

# Holding it all together

Adhesive application is just as crucial to making premium nonwovens-based products as the material components, says Mike Fornes of Nordson.

**A**dhesive application is critical to the construction of numerous nonwoven products on the market today – baby diapers, child training and swim pants, adult incontinence products, feminine hygiene pads and shields, bed pads and pet products.

Hot melt adhesive bonding stabilises the numerous components that make up these products.

## Performance

High bond strength isn't everything. For disposable hygiene manufacturing, adhesives are not only used for bonding the components, but are also a key factor in performance, including fit, breathability, retention, absorption and feel.

The absorbency and fluid retention of the core and acquisition layers, for example, can be affected by the adhesive application. Poor use of adhesive on elastic applications can also translate into leakage and redness on a baby's legs. Ultimately, different adhesive application processes provide optimal results within the very specific features of personal hygiene products.

## Process

Product function is one key consideration, but the manufacturing process also has to be considered when determining the best adhesive application.

Adhesive application processes must be consistent with the speed and technology of the line. Regardless of line speed, the technology has to be reliable, with low variability. In elastic application, for example, the selection of the optimal technology can result in savings of hundreds of thousands of dollars, increased manufacturing efficiency and product performance.

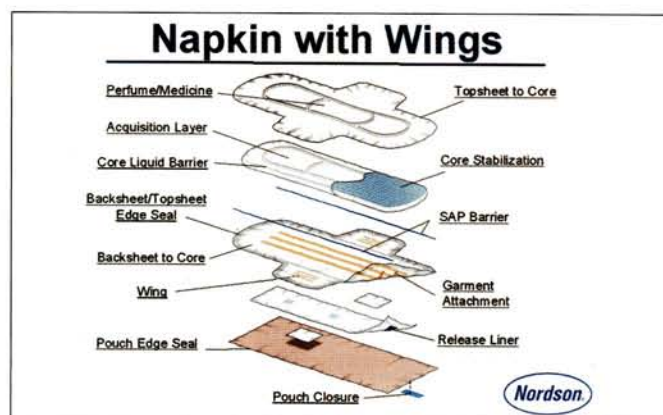
Basically, speed is the key to leveraging economies of scale. Typically, world-class manufacturers produce in excess of 1,000 pieces per minute for feminine care products and diapers, which means that anything in production that leads to waste or a faulty product will have significant negative impact on the bottom line. For that reason, the selection of the adhesive application method that is the most reliable and has the greatest capability for reducing waste and improving efficiency is critical. When first establishing a manufacturing

process, it can be tempting to cut corners by investing less in adhesive application equipment. However, investing in the best possible equipment leads to savings in the long term for a number of reasons:

- **Cost.** Not all adhesive application processes and equipment are the same. Choosing the right process and equipment will ensure product quality. It will also minimise costs. The right equipment and process ensures efficient use of adhesive. In addition, a highly engineered technology is designed to produce to exact specifications. The right process and equipment will also last longer, requiring fewer replacement parts and minimising downtime.
- **Quality.** A well-considered investment in process and equipment means not just high quality manufacturing equipment, but also a quality end product. Adhesive application makes a critical impact on the look, feel and performance of a product, meaning customer satisfaction is tied directly to the adhesive application process and equipment selected.
- **Performance.** To put it simply,



Typical components of a premium diaper



Typical component construction of a premium sanitary napkin



disposable hygiene products retain fluid and solid waste. They must perform that function impeccably while providing the user with comfort and consistent reliability. And all of those performance aspects depend on selecting the right adhesive application process and equipment.

- Manufacturing efficiency. Quality and performance are important, but maximising efficiency and reducing waste are just as critical. The best way to ensure this is by investing in the highest quality equipment.

