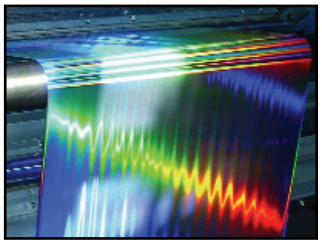
Enercon Technical Bulletin

Click Here to Visit Enercon's Website

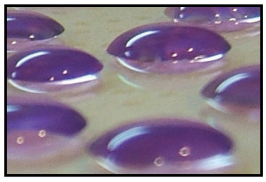
Application Insights: Converting of Metallized Films



Bump treating metallized film prior to converting is an industry best practice.

We are often asked to consult on applications involving the converting of metallized film. This technical bulletin will review some of the most common questions and misconceptions regarding this application.

Most application questions involving the converting of metallized films concern the dyne level required to convert. It is extremely important for both the film manufacturer and the converter to recognize that achieving a specific dyne level does not guarantee printing, coating or laminating adhesion.



Most converters will conduct a dyne test on metallized film prior to converting. While this is good practice, converters should be aware that dyne level measures wettability not adhesion. Dyne levels can be used to help predict the chances of adhesion success, but there are numerous material and process variables which can significantly effect adhesion success. Additionally it is important to note that consistent dyne level testing accuracy is subject to individual subjectivity and other environmental challenges.

The following are key considerations when relying on dyne levels to predict adhesion success.

1. Dyne level tests are highly dependent on the individual conducting the test.

- is the test conducted correctly and consistently each time?
- is testing conducted in a manner that accounts for environmental variables such as temperature, humidity, age of dyne solutions, cleanliness of swabs/pens and material?
- are the results interpreted consistently (it is not uncommon for two experienced individuals to report a variation of several dynes on the same substrate)

2. It is impossible to guarantee a dyne level reading is representative of the entire roll

- was the entire roll of material treated with exactly the same watt density, at precisely the same air gap and controlled temperature as the area tested?

3. Dyne levels decay over time

- additives used to make film easy to handle rise to the surface over time creating lower surface energy
- in addition to time, storage conditions of the material can impact the longevity of dyne levels, this includes cross contamination from the back side of rolled material

4. Dyne levels measure wettability, not adhesion

- recommended dyne levels for converting are provided by ink, coating and adhesive suppliers. It is not uncommon to have successful adhesion with lesser dyne levels.
- changes in material suppliers or film ingredients and changes in process variables such as line speeds and ink/adhesive/coating formulations can significantly effect bonding and alter the desired dyne level

www.enerconind.com/treating

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of metallized Films (continued)

To summarize:

