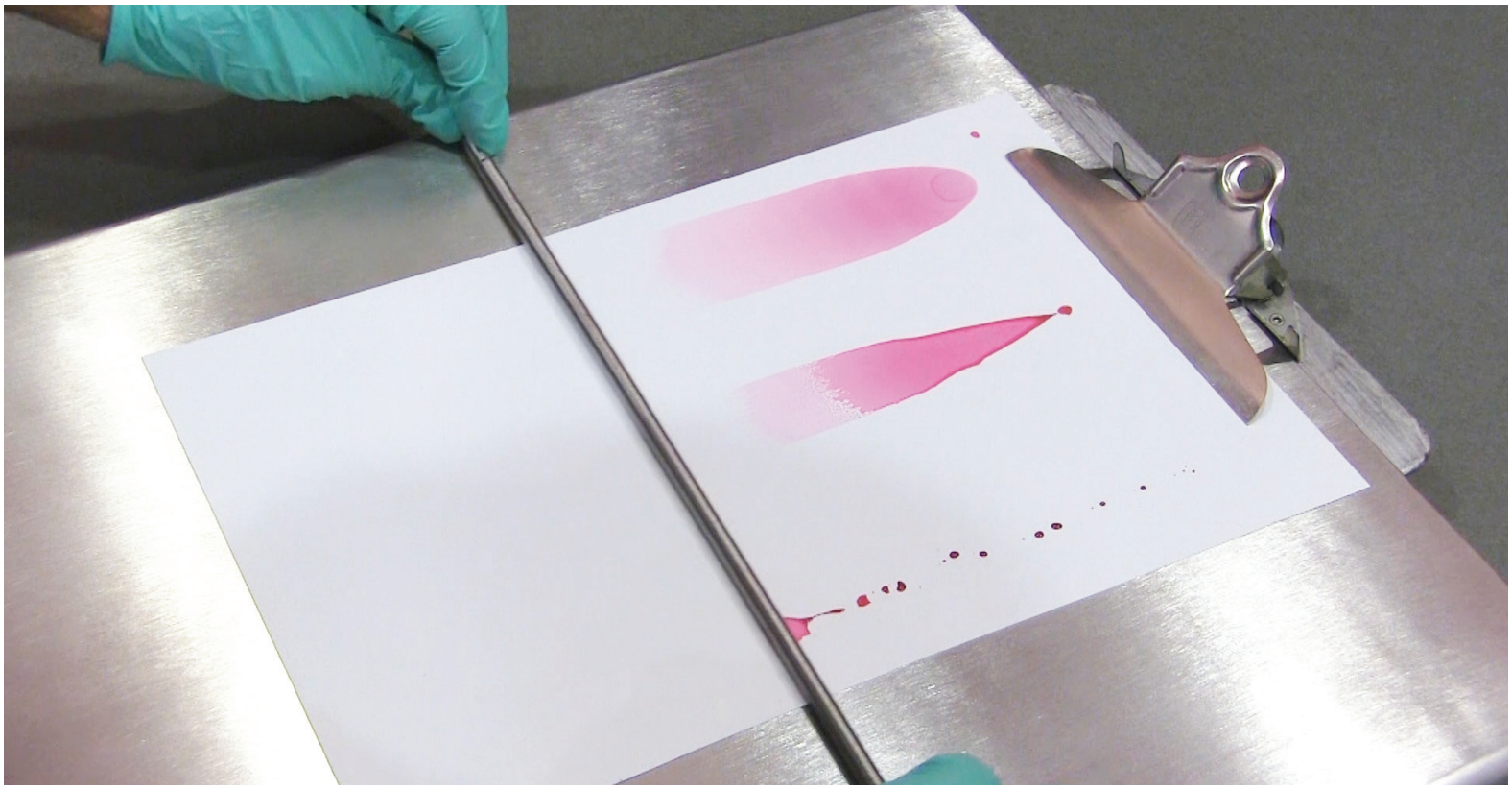

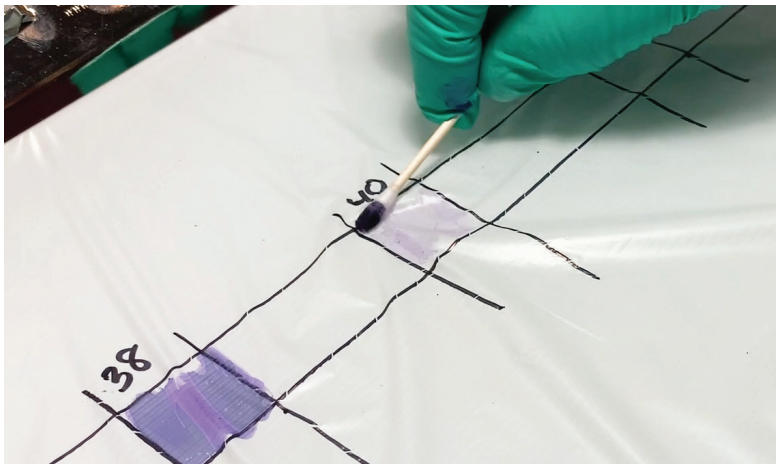

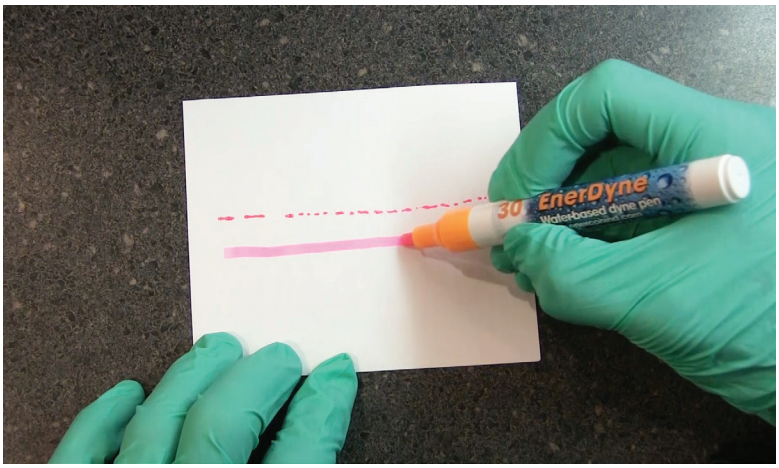

Buddy, Can You Spare a Dyne?

– Dyne Tests Only Work When You Do Them Right

Dynes are used to measure changes in a film's surface energy. But poorly executed dyne tests produce unreliable results. And false assumptions about dyne levels, adhesion and corona treating leads to