

COILWORLD



Vol 10 | Issue 6

CJL Publishing

November/December 2005

- *Temperature Variation Problems in Coil Coating*
- *Gentek: Specialists in Residential Market*
- *Equipment/Materials Suppliers Directory*

EDITORIAL



As we head into the new year of 2006, I'd like to briefly look back and reflect on some of the developments that have taken place in the history of our vibrant industry from the time in 1938 that Joe Hunter devel-

oped the first continuous strip coating line for producing Venetian blinds and later expanded to include various other applications.

Although efficiency and cost effectiveness remain staples of the marketability of pre-painted metals, some of the regulatory agencies brought new found attention from manufacturers to coil coating as an environmentally friendly process. And to that end, the industry continues to explore new process and technical trends that will continue to highlight the benefits of coil coating that can be realized if they are put into practice.

This issue features the first of a two part series 'Using Temperature to Stabilize Coil Coating Processes' that discusses the problems that temperature variations can cause in the coating process. In the case of coil coating operations, temperature related viscosity variations can result in significant quality issues with color match, surface finish, etc.

Also in this issue we cover a coil coater who has become a specialist in supplying painted aluminum and steel products to the huge residential housing market.

Couple these factors with industry consolidation that seems to be continuing, there is no doubt in our mind that this is a healthy, yet still evolving industry.

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Volume 10 Issue 6, November/December 2005
Copyright 2005
Coil World is published bi-monthly by
CJL Publishing, Inc.
8 High Point
Cedar Grove, NJ 07009

SUBSCRIPTION RATE
One year subscription rate for
U.S. and possessions, \$75.
In Canada and outside U.S. \$175
Payable in U.S. currency.

PRINTING
Johnson Press of America, Inc.
800 North Court Street
Pontiac, IL, 61764
815-844-5161 • fax 815-842-3000

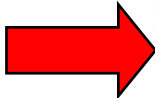
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Pre-Sorted postage paid at Pontiac, IL permit # 592. Philip Colaiacovo, President, Editor, and Publisher. Copyright 2005 by CJL Publishing Inc. All rights reserved. Materials in this publication must not be reproduced in any form without the written permission of the publisher. Applications for a free subscription may be made on the free subscription card in this issue. Paid subscription rates are \$75 per year in the U.S.; \$175 in Canada, Mexico, Europe and the Far East. Single copy price is \$15. Postmaster: Send address changes to Coil World 8 High Point, Cedar Grove, NJ 07009.

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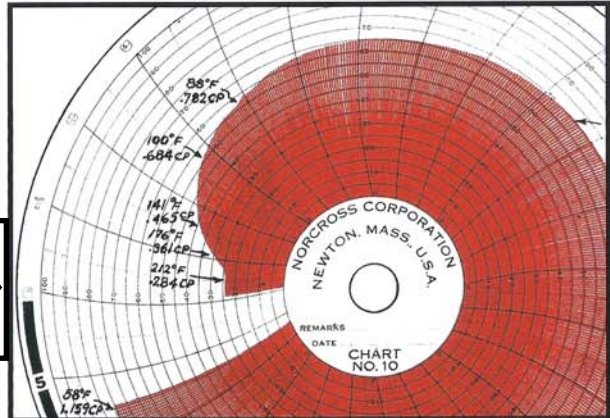
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Full Story Page 8

This graph demonstrates that even water, which goes from a solid to a liquid to a gas with very sharp transitions, goes through a viscosity change of nearly 2:1 between 50° F and 100° F.



Full Story Page 18

A Gentek QC operator checks out a piece of painted metal on a T-bend apparatus.



Full Story Page 10

This depicts the activity at the National Coil Coating Association's Trade Show during the Association's Fall Technical Meeting which drew more that 200 industry professionals.

Using Temperature to Stabilize Coil Coating Processes - Part I:

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 article is the first in a two part series that examines the relationship between temperature, viscosity and process variations, and addresses many of the associated issues, with the goal of establishing how the implementation of a carefully designed temperature control system can significantly improve quality while reducing operating costs. In this initial segment we will look closely at the impact of temperature on viscosity measurement and the standard method of adjusting viscosity: adding solvent.

Issue With Viscosity Measurement

It's been understood for some time that virtually all liquids show some change in viscosity as a function of temperature. Figure 1, taken from an old viscometer data sheet 1, shows that even water, which goes from a solid to a liquid to a gas with very sharp transitions, goes through a viscosity change of nearly 2:1 between 50°F and 100°F.