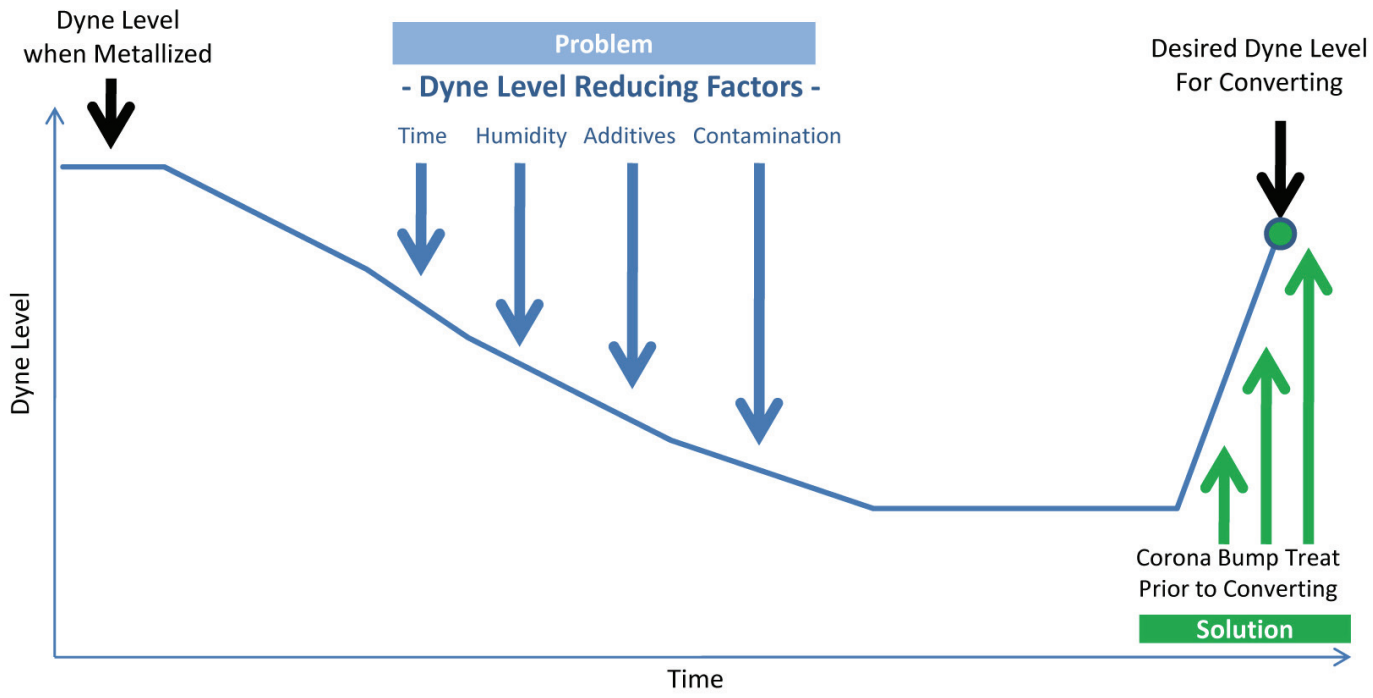
- Dyne level readings have inherent challenges which lead to variations in measurements
- Dyne levels do not guarantee adhesion
- Dyne levels decay over time
- Dyne level decay is accelerated by environment
- Dyne level decay is accelerated by slip additives rising up to the film surface
- Dyne levels can be contaminated from the underside of the film when rolled

So what's a converter to do?

Both the metallized film supplier and converter are at the mercy of the physics involved with dyne levels. Controlled storage facilities and a timely inventory procedures certainly help, but with all these variables at play its clear that a metallized film supplier can not reliably provide convertible material 100% of the time.

The industry's best practice is to eliminate dyne level decay issues by bump treating the material at the time of converting to create a fresh clean surface ready for bonding. This puts the converter in control of substrate the surface energy and his value added process.

On the following pages are independent industry experts who conclude that bump treating is the best practice for converting metallized film.



Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of metallized Films (continued)

Below is an excerpt from a technical article "In Line Corona Treating" authored by Leighton Derr formally of AET Films that address the bump treating concept.

What Happens When Corona Treating BOPP/OPP

When a corona treater creates corona the atmosphere that is exposed to the electrical discharge is jolted with electrical energy. The oxygen gas is excited to higher energy states as O2, O3 (ozone), and O (oxygen free radicals). These are extremely reactive species, which will undergo a chemical reaction with almost anything in the area. If they survive the trip to the surface of the film with sufficient energy they will react with anything on the surface and they can even react with the surface of the polymer itself.

With Polyethylene, the oxygen can react with the polymer by breaking into the polymer chain and inserting oxygen (oxidizing the polymer) in several different forms. Polyethylene can also cross-link due to this exposure. With polypropylene, only oxygen insertion occurs, again in several different forms. In both cases, the presence of these oxygen species presents chemical bonding sites for ink vehicles, adhesives and extruded polyethylene to attach to, forming a strong link. Without corona treatment polypropylene actually presents a very good release surface.

Treating Metallized OPP Films:

Metallized polypropylene films are a very different surface. First, the metal surface is not treated by the metallizer either during or after metallization. Second the exposed surface is not aluminum, it is aluminum oxide. (AIO2) which forms instantly when the metal coating is exposed to air during rewinding. Third, the aluminum oxide surface itself has an extremely high surface energy. (About 360 dynes/cm as measured by calorimetry)

But the metallized OPP film will measure quite low surface energies (frequently less than 36 dynes/cm). This is because the AIO2 surface energy is so high it pulls the low molecular weight hydrocarbons (i.e. oils/oligomers) from the core of the film concentrating these species on the surface of the AIO2. This is true of all metallized OPP films regardless of the manufacturer. (This does not seem to happen with metallized PET film however)

If surface printing or adhesive laminating metallized OPP film it is likely that bare roll treating the metal surface will be required to strip these oligomers from the metal surface. Extrusion lamination has not required Bare roll treatment, probably because the temperature of the molten Polyethylene vaporizes the oils/oligomers immediately upon contact.

