# Optimizing Hot Melt Adhesive Use in Packaging Operations

**Minimizing waste while preserving bond and package integrity**

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Resources once considered endless are becoming both limited and costly. The manufacturing of typical EVA (Ethylene Vinyl Acetate) hot melt adhesives used in packaging, requires petroleum and its byproducts, currently in short supply and high demand. The factors responsible for adhesive availability issues are expected to continue for the long-foreseeable future.

## Changes in the petrochemical industry

While the impact of rising global demand and the cost of oil on EVA production have been evident for more than a decade, the abundance of new, lower-cost natural gas, extracted from shale, is having an equally profound impact on adhesive manufacturers.

Both oil and natural gas are processed in an petrochemical operation called cracking. Petroleum cracking produces greater quantities of heavy byproducts/feedstocks used as tackifiers and waxes in EVA hot melts, polypropylene bottles, inks, and polyethylene films, to name a few.

Natural gas cracking produces fewer heavy feedstocks but, more light feedstocks that are in very profitable and in high demand in a wide range of industries. As a result, petrochemical plants continue to re-tool with the objective of processing/cracking greater amounts of low-cost natural gas.

## Increasing global demand

The demand for feedstocks has never been greater and is expected to continue. High profit-margin consumer products like athletic shoes, vehicle tires, flexible packaging films, plastic bottles, baby diapers and other disposable hygiene products compete with adhesive manufacturers for the same raw materials, driving prices higher. Growing economies in China and India and emerging industries like solar energy, which uses similar polymers in the manufacture of photovoltaic cells, place even greater demand on already tight supply.

## Adjusting to changing times

What can packagers do to mitigate the increasing prices and decreasing availability of hot melt adhesives?

The once-prevalent practice of placing more than enough adhesive on a package—to assure a strong seal or bond—is no longer feasible.

Packagers must determine the exact amount of adhesive needed to produce a secure bond, then follow up by implementing dispensing technologies that will preserve the integrity of their processes and bottom lines.

## Optimizing adhesive use

There is no magic to stretching, getting more mileage or sealing more packages per pound of adhesive. Rather, practical steps and the proper selection and use of dispensing equipment are the keys to success and savings.

## Intermittent, modulated adhesive bead dispensing

Packagers and packaging equipment manufacturers began experimenting with intermittent adhesive bead dispensing over a decade ago with moderate success in a variety of applications.

Pattern controls, which manage the duration of dispensing applicator open and close times, determine adhesive bead length and are commonly employed in automated packaging lines.

These controls can be programmed to replace long, continuous adhesive beads with shorter, intermittent beads in a process that was once referred to as stitching.

The lack of widespread adoption of adhesive stitching throughout the packaging industry is thought to be attributable to:

1. Abundant supplies of low-cost hot melt adhesives
2. Dispensing equipment limitations
3. Lack of data comparing the bond strength of long beads and shorter, intermittent beads

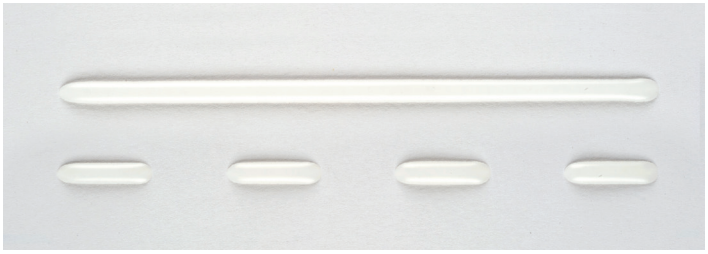
Today however, decreasing adhesive availability coupled with rising prices is driving renewed interest in intermittent dispensing technology.

## Limitations of previous applicator technology

Until recently, typical pneumatic hot melt adhesive dispensing applicator performance looked like this:

- **Service life:** 20 to 50 million cycles depending on adhesive type and application conditions
- **Frequency of adjustment (average):** 1.0 to 1.5 million cycles
- **Speed/cycle rate:** 15 to 20 ms
- **Average dispensing line-speed capability:** 15 meters/minute

Using the photo below as an example, a packager trying to reduce adhesive use, could replace 2 inch (51 mm) long beads with shorter, intermittent beads that will nearly touch when package flaps are compressed.



