GRAFITEC INTERNATIONAL

THEORY OF WIRE-WOUND BAR COATING

Technical Data Sheet D11/2

Sample preparation of inks, paints and other surface coatings onto their substrates is a very important operation for any laboratory working with these materials. The samples produced tend to fall into the following categories:

- Quality control of current products
- Research and development of new products using alternative materials
- Samples for customers to approve

Many products can be applied by wire-wound bar coating and the results then tested for various physical properties.

Wire-Wound Bar Coating

This method is suited for materials with a viscosity range from about 1 to 1000 centipoise, subject to them flowing out after coating. The coating thickness with normal close wire-wound bars is about 4-160μm. (For higher coating weights up to 1000μm, please refer to the Special Applications section below.)

The actual deposit from a wire-wound bar will depend on the absorbency of the substrate and the flow characteristics of the coating material. Figure 1 shows two turns of wire and the area of coating (A) that can pass between each turn. When divided by the wire diameter (D), this represents the theoretical thickness of even coating (T). This can be calculated to T = .107D.

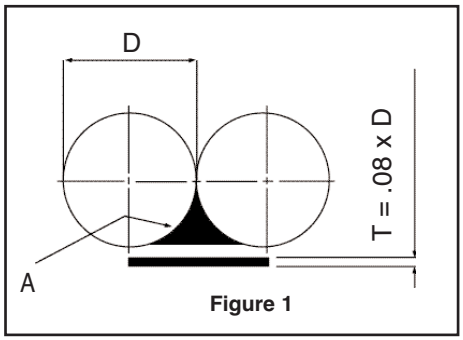


Figure 1

This assumes full flow with no losses due to friction or the substrate; in practice, approximately 25% is lost, altering the thickness of T = .08D (see the table below). If the specific gravity = 1, then a 10μ coating is equal to 10g/m^2 (gsm). The dry film weight may then be calculated from the percentage of solids content.

For example, applying a coating with a solids content of 40% and a specific gravity of 1.05 with a bar wound with .4mm-diameter wire:

.4 x .08 x 40/100 x 1.05 = .0134mm
= 13.4μ
= 13.4gsm

As this is a linear equation, it is easy to obtain a chosen coating weight if a range of bars is available, simply by weighing the first result and doing the calculation.

Effective Wet Film Thickness for a Given Wire Size

Wire Size **D**	Wet Film Deposit **T**
.125mm	10μ
.25mm	20μ
.5mm	40μ
.75mm	60μ
1.0mm	80μ

For example, the coating weight achieved was 13.4gsm with .4mm wire and the weight required is 16gsm:

.4 x 16/13.4 = .475mm-diameter wire

Bars are generally available in diameter increments of .025mm/.001" from .05-2mm/.002-.08" which equates to 2μm steps in wet film.

Repeatability

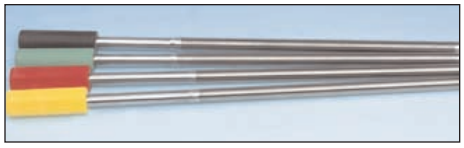
To achieve good repeatability, the bar should be used in conjunction with a suitable machine featuring repeatable drawdown speed and repeatable pressure on the bars. Infinitely variable speed between 10 and 250mm/sec is recommended to cater to all products.

In multi-user situations, such machines are essential to provide comparable results. With experience, color differences as low as ΔE = .2 are achieved in database preparation for computer color matching prediction equipment.

Calibration

Calibration is relatively simple to achieve during manufacture as wire diameter can be very accurately measured prior to winding. However, when subsequently being used for coating, different techniques must be used. If a suitable stable coating mixture and substrate are available, about four coatings should be made with each new bar requiring calibrating. The coatings should then be measured instrumentally for coating weight or color density, and an average taken. An allowable tolerance should be established. Then at regular intervals this test should be repeated and the bar replaced when it falls outside the tolerance limits.

Alternatively, where stable products are not available, a new bar should be kept as the standard bar and only used for making three or four drawdowns for comparison with those from the bars requiring calibration.

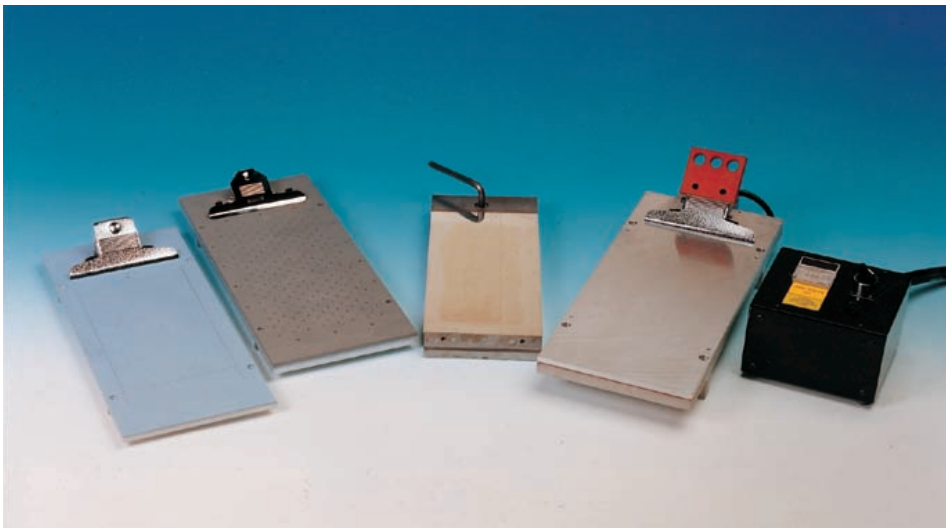


Bars color-coded for ease of identification

Hand coating

Automatic coating

Coating Beds



Vacuum, magnetic, heated and glass coating beds

Coating Beds

Material for the coating bed should be available with a variety of resilience to allow for different substrates (for example, a gravure ink on paper should have a harder bed than a gloss paint on card).

Alternatively, a magnetic bed for steel paint test panels will ensure that they are held flat during coating and provide the best samples for subsequent accelerated weathering.

A vacuum bed will hold materials that are non-dimensionally stable, such as polythene or virgin aluminum foil.

Special Applications

For higher coating weights and viscosities, bars may be wound both in a spiral fashion (Figure 2) or double-wound (Figure 3).

By varying the numbers of turns per inch and the wire size, various effects can be achieved.

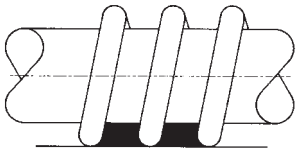


Figure 2

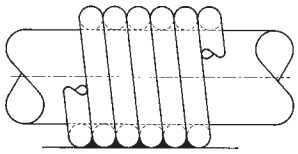


Figure 3

Wire-wound bars are also used on production machines as an easy way to control coating weight. Typical uses include adhesive coating, paper coating, carbon film, etc.

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