Reducing Cost & Lead Times through Cure Acceleration

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Abstract

Lamination using 2-component polyurethane adhesives is a common process in the flexible converting industry. All such systems, be they solvent-based or solvent-free, require time to cure. Curing is usually done in a large, dedicated heated room. In this paper, we discuss a new technology for accelerating the cure time of such adhesives. This cure accelerating primer is applied off-line to films and inks and therefore does not reduce the pot life of the adhesives. Without the need for a hot room, this technology accelerates the cure rate by up to 5-times.

Introduction

One of the most widely used methods for making multiple-layer flexible laminates is via adhesive lamination with 2-component polyurethane-based laminating adhesives. The variety of both solvent-based and solvent-free laminating adhesives makes this method feasible for many applications. Modern equipment and advances in the adhesives technology have spurred a rapid growth in the number of converters using solvent-free systems. One of the major concerns in choosing this method is the generally long cure times associated with such systems. Depending on the system, cure times can vary from overnight up to 2 weeks. Cure is usually accomplished in a special heated room, adding expense. Additives to accelerate the adhesives' cure can result in unacceptably short pot-life. In this paper, a new technology for cure acceleration will be reviewed. Performance and potential cost-savings are reviewed.

Why Use Cure Acceleration?

Development and testing of this technology have demonstrated the potential to enjoy the following gains through use of this technology:

- **Accelerate quality assurance** – the ability to determine the quality of a lamination within the first few hours after lamination offers the potential for preventing the manufacture of many tons of potential off-spec laminate.
- **Improve laminate quality** – testing has demonstrated the potential to reduce visual defects, improve ink adhesion, reduce wrinkling and prevent telescoping.
- **Reduce inventory –** Reducing inventories is a well-documented means of increasing capital available for operations.
- **Reduce lead times –** Demonstrate you responsiveness and ability to be first to deliver when new quotations are submitted.

What Is Cure Acceleration Technology?

The cure accelerator has the following attributes:

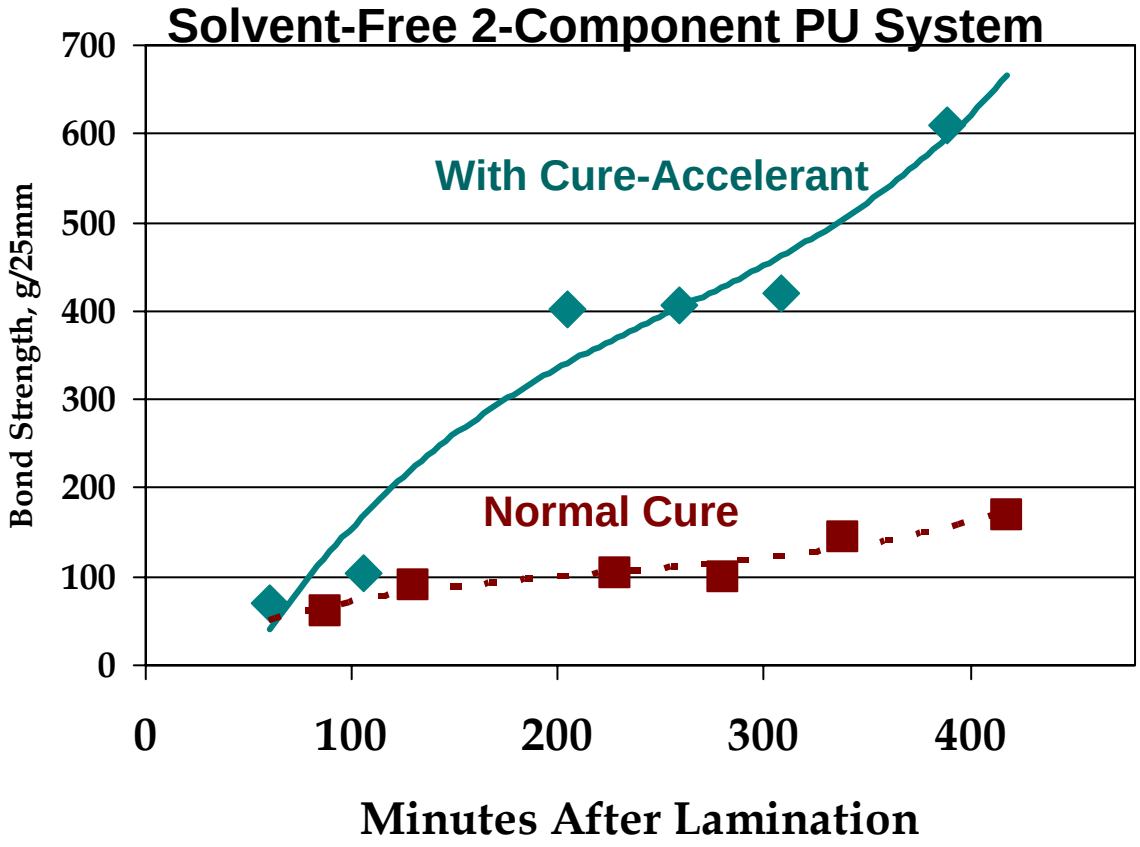
- **Water-based primer coating** – reasonably high solids and alcohol compatible for ease of drying.
- **Clear –** Will not detract from package aesthetics.
- **Excellent adhesive properties –** Bonds well to most ink systems (it has tested successfully on PU-based, vinyl-based, and NC-based inks) and also to most natural corona-treated or chemically treated films.
- **Amazing cure accelerant –** In most studies, cure is ~5X faster than without the accelerator.