Coating materials fall into the category of viscous liquids and are no different. Figure 2 shows the temperature-viscosity curve for a common polyester paint used in the coil coating industry. This shows the typical non-linear relationship associated with these materials over the normal ambient temperature range. It is worthwhile to note that this characteristic is shared with virtually all viscous liquids and is a physical material property not a defect. As we will see, this is a parameter that can be exploited to improve process performance.

The optimum coating viscosity for this material (26 ±2 seconds) is plotted on the graph to show its relationship to temperature. The entire acceptable viscosity range relates to a 5°F window from 81°F to 86°F. If the material temperature is outside of this narrow window, the material will be outside of its optimal viscosity range and either the material viscosity must be corrected or other process parameters must be adjusted to compensate. When the

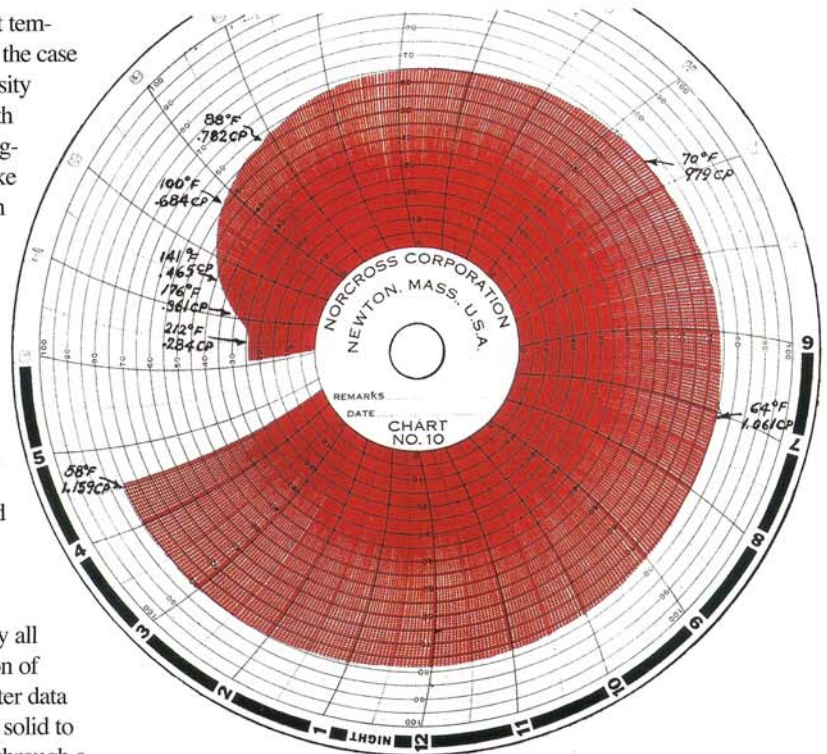


Figure 1: Viscosity vs. Temperature for Water 1

temperature is above 86°F the viscosity will be too low making it difficult to establish proper film builds. When the temperature is below 81°F the viscosity will be too high and can be reduced with a thinner – a common practice. It is here that many of the problems with the coating process begin.

Figure 3 shows the curve from Figure 2 plotted with the raw viscosity data from the coil coating operation at AlSCO Metal Products' Roxboro Facility. This data reflects 394 runs using the Valspar 080 White material over a 19 month period and encompasses all shifts and all operators. The obvious significance of this graph is the wide variation in measured viscosity at each temperature. At 69°F, for example, there are 21 measurements ranging from 20 – 61s. This far exceeds any variation that would be expected from the combination of coating manufacturing and aging. This points to errors in the