## Applications

For both diapers and feminine napkins – as key examples of applications – the ideal process and equipment are defined by the following characteristics:

- Bond strength. This refers to the strength of the adhesive bond, or how well the different layers need to be adhered to each other. Lamination bond strength is often tested with a peel strength test and the effectiveness of elastic bonding is measured by an elastic creep test.
- Product breathability and permeability. Breathability is the feature that allows air to pass through the product for comfort, and permeability allows fluid to flow away from the skin. Adhesive application can dramatically affect both these qualities, so it's important to consider carefully how the adhesive is applied between each layer. Proper adhesive application requires the right technology to achieve good bond strength without limiting the product's performance.
- Intermittent capability. An equipment feature that allows adhesive flow to be started and stopped at any time as the web, or substrate, is passing underneath the adhesive applicator.
- A robust operating range. This is the ability to set key parameters, such as air and adhesive flow rate and temperature, during equipment operation. The best equipment has a wide operating range, so that the equipment works without requiring precise control by its operators. Having equipment with a robust operating range means that if operating parameters are adjusted slightly, there is little chance of causing a problem with a product.
- Edge control. How precisely the adhesive application equipment can define the edges of an adhesive pattern. Edge control can also affect the way the final product is perceived in respect of details such as the flaps on feminine napkin wings.
- Pattern uniformity. Creating an even adhesive distribution results in predictable bonds, product performance and cost savings.
- Line speed capability. This is important for maximising production. Adhesive application technology must be able to support the maximum line speed for a product. Line speeds can range from under 100 m/min to over 600 /min.
- Both initial capital costs and ongoing costs of ownership are critical consider

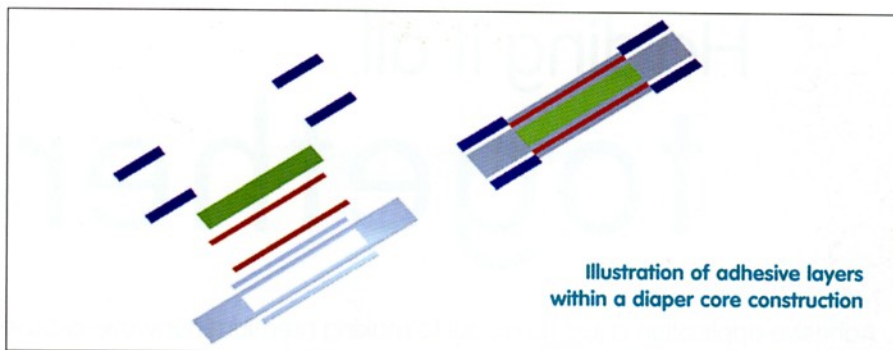


Illustration of adhesive layers within a diaper core construction

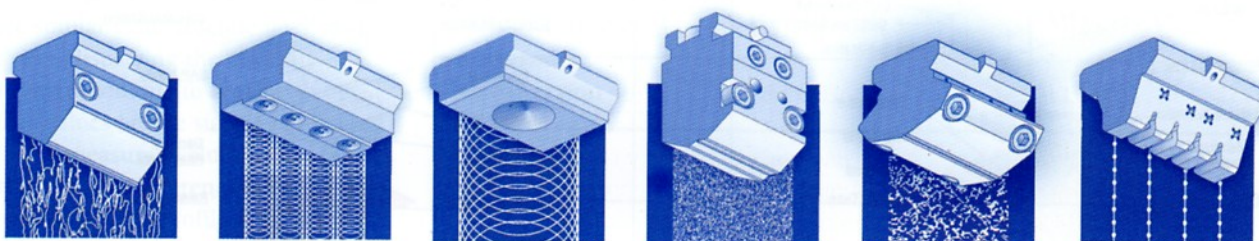
ations when selecting the right adhesive application process and equipment. State-of-the-art machinery, designed to produce the highest quality product possible, requires a higher initial investment, but is built to last longer – costing less to own and operate in the long run. More advanced technologies reduce waste, including process air consumption, which is an often overlooked cost of adhesive application. They also provide less clogging and easier cleaning and maintenance.

## Contact and non-contact

Each application process has its own strengths and limitations. Adhesive application processes fall into one of two categories – contact, in which the nozzle actually touches the web, and non-contact, in which the adhesive is sprayed from the nozzle onto the web, manipulated by process air.

Slot coating is the most prevalent kind of contact application, involving putting down a ribbon of adhesive. The ribbon can vary in width and pattern, such as stripes, depending on the application needs. In slot coating, the adhesive exits the applicator through a thin, wide passageway – the nozzle laying the adhesive directly down on top of the substrate.

Because there is no distance between



Different types of spray nozzles and their patterns



the nozzle and the web, it is easy to ascertain that the adhesive is being applied exactly where it's required. Slot coating also provides excellent edge control and sharp cutoff, creating precise sharp edges for applications such as feminine napkin wings and garment attachment.

