

Foaming Adhesives for Function and Efficiency

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Introduction

In the world of adhesive dispensing, foaming of single component adhesives has been around for many years and used in many applications. Typically, it is used in sealing of seams, filling of gaps, single use gasketing and bonding of components. However, use of foamed hot melt adhesives in coating and converting has been limited. This has mainly been due to the lack of exposure of the adhesive foaming process in the coating and converting industry and until recently, the capabilities of the foam application equipment. This paper covers the application of mechanically foamed single component adhesives for coating and converting applications.

Foaming 101

Single component foaming changes the material characteristics of dispensable substances by mechanical means. The foaming process uses a mechanical mixer, pressure and precise introduction of an inert gas to form a single solution. The result is an evenly distributed solution of an inert gas and base material. Base materials can include adhesives and other thixotropic dispensable substances. Most readily available, clean, dry inert gasses may be used. The most popular is nitrogen from a standard pressurized tank.

Once the solution leaves the pressurized foaming system and enters regular atmospheric pressure, the gas expands and a closed-cell foam is formed. Depending on the material and gas mixture, the solution can increase up to two to four times in volume as it leaves the applicator. A precision control system oversees and manages the entire process, including the pump speed and flow and pressure of the gas being introduced.



Sample Bead of Closed Cell Foam



Close-Up of Slot Coated Foamed Hot Melt Adhesive

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The density of any given volume of adhesive is reduced by replacing it with the inert gas, so the amount of density reduction depends on the amount of gas added. Consider a solid quarter-inch adhesive bead compared to a quarter-inch foamed adhesive bead. The quarter-inch foamed adhesive is the same size and takes up the volume, but contains 25 to 80 percent less adhesive. You can actually have more air than adhesive.

A typical foam delivery system begins with an unfoamed room temperature or heated base material in pails, drums or pellet/block forms ready for pumping. The material can be moved using a piston pump, gear pump, extruder screw or other typical mechanisms, depending on the process requirements. A 20L pail of based material is shown below.



The material is pumped at low pressure into a patented two-stage gear pump unit designed to force inert gas into solution with the base material. The gear pumps turn at different speeds, creating a negative pressure between the pumps that draws in the inert gas, injected from a tank.

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After the second mixing gear pump, a device monitors foam density and adjusts in real time the flow of the inert gas into the mixing area. With a gas density setpoint of 40 percent, for example, it will add more gas if density drops below 40 percent and reduce the gas if the density goes over that set point.

Following the foam delivery system is the dispensing system, which can include a metering pump to accurately meter the foamed material for line ramp up and ramp down based on web speed, a transport hose and a dispensing applicator. A foam delivery system offers many of the same application possibilities as traditional nonfoaming delivery systems. These include a variety of adhesive spray and contact slot technologies, applying continuous or intermittent patterns.

Nordson's foam delivery systems allow you to create foam materials from many pumpable high-performance adhesives and sealants. Simply choose the material that delivers the best combination of performance and value for your application. Options include both unheated and heated materials, such as:

- Silicones
- Pressure sensitive adhesives (PSAs)
- Polyurethane reactives (PURs)
- Urethanes
- Plastisols
- Ethylene vinyl acetate (EVAs)
- Butyls
- Many other forms of pumpable thixotropic materials

The Benefits of Going with Foam

Cost savings. Recent adhesive raw material cost increases, along with a decrease in the availability of resin have put a significant strain on manufacturers. Foaming allows you to achieve increased function while also using less adhesive, creating significant cost savings.

Storage. Using less adhesive requires less storage space since you'll need less adhesive on-hand.

Greater gap filling. Foaming delivers a unique benefit for irregular surfaces. Since the material expands as it is applied, it can fill in the gaps on an irregular surface like a nonwoven material. A non-foamed adhesive might just lie on the high points of an irregular surface, but a foamed adhesive can flow into the uneven areas of the substrate, which can create a stronger bond.

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More options, more savings. Using a foam delivery system can open up a range of thinner and more heat sensitive substrate possibilities that might not have been viable in your process before.

Because foamed adhesives contain less mass of adhesive within the volume being dispensed, the overall dispensed volume will dissipate heat more quickly. Quicker cooling allows you to use thinner materials, which can reduce your costs for the film or substrate.

Faster-cooling foamed adhesive can also enable the use of more heat sensitive substrates. If you've been interested in using a particular web material, but the potential burnthrough caused by solid adhesive prevented it, a foam delivery system can open up those possibilities. Foaming adhesive also reduces the weight of adhesives and end products, delivering lighter products with a softer hand and drape.

Faster set time. Because foamed adhesive cools more quickly, less chilling is required to cool the adhesive prior to rewinding the web or substrate. In some cases, foamed adhesives' faster set times can even eliminate the need for a chill roll after application.

Sustainability. With up to 80 percent reduction of material, foaming clearly decreases raw material use and the energy used to produce them. Additionally use of inert gas in a mechanical foaming process is a more sustainable solution than chemical multi-component foaming processes, many of which produce VOCs or employ isocyanates.

Adhesive production and processing requires two very limited resources: oil and water. It takes 1 lb. of oil to make 1 lb. of adhesive. So, for every 315 lbs of adhesive saved, 1 barrel of oil and 7,560 gallons of water are conserved. Manufacturers who minimize adhesive usage will not only conserve vital resources, they will also find that their processes are more efficient, more cost-effective and, ultimately, more profitable.

Because many substrates are films made of petroleum, the ability to use a thinner film will save environmental resources as well as costs.