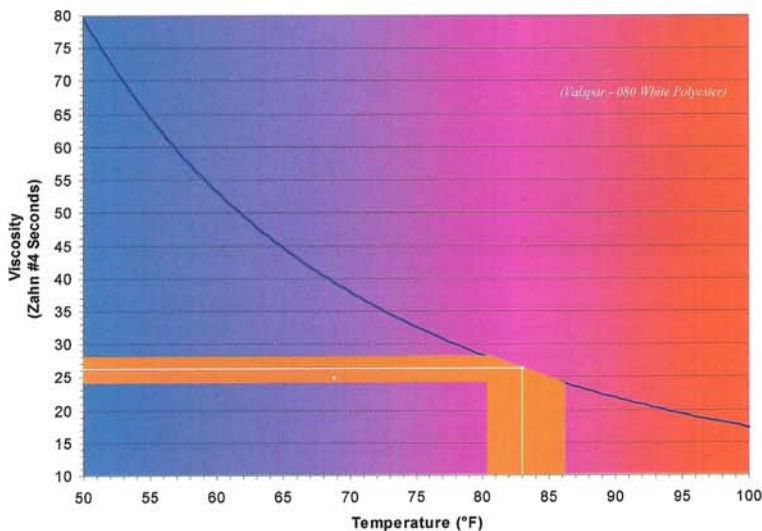


Figure 2: Coating Viscosity vs. Temperature Curve²

Zahn cup measurement process far in excess of the 5% often published by cup manufacturers. We should refrain from attributing this to poorly manufactured measurement tools or lazy or uncaring technicians, however. A statistical analysis of this data presents a much more reasonable root cause. The results of such an analysis are shown in the graph in Figure 4.

For convenience, the temperatures have been grouped into 5°F segments. Here we see that the average and median fit closely to the curve presented in Figures 2 and 3, suggesting that the aggregate of the measurements are reasonably accurate. The issues with the individual measurements are best clarified in the range plot. Note that above 90°F the total range of measurements is just 5s ($\pm 2.5s$), or about $\pm 12.5\%$ of the average measurement for these temperatures. This can be considered a very reasonable result when coating material manufacturing tolerance and age; cup tolerance and condition; and operator start and stop tolerances are combined.

The next plateau on this graph falls between 75°F – 90°F. Here we see total error rising to 19s ($\pm 9.5s$) or about $\pm 38\%$ of the average measurement for these temperatures. This situation grows worse for temperatures below 75°F where the average error rises to greater than 40s ($> \pm 20s$) or about $\pm 45\%$ of the average measurement for these temperatures! Given the large population in each temperature grouping, it is reasonable to infer that the coating material manufacturing tolerances and the effects of age are consistent between groups. This leaves the total increase in error attributable to the measurement process itself.

I would again caution against accusing your technician of negligence. In fact, the root cause lies in the tempera-

ture – viscosity curve itself. As the material gets colder the viscosity increases. The resulting slower flow out of the cup and thicker consistency make it significantly harder to determine an appropriate stop time. In addition, most cup manufacturers will agree that changes in temperature have a significant impact on cup performance. These factors combine to produce wide variations in measurement by even the most diligent and well-trained technician. This is the fundamental reason that viscosity measurements on data sheets are given at a specific temperature [usually 25°C (77°F)].

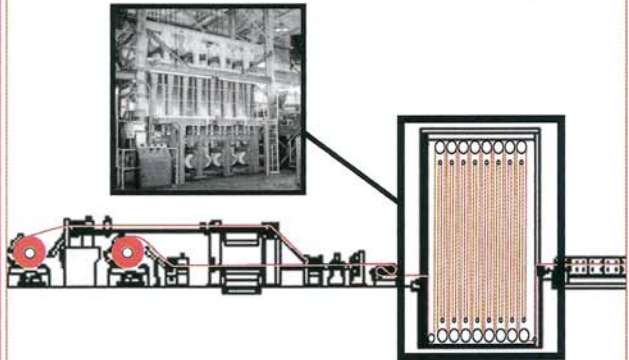
Also of significant importance is the distribution of the data amongst temperature groups. Some quick math reveals that, despite the North Carolina location and its relatively moderate year-round climate, the paint was brought to the process in the desired 81°F – 86°F temperature range only about 13% of the time and was below that range over 63% of the time. In fact, more than half of these batches

cont. on pg. 16

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Fall Meeting Focuses on Improving Processes

JOHN MITCHELL, PRESIDENT
NATIONAL COIL COATING ASSOCIATION



The 2005 NCCA Fall Technical Meeting attracted 225 industry professionals to the Renaissance Hotel in Chicago for three days of meetings, Sept. 21-23, 2005. Judging from evaluation forms submitted by attendees, NCCA members thought the presentations were insightful, timely, and helpful.

In all our meetings, we seek to improve our industry by sharing knowledge and promoting the growth of coil coated products. Our fall meeting focuses on technical expertise; this year's theme was "Improving Processes: The Continuing Challenge."

