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# COILWORLD

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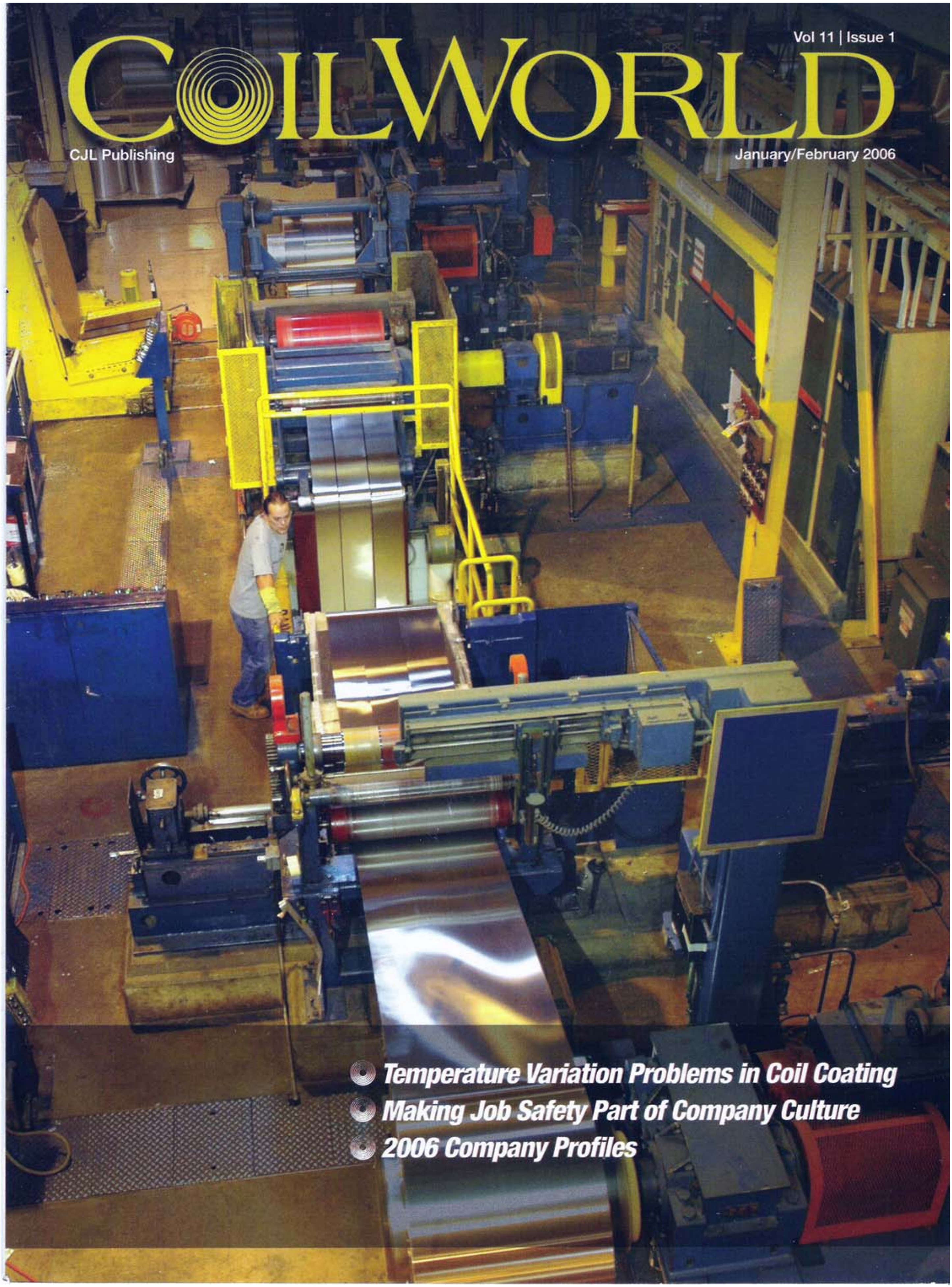

- Temperature Variation Problems in Coil Coating
- Making Job Safety Part of Company Culture
- 2006 Company Profiles