major problems. This paper discusses the best methods for dyne testing and how to interpret the results correctly.

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Buddy, Can You Spare a Dyne?

– Dyne Tests Only Work When You Do Them Right

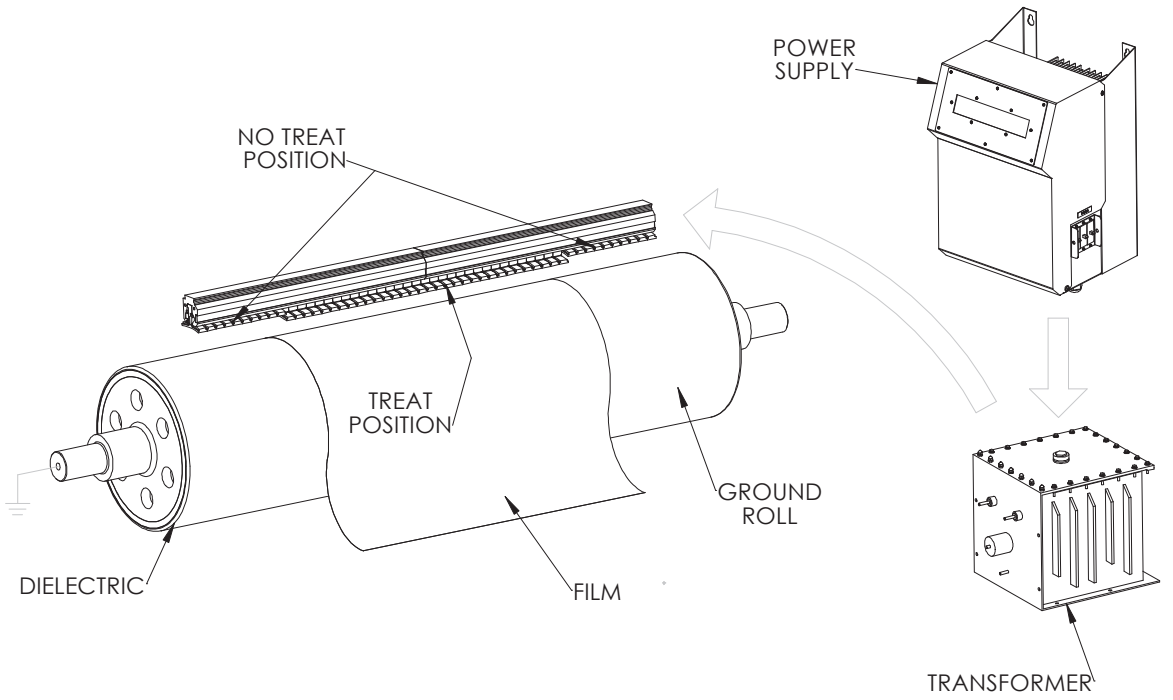
Why is a corona treater manufacturer writing about dyne testing?
Because it causes more confusion than any other topic.