How to Use Cure Accelerator

- **Mix 50/50 with water, alcohol, or water/alcohol mixtures**
- **Apply over the last ink on the press**
- **Dry & wind up –** the coating is non-blocking and stable overnight.
- **Laminate as usual –** run on your solvent-based or solvent-free laminator as either the primary or secondary substrate. The accelerant begins to cure the adhesive immediately upon contact.

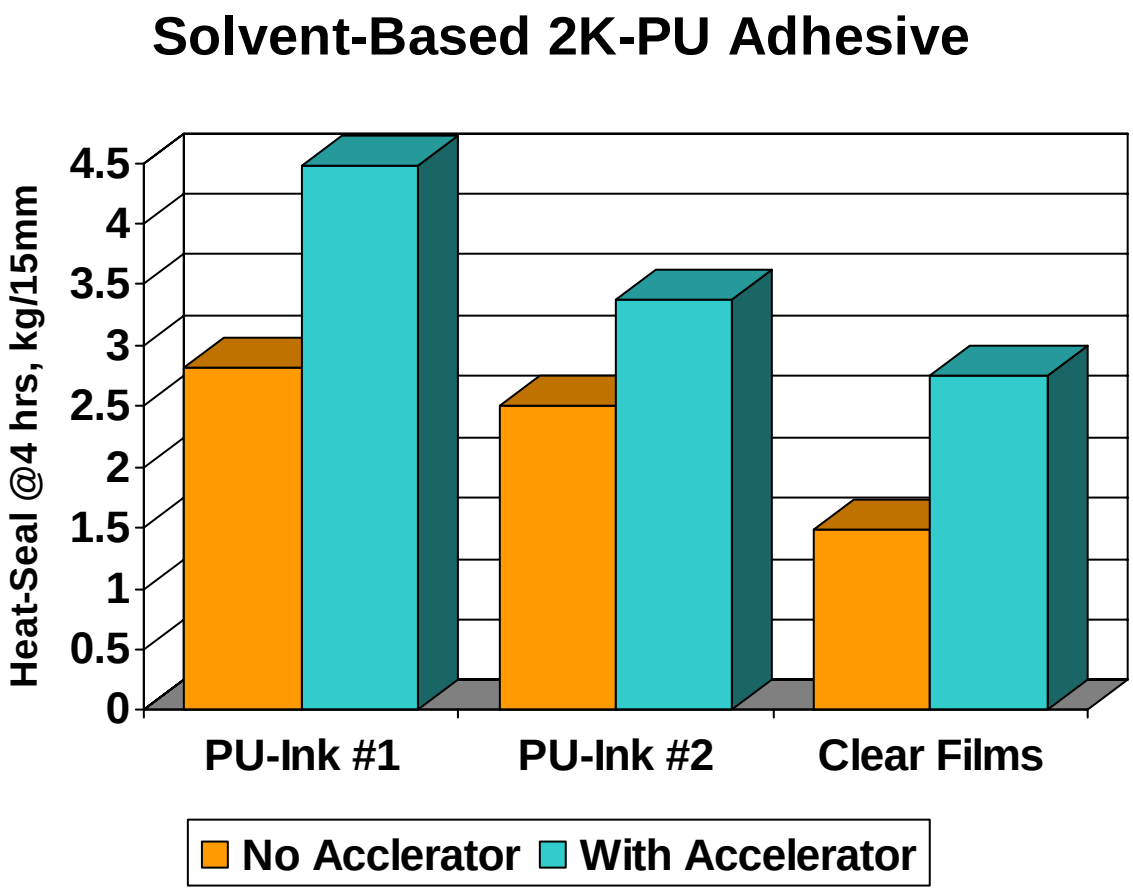
Typical Results – Solvent-Free Laminating Adhesive

This graph illustrates the cure acceleration, measured as a function of laminate bond-strength build-up. Bonds were suitable for slitting in about 2 hours, and fully-cured and safe for shipping in less than 24 hours.



Additional Results – Solvent-Based Laminating Adhesive

This graph demonstrates one of the quality improvements possible with the cure accelerating primer. In this case, ink adhesion & cohesive strength were improved.