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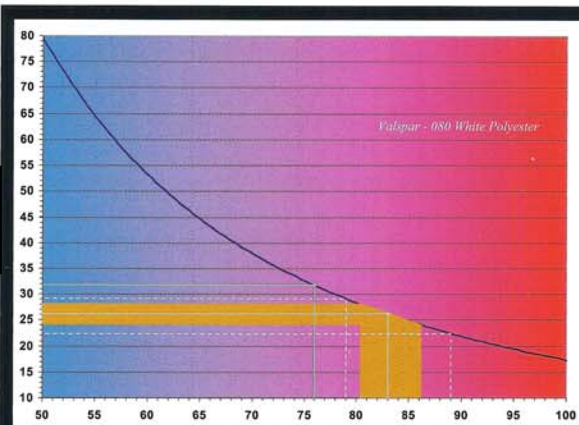
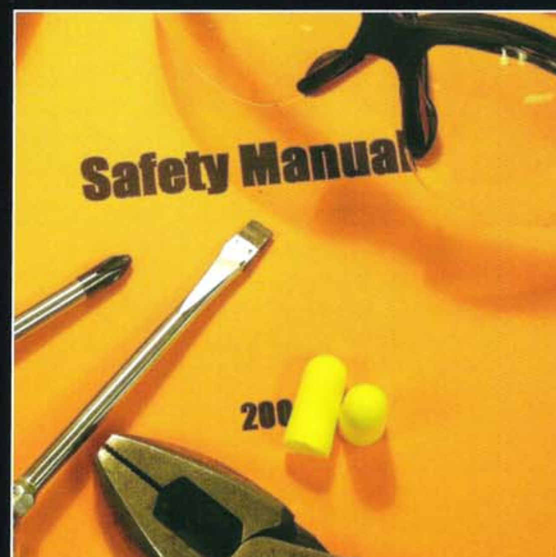



Chart detailing the analysis of Process Effect (see story on page 8)




Safety Manual's are key element's in effective safety programs. (See story , page 27)

***Correction***

*In our Equipment/Materials Suppliers Directory in the Nov/Dec 2005 issue we inadvertently omitted A*D*S Machinery Company and Rotadyne Roller Group. For A*D*S they should have been listed in the following categories: coil cars, coil end joiners, coil handling equipment coil pickling lines, decoilers, heat recovery systems, incinerators, inspection systems, levelers, roller &stretcher, levelers, tension, metal cleaning equipment, oven controls, gas, ovens coil, ovens, paint baking, pickling, push-pull, pollution control systems, pretreatment equipment, recoilers, rewind lines, scrap processing equipment, shearing equipment, straighteners, coil, strapping lines, tension leveling lines, thermal oxidizers, traverse winders, uncoilers and upenders. The Rotadyne Roller Group was omitted under the categories of Rollers, Rubber and Rollers, Urethane.*

Feature

# Using Temperature to Stabilize Coil Coating Processes - Part II:

By: Michael R. Bonner

*Virtually all coaters understand the problems that temperature variations cause in the coating process. In the case of coil coating operations, temperature related viscosity variations can result in significant quality issues with film build, color match, surface finish, etc. The magnitude of these issues cause most coaters to undertake procedures to adjust coating material viscosity in an attempt to control their process. This paper is the final installment in our two part series examining the relationship between temperature, viscosity, and process variations, and many of the associated issues. In Part I we examined the impact of temperature on viscosity measurement and the standard method of adjusting viscosity: adding solvent. In this final installment we look at how process parameters affect coating material temperature and how the implementation of a carefully designed temperature control system can significantly improve quality while reducing operating costs by making temperature a controlled, repeatable process parameter.*

## Using Temperature As A Tool

While the coating material viscosity may be adjusted for a specific temperature at a specific point in time using solvent, the mechanics of the coating system will endeavor to change that temperature (and thereby the viscosity) during processing. This is simple physics and there are no exceptions. The phenomenon is clearly demonstrated in Figure 1, which shows the temperature profile of a coil coating system with no temperature control over an hour's time. Plotted here are ambient temperature, drum temperature, and the temperature at several points across the face of the pick-up roller in the pan. This graph reveals many interesting details about