Slot coating technology is also extremely resistant to clogging.

### Limitations

But even with all these benefits, it also has a few limitations.

Because the nozzle comes into contact with the substrate, it can melt or distort thermally fragile webs. Direct nozzle-web contact also means that slot coating cannot be used on three dimensional applications. In addition, the nozzle wears over time due to constant contact with the moving web. As a result, slot coating, though still used extensively, is not always a possible option and not always the best solution.

Nordson offers two contact applicators, TrueCoat, a continuous slot coating applicator, and SpeedCoat, a slot coating applicator that allows for intermittent application. SpeedCoat also supports the use of multiple adhesives and patterns by a single applicator.

In manufacturing baby diapers, for example, it's possible to make two or three applications simultaneously with SpeedCoat, reducing overall investment by enabling one applicator to do the job of three. It also reduces costs by minimising the work of the adhesive melting and pumping system that feeds the equipment and by taking up less space on the manufacturing line.

### Patterns

In the picture at the top of the opposite page, four different coloured patterns are shown – all adhesives applied from one SpeedCoat applicator. These are some of the different diaper manufacturing applications, such as elastic, core and waistband that require different adhesives because of each application's unique needs.

Both TrueCoat and SpeedCoat applicators enable ultra high speed capability, allowing for economies of scale. In fact, SpeedCoat delivers the fastest intermittent capability in the industry.



TrueCoat slot applicator



SpeedCoat slot applicator

### Spray applications

The other application option available is one of the many types of spray applications. Because of their ability to distribute adhesive thinly, spray applications offer significant adhesive savings potential. The thin and even distribution from spray applications also creates improved product quality and performance, imparting greater breathability and permeability, as well as a high-quality hand or feel. Non-contact spray application is required for irregular, three-dimensional surfaces and thermally fragile substrates.

With spray application, there are several choices in process and equipment, including large swirl, mini swirl, consistent/random pattern, meltblown, slot-like spray and elastic coating.

### Large swirl

Nordson's CF spray application delivers a single large swirl pattern from each nozzle. Its frequency limit supports production speeds up to 350 m/min but with good reason. Large diameter adhesive spirals can only be spun so fast without losing consistency. However, if the pattern is broken up into smaller swirls, the speed can be increased.

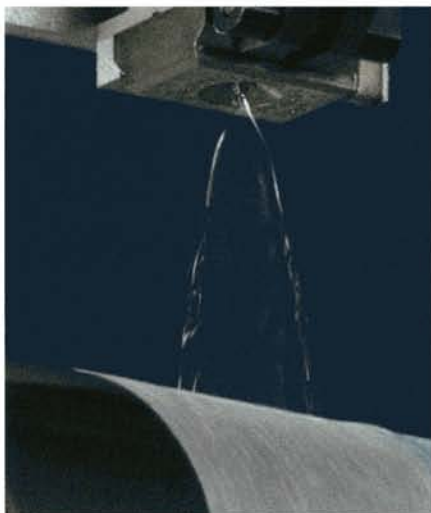
CF's large swirl pattern is most appropriate for layers that have generous edge resolution parameters. Typically, for a wider pattern, another nozzle can simply be added. However, since the CF large swirl nozzle comes only in 22-25 mm, the pattern can only be increased in 22-25 mm increments.

CF represents the lowest initial investment in the spray adhesive category and the resulting bond strengths are some of the best owing to the large adhesive filaments and crossing patterns which result in localised, high-strength bonds. In addition to the speed and pattern width resolution limitations, large swirl patterns are susceptible to pattern overlap or gapping – consecutive rows usually do not touch but as conditions vary, it is possible that the rows might touch or overlap, resulting in heavy and light areas of coverage which can visually detract from the product, or in extreme cases result in bleed or strike through.

At high pressures, some adhesive overspray can occur when applied to elastics. Significant amounts of adhesive are required to cover elastic threads, which can range from one to thirty strands, depending on the product and feature type. In order to adequately cover those elastics with the large swirl pattern's limited edge definition, a wide arc must be sprayed to compensate, which is not the most efficient use of adhesive or the most effective adhesive method for product performance.

