL is peeled back to observe retention of SAP/fluff. More retention indicates better wet strength.

WET PEEL
Quantitative test: used to demonstrate effectiveness of adhesive bonds when wet. A tensile tester records average peel after insult of nonwoven laminate and tissue.

AFTER MARKET
Create a complete picture of actual in-use core cracking: Cracking is observed in used diapers received from the market.
TESTING CORE INTEGRITY PERFORMANCE.

There is no single, industry standard lab test method to measure core integrity or the stability of the fluff/SAP distribution within the diaper core. Tests being used today range from employing simple tools to complex equipment and from acquiring quantitative to qualitative results. Most of the market focuses on testing core integrity directly by exerting force on the diaper to observe for core cracking as a measure of how well the core stays in place within the diaper. The force is generally some type of mechanical spinning, shaking or swinging after the diaper is made wet for a specified length of time. While these tests may provide some measure of quantitative data, they don’t reflect the realities of the abuse that the core endures before the insult or in final use. Plus, they often require some sort of cumbersome equipment.

Considering those issues, Bostik’s Nonwoven Global Business Unit created a test method that is comprehensive in terms of performance evaluation and also simple in terms of how it’s implemented in a laboratory environment. The Conditioned Core Cracking Test recognizes the validity of shaking a core to evaluate its integrity, as well as testing when the core is wet. Consideration was given to produce a complex system such as a core. So, they rely on their customers to provide core products for testing. However, to develop its core adhesive solutions, Bostik leased a complete diaper line for a period of time and actually made a core laminate. Then, the Conditioned Core Cracking Test was used to evaluate core integrity. Today, Bostik uses the method to test its customers’ products. Or, producers can easily duplicate the simple design to perform their own core testing.

CONSIDERATIONS FOR ABSORPTION PERFORMANCE.

While core integrity plays a powerful role in absorption performance, good core integrity results don’t automatically equate to good absorption performance, which must also be closely evaluated as part of a holistic approach. To ensure absorption performance, manufacturers must evaluate: Acquisition. How fast liquid can be absorbed under pressure Distribution. How well the entire core is utilized after acquisition Rewet. How effective is the core at keeping wetness away from the skin under pressure Wicking. How far can liquid be transported within the core

A “crack” is a separation in the core. At some point during the second round of drops, the core will separate due to gravity and the weight of the wet fluff, SAP and liquid. With a core crack, a second insult will not be well absorbed. Instead, the liquid will go into the crack that has been created and is likely to leak out of the diaper.

While some adhesive manufacturers have the necessary equipment and labs to produce and test their bonds on actual products, they don’t have the capability or equipment to produce a complex system such as a core. So, they rely on their customers to provide core products for testing. However, to develop its core adhesive solutions, Bostik leased a complete diaper line for a period of time and actually made a core laminate. Then, the Conditioned Core Cracking Test was used to evaluate core integrity. Today, Bostik uses the method to test its customers’ products. Or, producers can easily duplicate the simple design to perform their own core testing.

OVERCOMING CHALLENGES.

While reducing core fluff is a logical approach to achieving a thinner core, we know that each reduction in fluff creates new challenges for production, performance and the adhesive’s role.

Today’s norm, even in developed countries, is often a core structure containing 50% fluff to 50% SAP. With this ratio, the fluff fibers are entangled to create a fairly cohesive pad, keeping the SAP in place and providing a certain level of core integrity. However, some manufacturers may want to improve core integrity. In that case, an adhesive can be used for additional enhancement to final performance. When the 70% SAP to 30% fluff ratio is used, challenges become more complex. The transfer of the core from the drum to the backsheet is easily performed at 50% SAP. But at 70% SAP, a core wrap is needed to prevent the loss of SAP powder due to drum velocity and line speed. Bostik has seen that a core with a 70/30 ratio and no adhesive will fail immediately in its Conditioned Core Cracking Test because the SAP powder begins accumulating at the core bottom as soon as it’s shaken. A core adhesive is key to SAP immobilization — and performance — at this ratio.

Machine manufacturers have tagged the 80% SAP to 20% fluff ratio as a difficult technical step. Research has shown that a core adhesive is required simply to produce the core. Then, to achieve core integrity and reach any performance level, using the right adhesive for the core’s specific design is critical. While there are machine manufacturers offering this ratio as a target with their machines, we haven’t found any disposable hygiene producers who have yet reached this ratio.

Moving to fluff free is an entirely unique situation. With no fluff, there are no fluff fibers to hold the SAP powder together as a layer. An alternate approach is required; and an essential part of that is the adhesive. The decision as to which adhesive begins with an understanding of what the adhesive is required to do. This graph demonstrates how the selected fluff free core design correlates with required performance.
THE STATUS OF FLUFF FREE.

Over the last almost ten years, the topic of fluff free diapers has been at the forefront of the trends and dynamics of the diaper market. Many large diaper manufacturers have described concepts around fluff free cores and have patented intellectual property (IP). These patents are indicative of the main issues (detailed in this paper) with a fluff free core:

- Increased movement of the SAP particles
- Less diffusion of the liquid or less availability of absorbing capacity for multiple insults (gel blocking)

The crowded IP landscape reveals a wide variety of methods aimed at immobilizing SAP. Approaches identified include adhesive bonded designs, alternate bonding method designs, pre-made core (on a roll) absorbent ADLs and many others. Bostik has developed an approach in collaboration with BASF that achieves outstanding results from a SAP and adhesive system for a fluff free prototype core. It addresses the issue of SAP movement and diffusion of fluids by creating discrete pockets of SAP on the core laminate.

While there are only a small number of fluff free designs on the market today, acceleration in the quantity of IPs published suggests that there are more to come.

TOMORROW’S WINS ARE DRIVEN BY TODAY’S COLLABORATION

The next wave of disposable hygiene innovations are likely to be the result of greater collaboration between the producers of baby care, adult care and feminine care products and their suppliers, including adhesive partners. As a producer, you’ll want to establish partnerships with companies that have a broad range of products, expertise in the disposable hygiene industry and a reputation for innovative thinking. Then, share your challenges. Urge partners to collaborate. The best suppliers will be ready with the ideas you need to keep moving forward.

CONCLUSION

As the thin core trend grows and spreads across the global market, it’s critical that producers and suppliers adopt a holistic approach in answering the demand. Key to that is the role that adhesives play. When considering changes to the core, it’s important to select the right adhesive partner who can assist in the holistic evaluation of your goals around core design and provide a variety of adhesive options to meet your needs. In the end, core design and performance expectations determine the adhesive that will generate best results for the entire core system.

ABOUT BOSTIK’S GLOBAL NONWOVENS BUSINESS UNIT

An industry thought leader, Global Nonwovens creates smart, innovative adhesive solutions for the disposable hygiene industry worldwide, including solutions for the most demanding applications of elastic and stretch. It leverages unmatched formulation expertise, testing capabilities and technology to develop smarter adhesives that do more, providing higher performance and more efficient operations for its customers.

ABOUT BOSTIK

Bostik is a leading global adhesive specialist in industrial manufacturing, construction and consumer markets. For more than a century, it has been developing innovative adhesive solutions that are smarter and more adaptive to the forces that shape people’s daily lives. From cradle to grave, from home to office, Bostik’s smart adhesives can be found everywhere. With 2014 sales of €1.6 billion, the company employs 4,800 people and has a presence in more than 50 countries.
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