Weighing Your Coating Options

By Sean Teufler

Last month, my article focused on the necessities of good information gathering, how to obtain the requirements (see FLEXO January, page 35). It also described the application components in detail. In this second installment, we will put to the test sample coating data by evaluating examples of how to refine calculated volume when all the information is available. We are also going to look at strategies like banded rolls and sample evaluation when the target coat weight is not already defined for your calculation.

We learned in the first article that good data allows exact computation of what volume will be needed to achieve coat weight target. This is the preferred mathematical way to determine what you need without physically going to press for testing. The following lists required data for the calculation itself:

- Coat Weight Target
- Percent Solids
- Ream Size
- Deposit Efficiency
- Weight per Gallon (Coating)

Let’s assume for the following examples that we have all the information we need. Note that having a numerical value for each category without confirming it will lead to errant calculations.

Example 1: Printing Method: Flexo, water-based
Coat Weight Target (1.0-1.2 lbs/ream)
Percent Solids: 50 percent
Ream Size: 3,000sq.ft. (432,000sq.in.)
Deposit Efficiency: 20 percent
Weight Per Gallon: 9.2lbs

REVIEW DATA

The first thing we notice is a range for the coat weight target. If a more specific target is not identified, then use 1.1 lb/ream as the default weight. The range allows for a plus/minus difference of 10 percent in required volume, so even though it does not seem like a large difference, it affects the engraved volume by a lot. The solids are at 50 percent, and in most cases with a water-based coating, a reduction is not made in viscosity and is used as formulated. Ream size is 3,000sq.ft., or 432,000sq.in. The deposit efficiency checks out as flexo.
and we have already confirmed that with the printer. The weight per gallon was confirmed by the technical data sheet and should not change because the coating has not been reduced with any liquids. Let’s plug in some numbers:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Water</th>
<th>Material Type</th>
<th>Water</th>
<th>Material Type</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating Method</td>
<td>Flexo</td>
<td>Coating Method</td>
<td>Flexo</td>
<td>Coating Method</td>
<td>Flexo</td>
</tr>
<tr>
<td>Desired Dry Weight</td>
<td>1.00</td>
<td>Desired Dry Weight</td>
<td>1.10</td>
<td>Desired Dry Weight</td>
<td>1.20</td>
</tr>
<tr>
<td>Deposit Efficiency</td>
<td>20%</td>
<td>Deposit Efficiency</td>
<td>20%</td>
<td>Deposit Efficiency</td>
<td>20%</td>
</tr>
<tr>
<td>Ream Size</td>
<td>432,000</td>
<td>Ream Size</td>
<td>432,000</td>
<td>Ream Size</td>
<td>432,000</td>
</tr>
<tr>
<td>% Solids</td>
<td>50.0%</td>
<td>% Solids</td>
<td>50.0%</td>
<td>% Solids</td>
<td>50.0%</td>
</tr>
<tr>
<td>Weight Per Gallon</td>
<td>9.2</td>
<td>Weight Per Gallon</td>
<td>9.2</td>
<td>Weight Per Gallon</td>
<td>9.2</td>
</tr>
<tr>
<td>Required Volume</td>
<td>9.52</td>
<td>Required Volume</td>
<td>10.48</td>
<td>Required Volume</td>
<td>11.43</td>
</tr>
</tbody>
</table>

Notice how the seemingly small change in the coat weight requirement (1.0, 1.1, 1.2) makes approximately a plus/minus 1lbm adjustment in the resulting volume. This is a good reminder to be specific in target weight, or you will end up with a volume range as well.

**Example 2:** Printing Method: Gravure, two-part solvent-based coating

Coat Weight Target (1.2 lbs/ream)  
Percent Solids: 70 percent (or is it?)  
Ream Size: 3,000sq.ft. (432,000sq.in.)  
Deposit Efficiency: 40 percent  
Weight Per Gallon: 9.5 lbs (or is it?)

**REVIEW DATA**

The first thing we notice is solvent coating that has at least two parts. Ideally, coatings like these come with a recipe for how much of each component to mix together and a dilution schedule for the addition of a third unspoken-for component—the solvent. We have been given a specific target for the coat weight, 1.2 lbs/ream. The solids is at 70 percent per the MSDS/technical sheet, and in most cases with a solvent-based coating, a reduction is made in viscosity and is not used as packaged without alteration.