Instead of a single open/close cycle, the adhesive applicator now cycles 4 times in the same 2-inch distance.

Increasing the number of on/off cycles by 4X for every package previously caused unacceptable levels of applicator module replacement and downtime costs, nearly equal to the adhesive savings.

## Improved dispensing technology enables adhesive savings

To keep pace with advances in parent packaging machinery and industry demands for faster line speeds, greater flexibility, fewer maintenance requirements and less downtime, adhesive dispensing equipment and technology has progressed dramatically.

Today's best pneumatic applicators deliver speed and service life that rival electric applicators, at a fraction of the cost.

- **Service life:** 100+ million cycles depending on adhesive type and application conditions
- **Frequency of adjustment (average):** None
- **Speed/cycle rate:** 2 ms
- **Average dispensing line-speed capability:** 90 meters/minute

The dramatic increase in service life, combined with eliminating the maintenance and downtime formerly associated with dispensing applicators and modules, has made intermittent adhesive bead dispensing both feasible and cost effective.

## Bond strength: The hidden benefits of intermittent dispensing

Seal integrity and adhesive bond strength are characteristics packagers cannot sacrifice, even for the sake of adhesive savings.

Recent testing proves what was once considered folly. That is, less adhesive, when dispensed in short, intermittent beads can equal the bond strength of longer beads that use more adhesive.

Because bonding is strongest at the beginning and end points of each adhesive bead, increasing the number of beginning and end points delivers greater bond strength, despite using less adhesive *(see table/illustrations below).*

Advanced dispensing technology using new adhesive applicators that provide both long life and consistent performance for intermittent bead dispensing is being adopted rapidly by packaging machinery manufacturers, adhesive suppliers and end users alike.

## Additional Savings

In addition to adhesive optimization achieved with intermittent dispensing, packagers will also realize cost savings from:

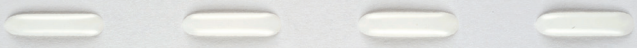
- **The extended service life** of new adhesive dispensing applicators which far outweighs the cost of maintenance, module replacement, inventory costs and downtime typically associated with older style applicators.
- **Insulated, cool-touch dispensing applicators covers** that reduce energy consumption up to 40 percent.
- **Speed/cycle rate capability** over 5 times faster than older applicators allows packagers to achieve higher line speeds and maximize productivity.

### Bond Strength

| Sample | Adhesive Type and Temperature | Bond Strength Solid Bead 1/8 in. dia. / .115g | Bond Strength. Intermittent Bead 1/8 in. dia / 0.08g | Intermittent Bead Bond Strength % vs. Solid Bead Bond Strength | Adhesive Weight Savings |
|---|---|---|---|---|---|
| Box A | 350° metallocene | 8.33 lbf/g | 8.11 lbf/g | 97% | 30% |
| Box B | 250° | 7.69 lbf/g | 7.97 lbf/g | 104% | 26% |
| Box C | 250° | 9.73 lbf/g | 9.96 lbf/g | 102% | 30% |
| **Average** | | **8.58 lbf/g** | 8.68 lbf/g | 101% | 28.6% |

**Solid Bead**

| | |
|---|---|
| Diameter: | 1/8 in. (0.125) |
| Length: | 2 in. long |
| Adhesive volume: | .115 gram adhesive |
| Bond strength: | Average 8.58 lbf (peak load) =100% |



**Intermittent Bead**

| | |
|---|---|
| Diameter: | 1/8 in. (0.125) |
| Length: | 1.4 total in. adhesive over 2 in. area |
| Space between beads: | 0.20 in |
| Adhesive volume: | 0.08 gram adhesive |
| Bond strength: | Average 8.68 lbf (peak load) = 101% |
| **Adhesive reduction:** | **Average 28.6%** |

**Nordson Corporation**
11475 Lakefield Drive
Duluth, GA 30097
(800) 683-2314
www.nordson.com/hotmelt

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