

Computer-Controlled Reprint 136

Computer-Controlled Viscometer Provides Coating Thickness Control of Approximately 30% at IBM

By Jim Eakins and Kent Wehmeyer, Senior Associate Engineers, IBM Corp., Boulder, CO, and Joseph Powers, Senior Associate Editor
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PROBLEM: Heart of a family of certain office copy and computer printing devices is a xerographic film manufactured at the IBM Corporation plant in Boulder, CO. The film consists of several layers of polymers and dies coated onto PET substrate by meniscus coating methods.

In meniscus coating, one of the critical parameters to applying an accurate and consistent coating thickness is the ratio of solvents to solute. Inherent in this coating is a large recycle of coating solution that is slightly more concentrated due to evaporation at the coating head. This combination of characteristics makes it necessary to continually monitor the solvent-to-solute ratio and add solvent to the coating solution in relatively small amounts, as needed.

Both previous attempts at on-line control of the solvent-to-solute ratio had failed. The first attempt was to measure the density of the solution. This failed due to the very small effect dissolved solids level had on density. The second attempt employed the use of an in-line viscometer, with a sensing element driven by an external motor. This necessitated a mechanical seal. Since the coating solution being tested becomes extremely sticky when it dries, the seal would drag and an erroneous reading would result. Also, if the viscometer was left off for any length of time, the seal would "freeze up" entirely.

SOLUTION: The mixing and coating operations in this facility were already under the control of a computer. The

answer to maintaining the proper solvent-to-solute ratio was to select a suitable viscometer and then integrate this and several other instruments into the existing computer control architecture. The other instruments fed the computer information about the temperature of the coating solution and the amount of solution in the coat tank (see diagram).

The viscometer chosen consists of a falling piston within a close-fitting cylinder. The time of fall of the piston is related to the viscosity of the surrounding fluid. This type of viscometer, when mounted in a vented tank, has no seals to "freeze up." Its simple design allows for reliability and low maintenance.

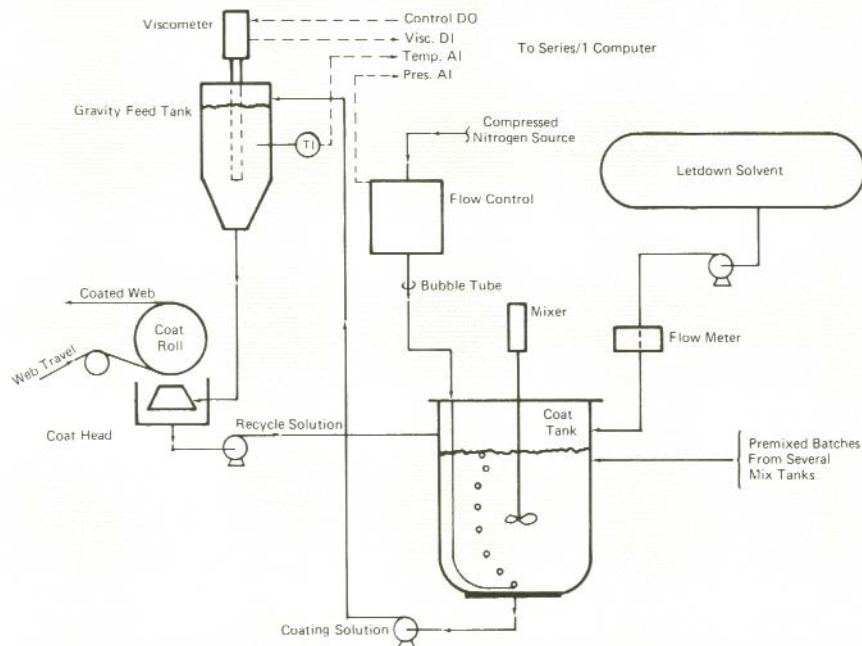


Figure 1: Coating solution viscosity control system (see text).

The computer controls the operation of the viscometer with a single digital output. The piston fall time is sensed by a single digital input. The level of solution in the coat tank is sensed by a bubble-type level sensor, built on site from stock components. The analog signal from this instrument and the temperature of the solution are fed to the computer. The computer now measures the drop time of the viscometer piston and adjusts for effects of solution temperature. When the maximum desired viscosity is reached, the amount of letdown solvent is computed, based on the total amount of solution in the coat tank.

The computer then automatically

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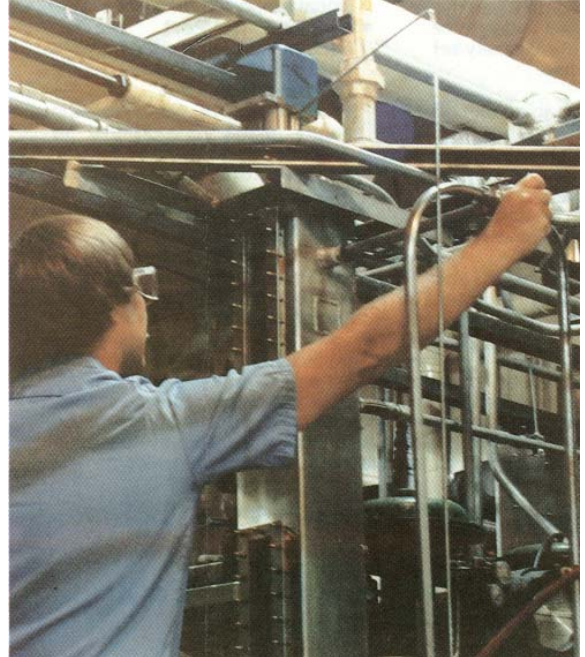
Prior to installation of this control system, approximately 40% of all coating thickness tests were outside of the desired operating range. Now, less than 10% are out of the desired range.

pumps the required amount of letdown solvent directly to the coat tank. A mix time is allowed to elapse before new viscosity measurements are made. Since each measurement takes approximately 15 seconds to perform, many readings are made with highs and lows discarded, and averages calculated before any let-down solvent is added. All these functions are performed without any operator intervention.

RESULTS: Prior to installation of this control system, approximately 40% of all coating thickness tests were outside of the desired operating range. Now, less than 10% are out of the desired range. Since startup 18 months ago, there has been no maintenance of any of the instrumentation. The entire system was purchased and installed for under \$5,000.

Model M8BO viscometer is a product of Norcross Corp., 255 Newtonville Ave., Newton, MA 02458

Series/1 computer used at this installation is manufactured by IBM, International Business Machines Corp., System Products Division, P.O. Box 1328, Boca Raton, FL 33432.



Simple design of viscometer allows for reliability and low maintenance.