There are three important takeaways from this article:

1. Train your operators how to properly conduct dyne tests and schedule “refresher” events with operators to generate consistent and repeatable dyne level readings.
2. Meeting a dyne level target **does not** guarantee adhesion success.
3. Document your results so you can troubleshoot when you don’t get the results you expect.

Corona Treating Process

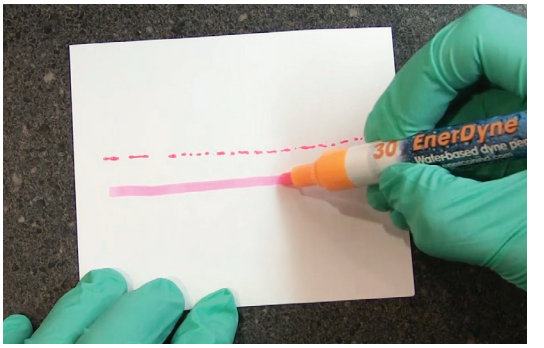
Generally speaking, polymer films are chemically inert and non-porous which makes them unreceptive to wetting out and bonding with inks and coatings. Corona treaters are designed to ionize air in a gap between an electrode and ground roll. Films passing through this air gap are exposed to corona which increases surface energy to enable wettability and promote adhesion of inks, coatings and adhesives. This change in surface energy is invisible to the naked eye. So, it is common practice to use dyne solutions to measure changes in surface energy.



Dyne Pens

The simplest and most common form of dyne testing is conducted with dyne pens. Dyne pens offer an easy and efficient tool to measure dyne levels, but they do have drawbacks. The tips of dyne pens can become contaminated from contact with surfaces and they only test a small area of the film. In addition, and as with most dyne level tests, they are highly dependent on the operator’s interpretation of the result.

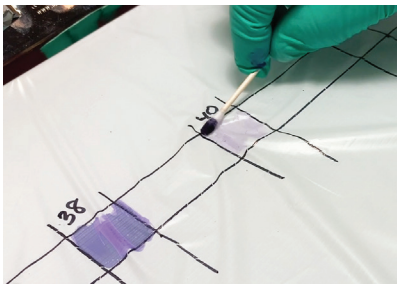
It is advised that dyne pens be used more as a pass or fail test than relied upon for a very specific reading. For example, a great usage case for dyne pens is checking which side of a film has been treated prior to loading the roll for a converting operation.



Enercon offers EnerDyne™ pens for purchase on-line.

Cotton Swab Method

A better way to test dyne level is the cotton swab method. Dyne solutions of various concentrations are placed on the substrate until a solution is found that wets out properly. Use an eye dropper style cap to place drops of the test solution from a calibrated dyne-level solution container to the tip of the sterile applicator swab. Use enough solution to coat the tip of the applicator, but not so much that it drips onto the sample. (DO NOT dip the sterile applicator swab as this will contaminate an entire bottle of dyne fluid!)



The solution is spread lightly over approximately one square inch of the test material. If the wetting solution stays intact for two seconds, the treat level is at least as high as the dyne level of that solution.