This coating requires mixing the two components to the proper ratio and adding solvent for reduction. The formula states that the resulting solids content will be 35 percent, but you want to make sure by recording all the weighing information to confirm the batch is correct. Describing the solids content and the weight per gallon accurately requires knowing the weight per gallon of all three components and how much is used of each in ratio. Once that is determined the true solids content and weight per gallon will be known. There is no issue with the ream size on this application. The deposit efficiency checks out as gravure, meaning it could still be a flexographic-type deck but the actual application goes from anilox to substrate without the use of a plate or sleeve.

Once again we have confirmed that information. What is our formula?

Our formula for this application: 9:1 ratio of the base and cross-linker. Reduce in half by solvent (identified as normal propyl acetate). Since the base and cross-linker happen to have the same solids content, once the mixture of the two is reduced by solvent then the resulting solids content is 35 percent.

- Base: 70 percent solids, 9.5 lbs/gallon  
- Cross-linker: 70 percent solids, 10.0 lbs/gallon  
- Solvent: Normal Propyl Acetate: 0 percent solids, 7.28 lbs/gallon

We take the ratio of 9:1 of the components and multiply by their weight per gallon: 9 (9.5) + 1 (10.0), add the dilution of solvent 10 (7.28) and divide by 20 for the real weight per gallon you will be using. Where did the 20 come from? This is the addition of all the parts, 9 + 1 + 10.

So, (9(9.5) + 1(10) + 10 (7.28))/20 parts equals 8.415 lbs/gallon, the true weight per gallon. Use that with the true solids of 35 percent and we’re in business!

Let’s plug in some numbers:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Solvent</th>
<th>Material Type</th>
<th>Solvent</th>
<th>Material Type</th>
<th>Solvent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating Method</td>
<td>Gravure</td>
<td>Coating Method</td>
<td>Gravure</td>
<td>Coating Method</td>
<td>Gravure</td>
</tr>
<tr>
<td>Desired Dry Weight</td>
<td>1.20</td>
<td>Desired Dry Weight</td>
<td>1.20</td>
<td>Desired Dry Weight</td>
<td>1.20</td>
</tr>
<tr>
<td>Deposit Efficiency</td>
<td>40%</td>
<td>Deposit Efficiency</td>
<td>40%</td>
<td>Deposit Efficiency</td>
<td>40%</td>
</tr>
<tr>
<td>Ream Size</td>
<td>432,000</td>
<td>Ream Size</td>
<td>432,000</td>
<td>Ream Size</td>
<td>432,000</td>
</tr>
<tr>
<td>% Solids</td>
<td>70.0%</td>
<td>% Solids</td>
<td>35.0%</td>
<td>% Solids</td>
<td>46.6%</td>
</tr>
<tr>
<td>Weight Per Gallon</td>
<td>9</td>
<td>Weight Per Gallon</td>
<td>8.415</td>
<td>Weight Per Gallon</td>
<td>8.79</td>
</tr>
<tr>
<td>Required Volume</td>
<td>4.17</td>
<td>Required Volume</td>
<td>8.93</td>
<td>Required Volume</td>
<td>6.42</td>
</tr>
</tbody>
</table>

**What the tech sheet told us before factoring in ratios and reduction/dilution.**

**Using correct ratio, solids & wpg: 9.1 components and 10 parts Solvent.**

**If you change the reduction, you change the solids and weight/gallon: 9.1 components and 5 parts Solvent.**

**BANDED ANILOX TEST**

The lesson is to always establish accurate data for the formula and final solids/weight per gallon of the coating actually used at press. If a coating requires significant additions of components and/or reducer while you test, you will need to document and double check the numbers so you are calculating with data from the final mixture you are using at press.

What happens if you don’t have conclusive data to work with, especially the target coat weight? You are going to need physical samples to weigh. There are a number of ways to get the samples. You can take existing anilox inventory and print
up test samples or you can also have a banded anilox made or borrowed that will have many volumes provide different coat weights for testing.