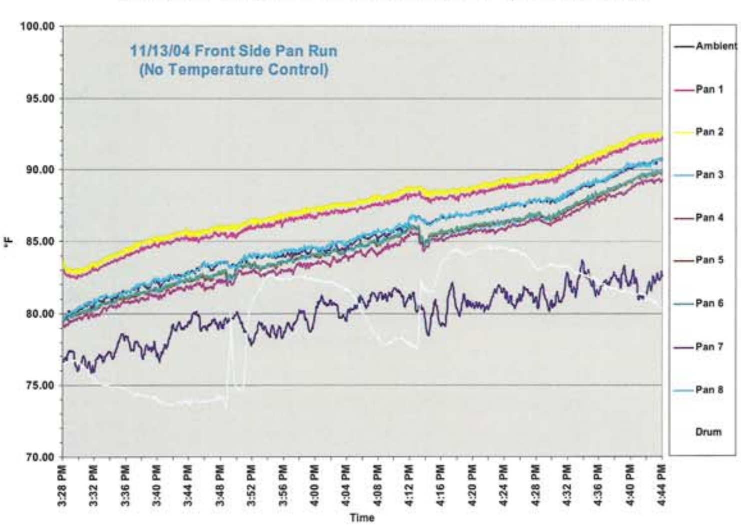



**Figure 1: The Effect of Process Components on Temperature[2]**

the coil coating process. The first point of note is that the process temperature rises 10°F while ambient rises just 5°F over this hour.

This suggests that controlling ambient temperature alone is not sufficient to maintain the temperature of the material being processed. Many factors combine to determine the temperature at any point in the coil coating system at any time. These include:

- Coater Area Ambient Temperature
- Material Storage Temperature
- Volume of Material in Source Container

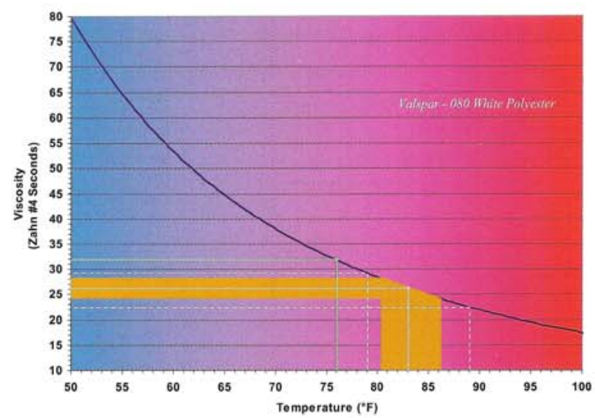



Figure 2: Analysis of Process Effect[1]

- Volume of Material in Coater Pan
- Surface Area of Coater Pan
- Material Flow Rate
- Pump Type / Horsepower
- Roller Drive Motor Horsepower
- Roller Pressure Settings
- Temperature of Strip Presented to Coater

In our previous article, we clearly defined the impact that temperature has on coating material viscosity. Furthermore, remember from our discussion that the total 4s (26s ±2s) processing range translates to a 5°F window from 81°F to 86°F. Even if the material is at the perfect 26s viscosity when the process is started, the factors above combine to move the temperature twice the allowable temperature tolerance in just one hour. This is analyzed directly in Figure 2. The viscosity is set (using solvent) at a drum temperature of 76°F then placed in the process where it is immediately raised to 79°F. At this time, it has changed temperature more than half the total allowable tolerance and, if coating viscosity was actually set originally to 26s, it will now have been driven below the 24s lower control limit. The remaining 10°F move from 79°F to 89°F (dashed lines) will continue to drive the material even further out of specification requiring other adjustments to compensate.

One of the most interesting points raised by Figure 1

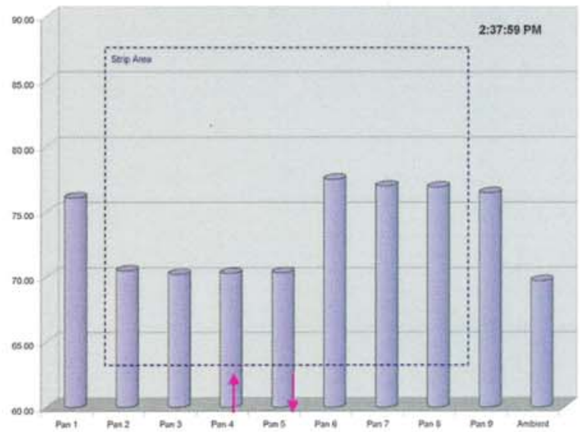



Figure 3: Thermal Profile Variation[3]

relates to drum temperature. Note that the drum temperature varies widely as the emptying drum is refilled from bulk supply. Also note that this has virtually no effect on the temperature of the material at the face of the pickup roller. The other factors influencing process temperature (as listed above) combine to completely swamp out its effect. This dispels the prevailing myth that drum temperature is the dominant factor determining process temperature. In fact, this suggests that drum temperature is only important when making viscosity measurements and solvent based adjustments.