For the right task, however, CF can be a good choice. Its strengths include robust operation, with minimal clogging, as well as high strength crossing geometry. Because the large swirl pattern distributes one strand, rather than dividing the same amount of adhesive into several smaller strands, any cross sectional area of a large swirl pattern will have a higher bond strength.





**Universal CF spray nozzles**  
(large swirl patterns)

As a result, the CF application offers the highest peak and average strengths of any spray application.

### Mini swirl

Nordson's Summit mini swirl applicator distributes a small swirling of adhesive. Its frequency limit supports production to speeds up to 400m/min. More precise than large swirl, the mini swirl application, and other types of repeating patterns, are still susceptible to pattern overlap or voids in pattern if not set up properly. Also, with the increased air flow necessary for creating the mini swirl pattern, and because the nozzle holes are smaller, the mini swirl application can be more susceptible to clogging.

Because external contamination and changes in process can yield visual pattern changes, Summit users need to clean the equipment more often. In return, users benefit from better edge definition and more uniform coverage than the large swirl application can deliver. Summit also accommodates a wide range of air pressure and adhesive temperature settings, providing more precise control of the process and a good, consistent pattern.

Its other benefits include high peak and average bond strengths, very good edge definition and more uniform coverage than large swirl. In addition, Summit offers good cutoff for intermittent application; a good line where the adhesive cuts off can be seen. While the lines will never be as precise as slot application, in applications where a



**Universal Summit nozzles**  
(mini swirl patterns)

thinner distribution with better hand is required, Summit can deliver a suitably precise line.

### Random pattern

The Signature spray application is Nordson's latest and most advanced technology. Limited initially to continuous applications, Nordson has since introduced a Signature offering for intermittent applications, so the equipment is available for the full range of application types.

Signature spray is Nordson's prime example of how advanced technology addresses many of the challenges of disposable hygiene product manufacturing. It is highly resistant to clogging and supports advanced production line speeds of 600 m/min or more. At 600 m/min, Signature runs faster than any line currently in existence.

But speed and robust operation are just the beginning. Signature spray's consistently random pattern delivers uniform coverage, and the equipment consumes very little air, for a true cost-saving benefit. Also, the width resolution can be adjusted within 5-6 mm by utilizing partial width coverage nozzles. This results in very good edge definition.

### Finer fibres

Meltblown is a well-known process for making nonwoven substrates, but in an adhesive version can also offer a useful adhesive application method. The meltblown nozzle has three peaks that run the width of the nozzle. The middle is



**Continuous and intermittent Universal Signature spray nozzles**

the adhesive port, with one peak on each side emitting process, or pattern. The clean, dry air interacts with the adhesive strand, stretching it out like small hairs. This creates a web of fine, random fibres that cannot be achieved with other spray applications, which use an angular spray pattern.

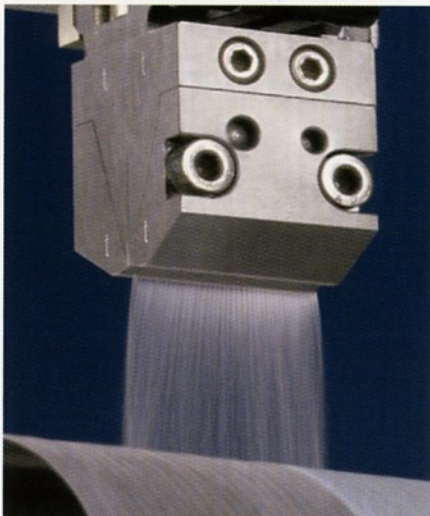
This fine web of adhesive results in lower bond strengths than swirl or consistent/random. The fibres are so fine that they have small cross sectional areas, which means reduced bond strength. The meltblown process also involves higher air consumption and works best when run in continuous operations.

However, the meltblown process also delivers a few key strengths that make it ideal for certain applications. In cases requiring only the slightest bonding with a good hand, for example, meltblown is a viable solution. It is the process used for adhering the layers in bathroom tissue, for example, allowing manufacturers to make multi-ply products that are soft and gentle for the user. Meltblown also delivers a high production speed capability of 600 m/min or greater.