Check your anilox inventory first to see if you already have a roll that will work for your situation. You should have the volume checked to confirm what you will actually be using instead of believing what the roll has been stamped. If you do not have an anilox that will work, then contact your anilox supplier to see if it has a banded roll already made that you can borrow for testing.

If you choose to go the route of having a banded roll created, seek assistance from the technical staff of the coating and anilox suppliers to help narrow your choices to the most likely successful engravings based on the information. All you’ll need to get started is a target volume or volumes. Once you’ve ran a test, you can then evaluate the samples for fit/form/function and determine which volume and cell geometry works best for you.

In the example I will use, the banded roll is testing a range of volumes (8.0 to 11.0bcm) in 0.5bcm increments. There is enough volume separation to distinguish each band. Often it is recommended to add dead band areas between engravings to simplify identification of each band.

Once you have samples printed, you will need to prepare them for weighing. Evaluation of samples is simple if you keep a few things in mind. You need to determine the net weight value while making sure you don’t corrupt the sample. The net weight value can be determined by weighing printed and unprinted samples to determine exactly how much adhesive/coating is there. Make sure the only difference is in the coat weight.

Inference in the net coat weight can come from other print on the sample that is not consistent, the size of the coated area measured, contamination, etc. The coat weight difference is very slight in small samples so any disturbance in the measurement leads to chaotic results. Getting dissimilar size samples for comparison frequently leads to area and net weight errors. Remember the anilox is indifferent to the area coated but sensitive to the coat weight required in a given area. The means there is a direct relation between the deposit and the volume of the anilox.

**STEPS FOR EVALUATION**

A. Use a calibrated scale that measures the weight range of the samples down to thousandths to ten-thousandths of a gram. If you don’t capture a difference, you need a scale that allows for smaller weight differences.

B. Weigh a substrate sample with and without coating to determine exactly how much adhesive/coating is there. Don’t change anything else or the data will be false. Try to get at large a sample as possible that you can reasonably weigh.

C. Know the current volume is correct. It may not be what is stamped on the side of the anilox due to cell plugging or wear, so have the volume checked to make sure what the volume is at the time just before testing and that the samples were generated from a clean anilox.

D. Test other target weight samples to confirm it is what you want and to make sure no errors were made. Average the net weights if necessary.

**CROSS MULTIPLY**

There is one other possibility in evaluating samples and it has the simplest solution for determining the required volume. In the case where you have known coat weight and volume and know what coat weight you would like to target, you can simply cross-multiply to determine the target volume.

\[
\text{Current weight} / \text{Current volume} = \text{Target weight} / \text{Target Volume}
\]

Solve for \( x \). \( 1.5x = (1.0)(15) \). Therefore, \( x = 10 \), target is 10bcm.

B. Current weight / Current Volume = Target Weight / Target Volume. That means \( x \) is the target volume and the only unknown value. Just catch-multiply and you will get your answer.

For example:

- Current weight: 1.5lbs/ream
- Current volume: 15bcm
- Target weight: 1.0lbs/ream
- Target volume: \( x \)

C. Current weight / Current Volume = Target Weight / Target Volume.

Current weight / Current Volume = Target Weight / Target Volume. That means 1.5lbs/ream / 15bcm = 1.0lbs/ream / \( x \).

Solve for \( x \). \( 1.5x = (1.0)(15) \). Therefore, \( x = 10 \), target is 10bcm.

Your target volume is 10bcm in order to get the target coat weight of 1.0lbs/ream.

The task of determining the proper coat weight for product application, cost savings and/or performance characteristics requires reliable data acquisition and refinement to give you the correct results the first time. Careful and deliberate analysis prevents many of the errors that can occur and the resulting frustration. The dynamics of a coating application require reliable data acquisition and refinement to give you the correct results the first time. Careful and deliberate analysis prevents many of the errors that can occur and the resulting frustration. While the majority of applications net straight-forward calculations, you may come across situations where you must refine the data set to get your true volume. You may also discover that with limited information you will need to perform sample weight calculations or banded roll trials. In the final analysis, always remember that no matter what direction you take for a coating application, seek assistance and guidance from both coating and anilox suppliers to help you determine the right anilox for your application.

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