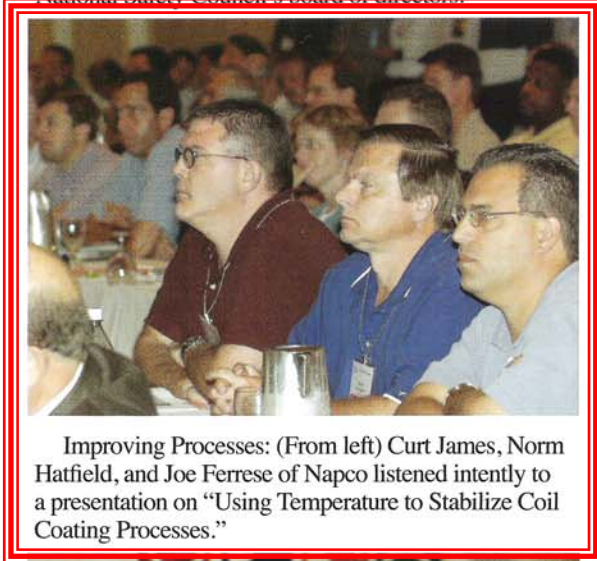
Here's a pictorial overview of some of the presentations and events:



Showing the Latest: The annual NCCA Trade Show again attracted a packed crowd for the 3-hour duration of the show. More than 20 exhibitors presented some of the latest technologies for coil coating lines. Pictured: Gene Pankake of Gap Engineering extolled the virtues of Gap's patented coating application process and equipment.



Promoting Safety: Jim Stanley, president of FDRsafety, told the story of how AK Steel became an industry leader in quality, safety, productivity, and profitability. Stanley serves on the National Advisory Committee on Occupational Safety and Health and the National Safety Council's board of directors.



Improving Processes: (From left) Curt James, Norm Hatfield, and Joe Ferrese of Napco listened intently to a presentation on "Using Temperature to Stabilize Coil Coating Processes."



Managing Water: John Favilla of GE Infrastructure Water & Process Technologies explored how to control, conserve, recover, and reuse water in today's coil coating lines.

NEWS



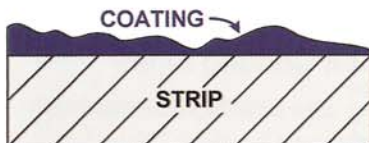
STEELSCAPE RECEIVES SAFETY AWARD

Steelscape Inc. has received a safety award given by the National Coil Coaters Association who selected the company's Kalama, WA

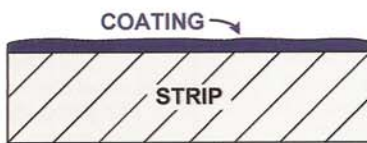
facility for the 2005 "Best Practices in Safety" award. The NCCA evaluated 36 coil coater plant-sites throughout the United States. Participating companies were asked to submit safety data for each plant site including OSHA 200 forms and safety program components for the calendar years of 1999-2004. Several companies were then visited by a panel of NCCA representatives for further evaluation. The evaluation team reviewed plant site comprehensive safety programs and conducted plant walk-throughs of each plant site interviewing employees and evaluating over-all safety culture.

For more information contact:
Steelscape Inc.
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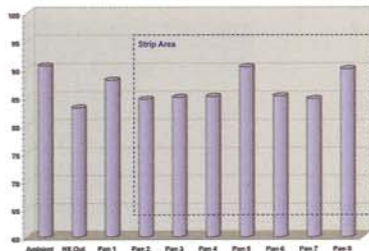
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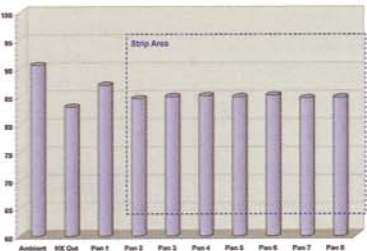
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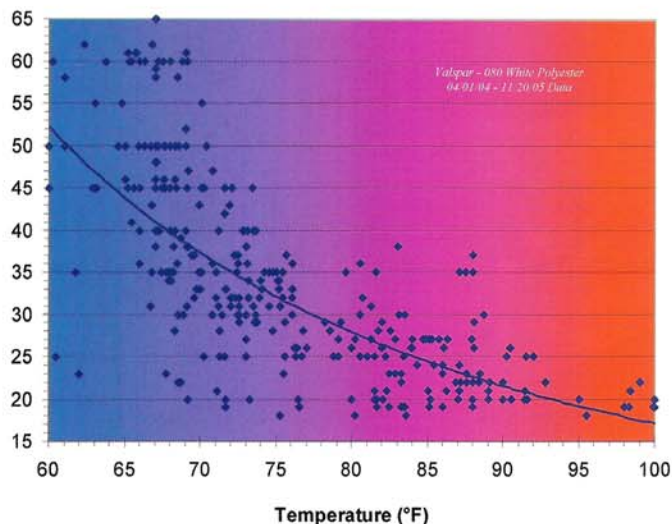


Figure 3: Production Viscosity Measurements²

(54%) fell into the 60°F – 75°F “hardest-to-measure” range. Furthermore, it is these inherently unreliable measurements on which the rest of the coating setup is based allowing this error to be multiplied through to the end product.