Situations that call for the meltblown process are:

- Where lower strength bonding is acceptable.
- Where strike/bleed through is a problem, if, for example, an adhesive pattern with a larger cross sectional would show or be felt through the substrate.
- When the substrate is thermally fragile and therefore easily distorted.

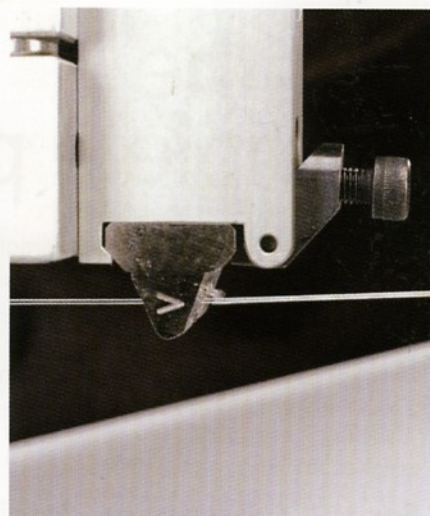




**Universal Control Coat  
slot spray nozzles**



**Multi-strand elastic coating  
using large swirl CF spray nozzle**



**Individual strand elastic coating using  
SureWrap nozzles**

### Slot Spray/Control Coat

Nordson's Control Coat Slot Spray application is similar to a slot application but without making contact with the substrate. Instead of having several tiny holes like meltblown, it involves a pair of thin slots that emit air, as well as a slot-like hole for dispensing adhesive. This allows Control Coat to dissipate more air and create a more breathable adhesive layer. As a result, slot spray adhesive application is the standard for baby diaper backsheet constructions.

The slot spray has lower bond strengths than swirl or consistent/random, as well as medium-to-high air consumption, but these limitations are outweighed when a highly breathable layer is required. Control Coat delivers a smaller fibre size, a very uniform pattern and excellent slot-like edge control, with square leading and trailing edges as well as side edges. In addition, it supports high speeds of 600 m/min and both continuous and intermittent applications.

### Multi-strand elastic

Elastic coating is a critical part of the diaper manufacturing process, since elastic features to a large extent define the fit of the product.

Too-tight or too-loose elastic can hurt product performance and customer satisfaction. The right adhesive application depends on a product's specific elastic configuration.

Multi-strand elastic coating accommodates all types of elastic configurations, and it is a low-investment, highly robust process with easy setup. However, it can result in a less uniform strand-to-strand coating, leaving the centre strand undercoated. If employed to adhere a diaper's leg elastics, for example, it would spiral over multiple strands, wrapping outer strands, but only coating the middle strands on top and bottom. This situation causes the middle strands to creep or relax and have limited functionality – not a feature of a high quality product. Multi-strand coating also uses more adhesive, and at high pressures there can be some overspray with the process.

### Individual strand elastic

For configurations of six elastic strands per nozzle or less, Nordson's CF spray or Mini Swirl Summit technology can be used, but the Nordson SureWrap nozzle technology is the preferred method for strand configurations that can be accommodated on a 25 mm nozzle – which covers almost all diaper applications. SureWrap offers uniform strand coating over each individual strand of elastic.

This individual strand coating is critical to performance, because unlike the multi-strand process, it allows each strand of elastic to retain the qualities that make it effective in the diaper's performance.

SureWrap is a robust process and allows for highly efficient adhesive use.

In fact, users have achieved savings of up to 70% in production. As mentioned, SureWrap provides excellent creep resistance, creating a high-performance, high-quality product.

Nordson's patented Integral Strand Guiding also simplifies SureWrap setup. The grooved nozzle guides each strand through the adhesive application, so that although the adhesive nozzle never touches the strand, the adhesive hits exactly where it is supposed to every time. Without this, the elastic has to be guided from a point further from the nozzle, which reduces precision.

### Conclusion

When selecting the adhesive application process and equipment for a product, specific feature requirements must be considered carefully in order to manufacture world class products.

With the right adhesive application method and equipment:

- Costs are managed
- Quality is ensured
- Performance is guaranteed
- Manufacturing efficiency is optimised
- Customer satisfaction is achieved
- Profitability is maximised

Nonwovens industry leaders not only select the best possible equipment for their manufacturing lines – but also protect that investment with consistent preventative maintenance, including genuine Nordson replacement parts and proper preventative maintenance schedules.