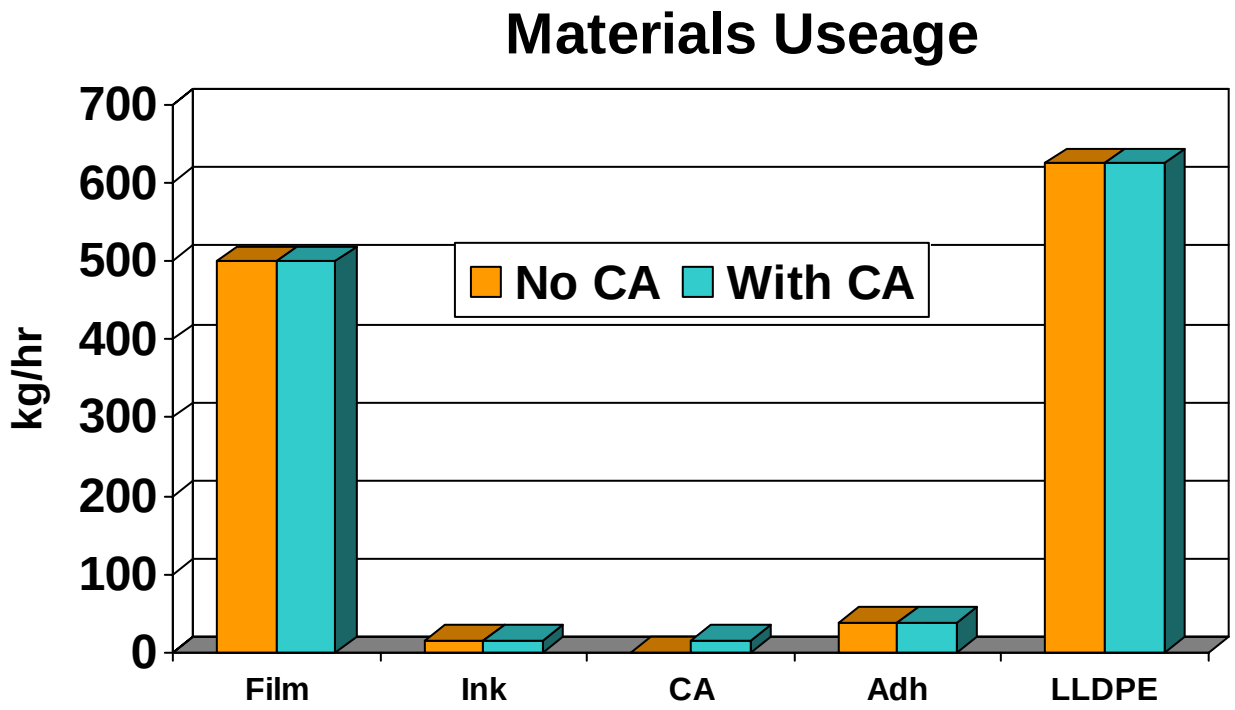


Potential Cost Reduction through Cure Acceleration

Based on the potential for reduced cure time and improved quality, we can now estimate costs savings that might be achieved.

As a basis for estimating cost reduction, assume a single laminator running at the following conditions:

- **Structure –** Assume the following structure:
  OPET / ink / CA (Cure Accelerator) / adhesive / LLDPE film
  23um /1g/m^2 / 1g/m^2 / 2.5g/m^2 / 40g/m^2
- **Width** – 1.3 meters
- **Speed –** 200mpm
- **~1200**-kg/hr raw materials



Adding the cure accelerator to the structure is about equivalent to adding a layer of ink. Using the cure accelerator allows you to detect quality problems many hours faster than normal. Based on Graph 1, the minimum time savings would be about 5 hours. In some cases it could be several days. The amount of ***scrap prevented*** is significant:

- 5 hrs ~ 6 metric tons
- 12 hrs ~ 14 metric tons
- 2-days ~ 58 metric tons

Many converters wait a minimum of 4-5 days before shipping adhesive laminations. Based on this scenario, the potential ***inventory reduction*** is:

- 4 Days ~ 115 metric tons

The associated ***lead-time reduction*** – ship in 1 day versus 1 week – translates in your ability to be responsive and possibly differentiate pricing ("rush-order" pricing?).

Eliminate Hot Room Expense

The expense of operating a hot room varies widely depending on geographical location and size. However, some estimates obtained from various sources indicate a general range:

- Estimates: $300 - $1200 / month

Eliminating this expense can offset a significant portion (~5 to 30%) of the cost of using cure acceleration.

Conclusion

Cure acceleration technology is a new way to improve both quality and your bottom line in adhesive lamination businesses. Data and case studies shared in this paper indicate the following goals are possible:

- Accelerate Quality Assurance
- Improve Quality
- Reduce Inventory & Lead Times
- Eliminate Hot Room Expense

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