The Issue With Solvent Reduction

As previously related, little can be done when the temperature is above the 86°F upper limit and the resulting viscosity is below the 24s lower limit. Other actions (i.e. – roller pressures, speeds, etc.) must be undertaken in a system without temperature conditioning to compensate for this problem. As we have clearly demonstrated however, for the majority of batches the temperature is below the 81°F lower limit and the resulting viscosity is therefore above the 28s upper limit. The most common practice in this instance is to add solvent

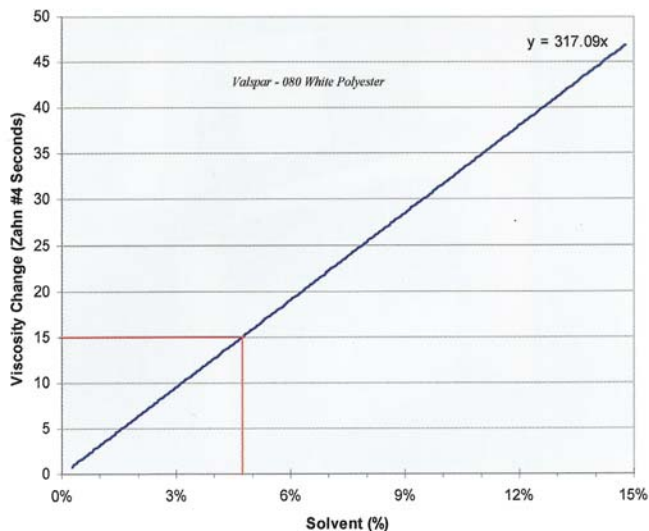


Figure 5: Viscosity vs. Solvent Addition³

to the coating material to reduce its viscosity.

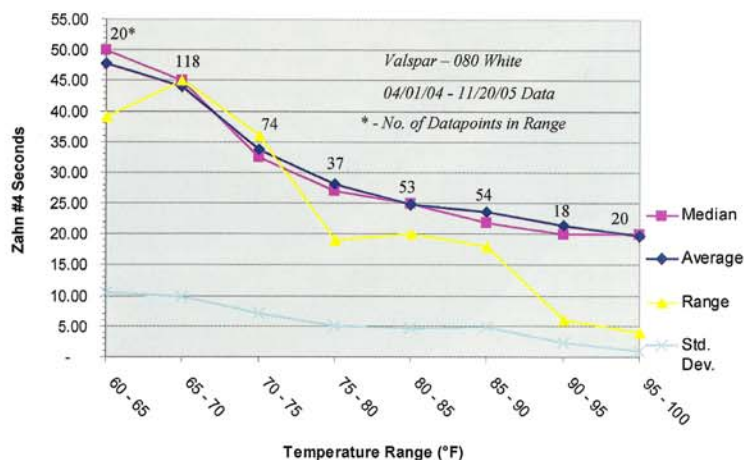
Figure 5 shows the relationship between solvent addition and change in viscosity. Since this is a simple volumetric ratio, the relationship is linear. In the previous section it was established that more than half of the batches in our example would require viscosity reduction on the order of 15s (41s – 26s = 15s). This has been marked on the graph showing that this reduction will require the addition of nearly 5% of solvent by volume. This amounts to 2.5 gallons (9 liters) per 50 gallon drum.

It is important to note that every ounce of this solvent will be driven off in the oven as the paint is cured to be either incinerated or, worst case, discharged to atmosphere. To correlate temperature to solvent addition, we return to the temperature – viscosity graph introduced above. In Figure 6, this curve has been broken down into 10°F increments to show the impact on viscosity. Here we can see that a change in temperature from 60°F to 70°F produces a 15s change in viscosity. Therefore, this 10°F change in temperature has the same effect as the addition of 2.5 gallons of solvent.