The Ultra FoamMix® foaming system

For non-reactive adhesives, Nordson's patented *Ultra FoamMix® foaming systems* produce foamed material from a variety of flowable sealants, including silicones, PURs (polyurethane reactive) and plastisols at elevated or ambient temperatures. Foam delivery systems can easily be added to both new and existing lines. Selection depends on the way adhesive feeds into the system, your application requirements and preferences. Options include:

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- The Ultra FoamMix cube for traditional or reactive adhesives, such as PURs, or silicones and other materials packaged in drums or pails.



- The Ultra FoamMix tank for PSAs, EVAs or other non-reactive hot melt materials.



- The Ultra FoamMix extruder for polyamides or polyesters, which are ideal for applications where the adhesive needs are very high or melt on demand is the best solution. Unlike a tank system, the extruder has a minimum of material under temperature.



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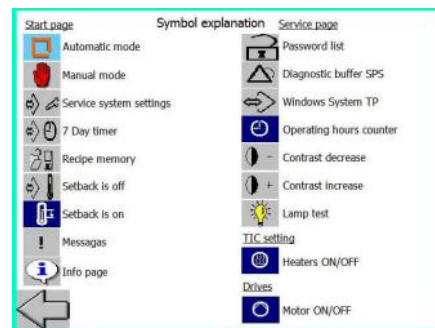
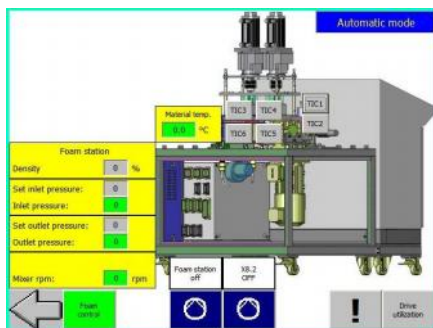
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Nordson's foaming systems improve productivity by automating many operator functions:

- New control design permits customization of most system settings with password protection to minimize unauthorized access.
- Standard seven-day clock with manual override allows automatic start-up and shutdown for each day of the week. Reduced temperature standby mode minimizes adhesive degradation and lowers unit energy consumption during idle periods.
- Programmable temperature alarm bands for each zone monitor and identify potential problems before operation is affected. Other programmable features include over-temperature setpoint, sequential or simultaneous start-up, display of heater proportioning, and Celsius or Fahrenheit display.



Other System Considerations

Bulk Melters. Providing simple installation as well as easy day-to-day operation production flexibility and adhesive integrity protection, Nordson® VersaDrum bulk melters are designed for precise demanding hot melt adhesive application from 200-liter or 55-gallon drums. With a variety of pump types and sizes, VersaDrum melters are customizable to accommodate a wide variety of adhesives and meet specific manufacturing requirements.



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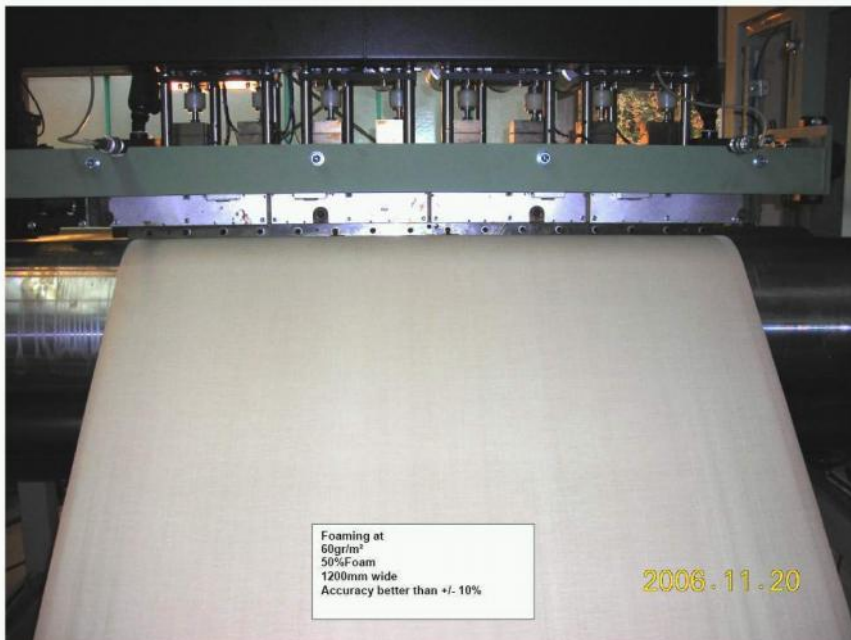
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Metering systems. Nordson's GP200 remote metering stations expand production capabilities by increasing delivery points of existing melters with metered add-on precision. They provide an economical alternative to purchasing an additional melter, converting from non-metered delivery, or adding application points.



Applicators. Typically contact slot applicators would be used for continuous converting applications. For wide web application, Nordson's BC 31 and BC 35 slot applicators deliver continuous precision coating. After a very low volume purge of adhesive resident in the slot nozzle only, the contact slot applicator can provide consistent continuous foam coating. Consider also the varied types of adhesive spray technologies. Shown below, these technologies can provide varying breathable adhesive laminations (not recommended for PUR type adhesives).



Foaming @ 60gsm, 50% Density Reduction, 1200mm wide



Slot Coating of Foamed Adhesive

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The Potential of Foam

The applications for foam delivery systems are virtually endless, but in the coating and converting industry, the technology is relatively new. As knowledge of the technology— and the ease of incorporating the technology— spreads, an ever-growing range of innovative ways to use the benefits of foam will continue to appear. Current applications take advantage of foam's gap-filling feature, including foam tapes and labels for application to rough surfaces and lamination of substrates with rough surfaces.

For more information on Nordson foaming systems, please contact:

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Or learn more about [foaming systems on our website](#): Just [click here](#).