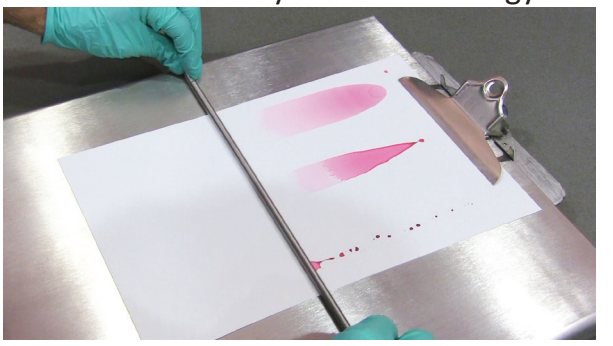
Repeat the procedure until a solution is used that will bead up on the surface of the material being tested. The film treat level would be identified as the last solution level that remains wetted out for 2 seconds on the surface. A clean cotton applicator must be used for each dyne solution to avoid contamination that may distort the results. (Watch video of Cotton Swab Method.)

This method has been a standard for years, but is also subject to inconsistencies including variables of the specific applicator swab used, the application of the fluid to the substrate, the fact that it only tests a small area of the film, and the tester's personal interpretation of the results. This procedure should be done in a lab environment, especially when using solvent formulations, because of the risk of spills and accidental skin contact.

Please review ASTM D2578. This test method is recognized as an industry standard. It is highly recommended that you invest in the test document ASTM D2578-17, *Standard Test Method for Wetting Tension of Polyethylene and Polypropylene Films* to properly understand how to conduct and interpret the test method.

Mayer Rod Method

The Mayer Rod Method (TAPPI Test Method T 552) is the most accurate of the dyne surface energy measurement tests for polymeric films and coated surfaces.



A substrate sample, usually measuring 8-1/2 x 11 inches, is clamped to a clipboard. At the top of the sample, a single drop of three (3) different level dyne solutions, which bracket the desired treatment level, are placed horizontally from each other. A #4 or #6 wire-wrapped metering rod, also known as a Mayer Rod, is then placed just above the

droplets and pulled down. When a film of liquid breaks within the two second period, the tester knows that the treat level of the film is below that dyne solution level. (Watch video of Mayer Rod Drawdown Method.)

This tends to be the most accurate test because the metering rod lays the solutions down at the same relative thickness as well as provides an immediate and direct comparison between the different dyne fluid values. The rod must be thoroughly cleaned with isopropyl alcohol after each use.

Other Surface Energy Measurement Technologies

Another wettability measurement is contact angle, traditionally done with a manual goniometer. The lower the contact angle, the higher the surface energy and wettability of a surface. Today, new electronic devices are used to measure not only contact angle, but also polar dispersions. They ensure precisely metered droplets are used and add a significant degree of repeatability to testing.

Enercon uses all the devices described in this article. Which tool you use is less important than ensuring they are used properly, results are documented and understanding what the results mean.

Dyne Level Does Not Guarantee Adhesion

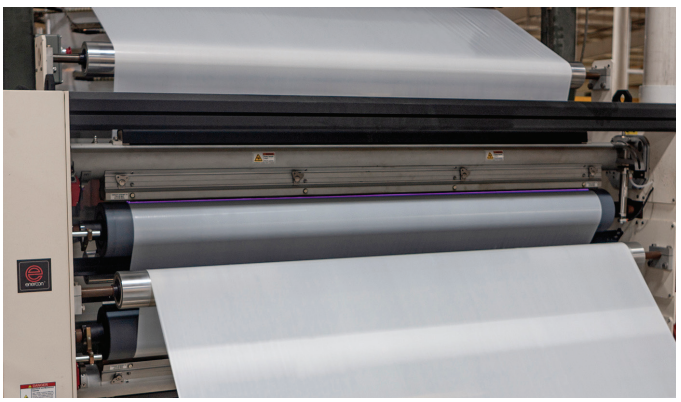
On the positive side, dyne level gives some indication that you have a chance at adhesion success, but it does not guarantee it. In fact, it is not unheard of to see different adhesion results from materials that display the same dyne levels. So, how can this occur?

Some common reasons are variables in the process and equipment used to apply the ink, coating or adhesive. These all occur after the surface treatment process is completed. Operating and process variables can have a major impact on adhesion results as well as the migration of surface additives and other contamination on the material surface. This is one of the reasons it is recommended that surface treatment occurs immediately prior to your converting process.