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

How do I print on metallized films (foil like, highly reflective) with a wet offset printer that has UV curing system?

First you must have an ink designed for metallized films which you will have to find by discussing with your ink suppliers. Next the metal surface is easily contaminated when wound in a roll which can cover the aluminum with organic material which forms a weak layer on the metal and this is where the ink bond is failing.

In general with printing on metallized film it is advisable to prime the metal surface to insure uniform adhesion. In some cases if the film is "old" the contamination of the metal surface interferes with the primer so the metal surface may need to be "cleaned" with a corona treatment step.

So for the most uniform result with a "good" ink you should treat the metal surface to clean it and then prime the clean surface prior to printing.

- Eldridge M. Mount III, EMMOUNT Technologies

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

What is your opinion about the best way to print on metallized BOPP (metallized side of the film). Is it better to apply a primer before printing or an in-line corona treatment to be sure of a good adhesion of the ink?

"I am answering on behalf of the technical committee of the EMA (European Metallizers Association) and member of the "Ask AIMCAL" group to your question about the best way to print metallized BOPP film.

I would do both - using a primer as well as an inline corona treatment. The treatment is absolutely necessary to be sure to get an adhesion especially when the metallized film is not absolutely fresh metallized. The primer would be useful because of two reasons: the adhesion of an unpigmented coating/lacquer on a critical substrate is better than the adhesion of a highly pigmented ink.

On the other side, if you are using a white ink in your printing design, you do need a primer to avoid the white ink to appear grey. I hope this will answer your question. Should you have additional questions, please do not hesitate to contact us again".

- Werner Geitner, HUECK FOLIEN Ges.m.b.H

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

How will humidity affect corona treatment?
When will we know if the humidity is too high or too low?
What is the optimum humidity for corona?
To clarify, we have been testing OPP and CPP.

In general it is best to use conditioned air for critical treatment applications but this is not what is generally done in practice. In principle the moisture can add reactive chemical species to the corona which can in principle change the chemistry of the treatment but this is difficult to define in terms of the chemical changes to the film surfaces. More often it causes other problems associated with condensation of gasses in the exhaust and cleanliness problems due to film contamination etc.

There are definite seasonal differences in how the treater can be run which most likely relate to both ambient temperature and moisture levels in the air, which can affect surface chemistry of the film. In general during summer I have observed a need to lower power settings due to film temperature and potential for blocking etc which diminishes or controls the tendency to over treat the film surface. This has resulted in seasonal changes in film properties which is where you should look to define if you have a moisture level problem.

- Eldridge M. Mount III, EMMOUNT Technologies

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

We use a corona treater to raise the dyne level of film on our laminator, after it has been applied to raw board with an adhesive. When we hit the film with the treater, it typically raises the dyne measurement from about 32 to 36. If we were to hit the film again, would the dyne raise another 4 points or would it stay at 36?

The second treatment step would not necessarily raise the dyne level another 4 dynes as in the first step. The actual increase depends on the film surface polymer type as well as the impact. A second pass may result in over-treatment, which could hurt bonding to ink or in other lamination steps by degrading the surface, so you must be careful about successive treatment steps. It is important to look at the treatment power applied to the film to determine the likelihood of polymer damage. The impact of repetitive treatment steps needs to be looked at in terms of what the treatment is supposed to do for the product.

- Eldridge M. Mount III, EMMOUNT Technologies

What happens on the second pass can depend on many things. The level can improve, stay the same or even degrade. Part of this depends on how effective the first treatment was. If the voltage is too low or the components of the unit are not tuned up, you may gain. If the room humidity or temperature the web experiences after treatment are too high, you can lose treatment effectiveness. Contamination after treatment is also a possibility.

I am sure you cannot double the level with a second pass. Any increase gained will be slight. You did not mention what film you are using. For example, polyethylene and polypropylene both start at about 32 dynes and go to 36 with treatment, so your 4-point jump is very normal.

