Coating Operation

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Viscosity Control for Coating Operations

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Why control viscosity? Accurate viscosity control can reduce expenditures significantly in coating operations. Industry always attempts to reduce operation costs, so let's see how viscosity control helps. Until recently — perhaps the last 10 years — viscosity control was not given much attention in coating operations. Increased competition and higher costs of materials have caused many industrial concerns to utilize viscosity regulating devices to reduce costs. This is especially true of companies with a large volume of coating operations.

A typical sheet metal coating operation consists of a system of rollers which transfer liquid coating material from a vat (supply reservoir) to sheet metal or other flat material. Metering rollers transfer a wet film of the coating material to distribution rollers. The metering rollers control the thickness of the wet film — in most instances approximately .002 inches thick. The wet film moves from the distribution rollers to application rollers and finally to the sheet metal as it passes between the application rollers. At this point the coating procedure is complete and the coated sheet metal is conveyed through a long oven to dry the coating.

Viscosity control is important because it reduces coating material waste resulting when the coating material is too thick or too thin. Unnecessary expenditures for coating materials are made when the coating mixture is not thinned enough — and thinner is wasted when the coating mixture is thinned excessively. More than an adequate coverage is wasteful and unnecessary — while less than adequate coverage results in sub-standard quality or costly re-coating. Many methods of viscosity control leave much to be desired — to put it mildly! For example, some coating machine operators check viscosity by the "feel" of the coating material in the supply reservoir — how crude! Also, thinning is done in a hit or miss manner.

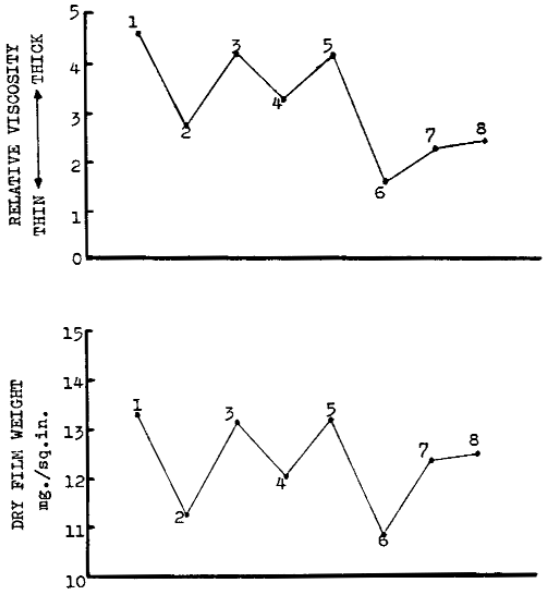

Figure 1. Co-variance of viscosity and film weight.

Although there are several methods of accurately measuring viscosity, the most common method is the use of a Zahn or Ford cup - a highly polished cylindrical cup with a standard sized orifice at the bottom. The cup is filled with the liquid being tested, and the viscosity is determined by the length of time it takes the liquid to drain from the orifice — a short draining time indicates a low viscosity (thin mixture). Many companies check viscosity in coating operations with this method to determine when thinner needs to be added. The coating machine operators add thinner when it is needed — but this method is not accurate and operators some times neglect their duties. Another disadvantage is the time required to measure viscosity and add thinner.

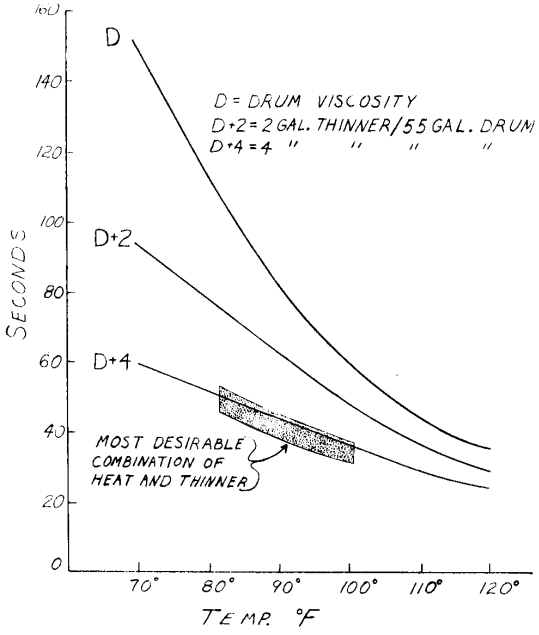

Figure 2. Effects of heating and thinning on the viscosity of a pigmented coating material. Viscosity is represented by the time (seconds) it takes the coating material to drain from a #4 Ford cup.

An indirect measurement of viscosity involves weighing the dried coating film on the sheet metal. There is a direct relationship between dried film weight and viscosity. *Figure 1* illus-

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trates the correlation between these measurements for 8 samples. This relationship between dried film weight and viscosity for a particular coating material can be determined by comparing simultaneous measurements of viscosity and dried film weight — this must be done without changing the coating machine roller adjustments. This procedure is performed several times to obtain sufficient data for a comparison like *Figure 1*. Dry film weight measurements (mg./sq. in. of surface area) are made by weighing a sample of the coated sheet metal, then re-weighing the sample after sanding off the coating with steel wool. The difference between these measurements is the weight of the dry coating film. This measurement of dried film weight is used by some companies for periodic quality control checks. But these quality control checks are of little value because they cannot correct wasteful operating conditions. Why not control the operation by accurately regulating the viscosity of coating materials?