Another interesting note from Figure 1 is that the various points across the face of the pickup roller show a significant variation in temperature. This is depicted more clearly in Figure 3. We refer to this as the "Thermal Profile" of the coating head. What we cannot see from this graph is that this uncorrected profile displays continuous variation. What we can see from this graph is that this variation can exceed 7°F at times. This means that the total temperature tolerance is exceeded by variations across the width of the strip. The result is that portions of the coating across the width will always be outside of the viscosity specification. As shown, this can be a sharp change that cannot be compensated for by simply varying the applicator roller pressure from side to side. To assure adequate film build at all points across the width of the strip under these conditions, it is often necessary to increase the total film build, laying down more material than is actually required in some areas to insure the minimum in others. The varying nature of this uncorrected profile means that operators must continuously monitor the output and attempt to make compensating adjustments to correct for the viscosity changes occurring in the coating material. This has led many to refer to the coil coating process as more art than science. The variations in the thermal profile manifest themselves in myriad processing issues including:

- Film Build Variations Across Web/Strip
- Film Build Variations Between Runs
- Inconsistent Line Setup Parameters
- Increased Coating Material Usage
- Increased Solvent Usage
- Increased Scrap

The goal then must be to reduce variations in viscosity as the coating material is being applied to the strip. Simply stated:

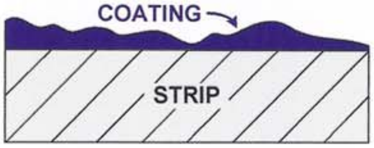
The goal is to stabilize the viscosity of the coating material at the point of use, which is actually the 1/2" thick area directly adjacent to the face of the pick-up roller... identifying and correcting the factors that create viscosity variation at the point of use can be complex and must be treated on a case by case basis. It is clear however, this can only be accomplished through the careful manipulation of temperature.

Figure 4 shows this same system after correction of the thermal profile. Here we see that the total temperature variation across the width of the strip has been reduced to about 1°F. This translates to a total edge-to-edge viscosity variation of about 0.8s or just 20% of the total operating window. Furthermore, this stability is maintained whether operating near ambient or 20°F from it. This is important because ambient variations in excess of 20°F over the course of a day are not uncommon in many coating facilities as morning temperatures in the 60's become afternoon temperatures in the 90's.

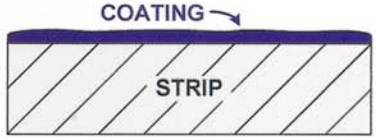
This stability can present yet another opportunity for significant cost savings through the reduction of coating material usage; generally one of the greatest costs in the coil coating operation. In a case where a 1.0 mil film build is being applied to assure the thinnest areas remain above a 0.8 mil minimum, this flattening of the thermal profile and its associated stabilization of viscosity may allow an aggregate reduction to 0.9 mils, or a 10% savings in coating material. In addition to raw material savings, these process improvements will also result in fewer quality control holds and the costs associated with

**continued on page 42**

*To Get From This…*




*To This…*

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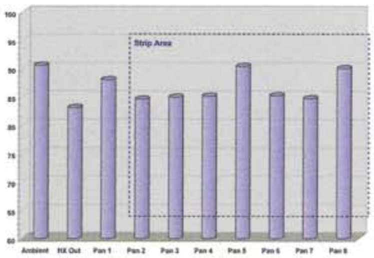
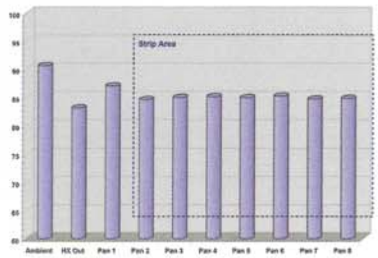



*To This!*




- Shorten Setup Times
- Reduce In-Process Adjustments
- Reduce Rejects
- Reduce Coating Use
- Reduce Solvent Use