A significant benefit comes from the fact that this occurs in the temperature – viscosity area hardest to measure and manage. The use of temperature can eliminate viscosity adjustment errors caused by the difficulty in measuring at lower temperatures. In addition, solvent usage is significantly reduced. The magnitude of this reduction can be easily calculated if a few basic operating parameters are established. Using the Alско example followed throughout this paper, we will utilize the following conservative assumptions:

- 2.5 gallons of solvent/drum
- 14 drums of paint/day
- 54% of drums subject to these parameters
- Xylene specific gravity = 0.86

Figure 4: Viscosity Measurement Statistical Analyses²



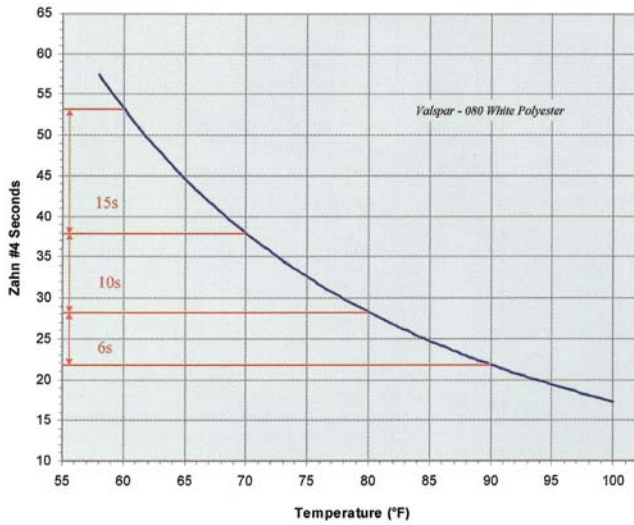


Figure 6: Viscosity vs. Temperature²

Using these parameters we can calculate the following solvent usage reductions to be realized through the elimination of solvent addition for viscosity adjustment:

$$\frac{2.5 \text{ gal}}{\text{drum}} * \frac{14 \text{ drums}}{\text{day}} * \frac{365 \text{ days}}{\text{year}} * 54\% = \frac{6,899 \text{ gal}}{\text{year}}$$

$$\frac{6,899 \text{ gal}}{\text{year}} * \frac{8.34 \text{ lbs}}{\text{gal}} * 0.86 = \frac{49,478 \text{ lbs}}{\text{year}}$$

$$\frac{49,478 \text{ lbs}}{\text{year}} * \frac{\text{ton}}{2,000 \text{ lbs}} = \frac{24.75 \text{ tons}}{\text{year}}$$

By reducing solvent usage by 25 tons/year, oven solvent levels (LEL's) will also be reduced. For those lines whose line speed is limited by LEL's, this presents the opportunity to increase line speed and therefore increase production throughput. For those whose production is limited by emissions permitting restrictions, this offers the opportunity to increase throughput without increasing permit levels or purchasing emission credits.

If solvent addition can be eliminated there will be labor reductions in addition to the cost savings attributed to the solvent usage reduction described above. These can be quantified using the following conservative assumptions:

- Xylene thinner @ \$3.00/gallon
- 10 min/drum to measure/adjust viscosity
- \$35.00/hour burdened labor rate

These result in the following cost savings calculations:

$$\frac{6,899 \text{ gal}}{\text{year}} * \frac{\$3.00}{\text{gal}} = \frac{\$20,697.00}{\text{year}}$$

$$\frac{1 \text{ hr}}{60 \text{ min}} * \frac{10 \text{ min}}{\text{drum}} * \frac{14 \text{ drums}}{\text{day}} * \frac{365 \text{ days}}{\text{year}} * 54\% * \frac{\$35.00}{\text{hour}} = \frac{\$16,100.00}{\text{year}}$$

$$\frac{\$20,697.00}{\text{year}} + \frac{\$16,100.00}{\text{year}} = \frac{\$36,797.00}{\text{year}}$$

Therefore it is clear that the conversion from solvent based viscosity reduction to temperature control based viscosity adjustment offers not only significant operational improvements, but significant cost reductions as well.

In the final installment of this article, which will appear in the Jan/Feb issue of Coil World, we will examine the factors that influence process temperature and the operational and cost advantages of making temperature a controlled, repeatable process parameter. ●

BIBLIOGRAPHY:

- 1 - Water Temperature vs. Viscosity data provided courtesy of Norcross Corporation.
- 2 - Material Temperature vs. Viscosity data provided courtesy of Alscro Metal Products - Roxboro, NC.
- 3 - Material Viscosity vs. Solvent data provided courtesy of Alscro Metal Products - Roxboro, NC.

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

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