The methods of controlling viscosity discussed thus far indicate a lack of interest in accurately controlling viscosity. This lack of interest implies that accurate viscosity regulation is not very important. The fact is that management is just now realizing how important viscosity control really is. However, industry has always realized that thinning is not the only way to reduce viscosity — most coating operations use heat to assist in reducing viscosity. When coating materials are purchased in 55 gallon drums, the viscosity is often very high — especially in cold weather. The thick coating materials (usually lacquer, varnish or pigmented coating) must be made less viscous to be usable. For most coatings, heating up to temperatures around 110°F is less expensive than adding thinner (*Figure 2*). Although heating is an excellent means of reducing viscosity, it is rarely used for controlling viscosity, since the viscosity of a coating material will frequently vary from drum to drum. Heating can accurately control viscosity only when drum viscosities are uniform — uniform drums of a coating material may be heated to a certain temperature to always produce a certain desired viscosity.

Since drum viscosity usually varies, solvent is usually used for regulating viscosity accurately. Several devices have been designed to add solvent to maintain desired viscosity. One popular viscosity control system is manufactured by the Norcross Corporation (*Figure 3*). The Norcross device has a controller which will automatically maintain the desired viscosity. After a control point is set, the controller continuously indicates the coating material viscosity — a recording controller is available if a continuous record of viscosity is desired. The system measures viscosity periodically with a piston assembly (refer to *Figure 4*). As the piston is raised, a sample of the liquid to be measured flows in through the tube openings. The piston is then allowed to fall, forcing the sample back out of the tube openings. The clearance between the piston and the inside of the tube is the measuring orifice. Viscosity is measured by the length of time the piston falls, and viscosity measurements are electrically transmitted from the measuring element to the controller. When the viscosity exceeds the controller setting, a valve is opened adding solvent to maintain the desired viscosity. This system will control viscosity so accurately that standard viscosity measuring apparatus cannot detect viscosity variations.

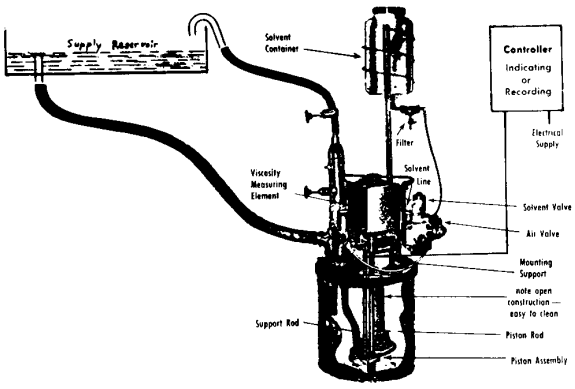

Figure 3. An automatic viscosity control system manufactured by Norcross Corporation.

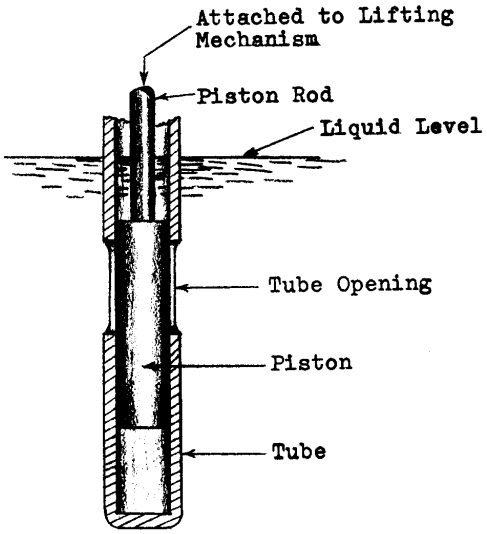

Figure 4. Simplification of teh piston assembly of the Norcross Viscosity Control System.

Before a viscosity regulating device is installed, information about present operating conditions is usually determined to confirm the need for viscosity control. After installation, the in formation can be compared to new information obtained while using viscosity

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regulating equipment to determine savings. The following should be determined:

1. variations in dry film weight
2. variations in coating viscosities
3. correlation between variations in dry film weight and viscosity with constant settings of roller adjustments
4. quantity of coating required for adequate coverage

Savings of 10% or more for coating materials are common after installation of viscosity regulating equipment. However, even greater savings result when metering roller settings are accurately maintained. Accurate adjustments for metering rollers should be provided before viscosity regulating devices. Let's see how fast a viscosity regulator can pay for itself — assuming that metering roller adjustments are accurate. Assume the following data for one coating machine:

Cost for coating material = $50,000/year

Installation cost of viscosity control system = $1,000

Savings for coating material = 10%

$$\text{Break-even point} = \frac{\text{Investment}}{\text{Savings}}$$

$$= \frac{\$1{,}000}{(.10)\quad (\$50{,}000/\text{year})}$$

$$= .20 \text{ year or } 2.4 \text{ months}$$

This is a typical example of how some companies have quickly reduced operating costs with viscosity regulating equipment — few investments will produce savings so fast. Other benefits include less operator attention for viscosity control and fewer sub-standard coatings.

Although many companies have introduced viscosity controlling devices into coating operations, some companies with relatively few coating operations have not installed viscosity regulators. They have failed to realize that viscosity control can be profitable even in small operations. Low investment cost and substantial savings make viscosity control feasible for almost all coating operations.

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