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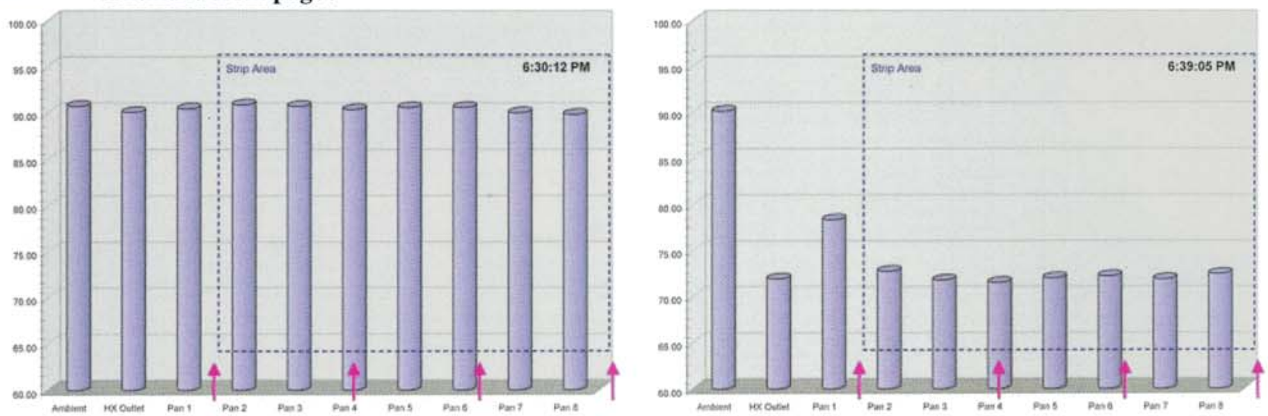


Figure 4: Corrected Thermal Profile[3]

handling, rework, scrap, inventory carrying, and the like. The inherent stability of such a system not only eliminates the need for the operators to make mid-run adjustments, it also reduces variation in line setup parameters. By separating coating material temperature from ambient and other influences, line setups become repeatable whether the process is being set up in January or July. This significantly reduces scrap at startup. In all, scrap reductions in excess of 25% can be realized. For a line consuming $5,000,000 in paint each year and incurring a $500,000 in scrap, these savings can be show to be:

$$\frac{\$5{,}000{,}000}{year} * 10\% = \frac{\$500{,}000}{year}$$

And,

$$\frac{\$500{,}000}{year} * 25\% = \frac{\$125{,}000}{year}$$

For a total reduction in material and scrap costs, realized through these process control improvements, of:

$$\frac{\$500{,}000}{year} + \frac{\$125{,}000}{year} = \frac{\$625{,}000}{year}$$

**So why is this important now?**

As the graphic in Figure 5 shows, at the same time corporations are demanding higher margins to improve shareholder value, global competition allows customers to demand lower prices and longer product warranties. In fact, building products such as siding, gutter and downspout, etc. now are supported by warranties in excess of 10 years; roofing products are out to 30 and 40 years or more. Even car bodies, responsible for giving the Midwest its "Rust Belt" moniker, now virtually all come with a minimum 10 year rust-through warranty protection. Lower prices and higher margins leave less money available to put into the process. Should this downward pressure on processing costs result in manufacturing defects, these defects can result in catastrophic losses before the end of the product warranty cycle.

The importance of controlling temperature cannot be overstated. A carefully designed and implemented temperature control system can result in:

- Repeatable Line Setup Parameters
- Consistent Film Build Across Web/Strip
- Consistent Film Build Between Runs
- Reduced Coating Material Usage
- Reduced Solvent Usage
- Reduced Emissions
- Reduced Scrap
- Increased Throughput

It is clear from this evidence that the impact temperature has on the performance and quality of many manufacturing systems cannot be overstated. It is equally clear that this can have a far-reaching impact on the current and future financial performance of a company. Temperature, then, must be converted from an uncontrolled variable to a powerful tool for use in reducing operating costs and improving product quality.


Figure 5: Market Forces on Coating Processes

**BIBLIOGRAPHY**

*1 – Material Temperature vs. Viscosity data provided courtesy of Alsco Metals Corporation – Roxboro, NC.*
*2 – Process Component Temperature Impact data provided courtesy of Alsco Metal Products – Roxboro, NC.*
*3 – Coil Coating Thermal Profile data provided courtesy of Alsco Metal Products – Ashville, OH, utilizing St. Clair Systems' Profile Analysis and Correction System.*

*Michael R. Bonner is the Vice President of Engineering & Technology for St. Clair Systems, Inc., a leading supplier of process temperature control equipment for industrial processing systems.*