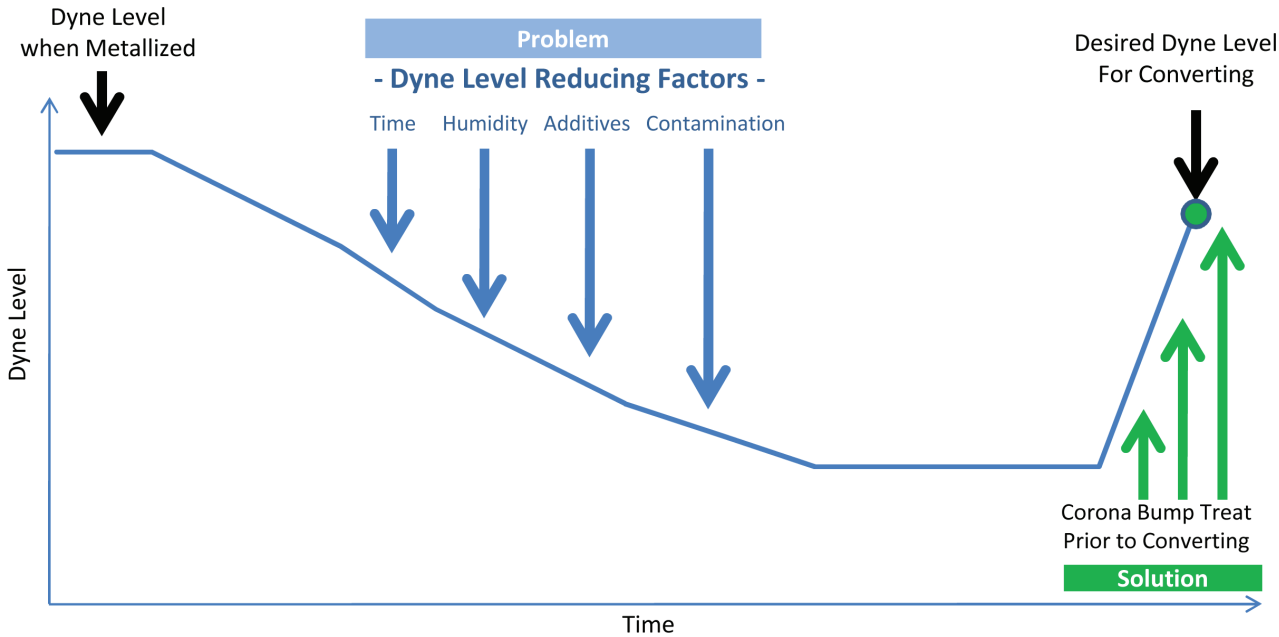
Ultimately, good adhesion will require entanglement at a molecular level between the material surface and the coating. Entanglement is dependent upon the variables discussed above including material and coating compatibility, surface wettability, the availability of functional bonding sites and control of process parameters. The key takeaway is that dyne level indicates the surface's wettability which is only one of many factors that contribute to successful adhesion.

What about the corona treater?

Corona treaters are used when film is extruded and again to bump treat the film prior to converting. When adhesion fails, many converters are quick to blame the corona treater since it's designed to increase surface wettability and promote adhesion. While that's true, we've demonstrated how many other factors affect adhesion as well.



This is not to say there is never a problem with a corona treater. The good news is that these problems are relatively easy to identify. They can range from



the corona treater not being turned on, to an inability to generate any corona, to a system fault or an application or process issue. It's recommended to always document all of your setup information for each job you run, including power level, line speed and the expected pre- and post-treatment dyne level results.

If you are experiencing a decrease in dynes and think there may be a problem with the treater, try this: reduce the line speed by half and increase the power level to full. Run the film and see what dyne level you achieve. If the dyne level improves, chances are there is something different about the film you are treating and that is causing the unexpected treatment result. For a more in depth look, please check out Enercon's webinar called *Blame the Corona Treater.*

Dyne Test Summary

- Pick a test method ASTM D2578 or TAPPI T 552 and stay with it!
- Remember: in these two dyne test methods, the time factor is *two (2) seconds*. Whatever happens to the fluid after that does not matter as it relates to reading the dyne value.
- Train and retrain those doing the tests to achieve consistent, repeatable data.
- Always use fresh dyne solutions, pens, sterile cotton swabs, & clean Mayer rods for each test.
- Meeting a dyne level target doesn't guarantee adhesion success.
- When you get results that are different than you expected, ask, "What's changed?" And if you have documented your complete setup and recipe for success, you should be able to determine the cause.

For more information, watch the webinar: Truth or Dyne? How to Properly Conduct Dyne Tests & What Your Results Really Mean.

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