- Larry Gogolin, Gogolin & Associates

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a greatindustry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

Trying to laminate a metallized BOPP film to a clear, coextruded BOPP with a solvent-based adhesive, but the product delaminates. The metallized film was stored for 5 months in the warehouse. Should the film be corona treated before lamination? If so, at what dyne level?

If there is low molecular weight material or slip coating used to improve the handling on the other side of the web some of these materials may have been transferred across while the roll was stored in the wound-up state. The longer the time in storage, the greater the chance of transfer.

Similarly during storage, the temperature the roll experiences is important. Any residuals within the polymer that may migrate to the surface will do so more easily if the temperature rises. Also, any low molecular weight material will be more mobile if the temperature is elevated. If the temperature cycles between daytime highs and overnight lows, the rolls will expand and contract. The relative movement of the layers of polymer will put additional contact pressures on the surfaces and also help material transfer. In extreme cases, this can microscratch the surface, particularly if one surface has filler particles protruding.

A final consideration is humidity. Moisture is another source of surface change. The moisture can start a chemical change by producing hydroxides that can reduce the surface activity. Thus, if film rolls are to be stored for a long time, it is preferable to maintain a constant, preferably low, temperature, and a low humidity. Even then, a slow, progressive decline in performance would be expected.

So if there are problems with adhesion after long storage, it may be worth looking at a surface treatment, particularly if contamination from low molecular weight material is suspected. It may be worth checking the surface energy of the material just after metallization and just before it is used after the five months storage to compare the values and determine whether there have been surface changes.

- Charles A. Bishop, C.A.Bishop Consulting Ltd.

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

What is the shelf life of metallized polyester film for packaging applications? What are the recommended storage conditions?

...What usually limits the apparent life of metallized films for printing and laminations is surface contamination of the metal surface while in roll form. This may be more pronounced with oriented polypropylene than polyethylene terephthalate, but the apparent wetting tension of the metal will drop as the metal surface is contaminated. Often the metal can be cleaned by corona treatment on the converting equipment.

A second effect sometimes seen is oxidation of the metal by moisture at the ends of the roll. Consequently, storage should be such to minimize diffusion of additives or contaminants to the film surface. The film should be stored in a cool place and should be wrapped in a polyethylene cover, which is tucked into the core especially if storing for a long time. Storage temperature will be based on the shrinkage properties of the film to prevent the formation of baggy lanes or gauge bands.

- Eldridge M. Mount III, EMMOUNT Technologies

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk

Application Insights: Converting of Metallized Films (continued)

AIMCAL is the Association of Metallizers, Coaters and Laminators and their organization and website are a great industry resource. Below are questions posted on www.askaimcal.org regarding dyne levels and converting of metallized film. The answers are provided by independent industry experts

What is the shelf life of metallized polyester film for packaging applications? What are the recommended storage conditions?

Shelf life is dependent on a number of factors. The surface treatment chemically modifies the material to a specific depth. Different treatments will reach different depths. The shallower the depth, the easier it is for the treatment to be reduced in effectiveness. Hence it is common for people to want to coat or laminate only after a very recent surface treatment.

There are several ways the surface treatment can be reduced. If there is low molecular weight material on the polymer surface before the treatment, it will not only be on the surface treated but also on the other side of the web. Some of the low molecular weight material transfers across while the roll is stored in the wound-up state. Any residual low molecular weight material on the reverse side will have time to transfer onto the treated surface while in storage. The longer the storage time, the greater the chance of transfer.

Similarly, the temperature the roll experiences during storage is important. Any residuals within the polymer that may migrate to the surface will do so more easily if the temperature rises. Also, any low molecular weight material will be more mobile at elevated temperatures. If the temperature cycles between daytime highs and overnight lows, the rolls will expand & contract. The relative movement of the layers of polymer will put additional contact pressures on the surfaces and also help any material transfer. This can, in extreme cases, put microscratches into the surface, particularly if one surface has filler particles protruding.

A final consideration is humidity. Moisture is another source of surface energy degradation. The moisture can start a chemical change by producing hydroxides that can reduce the surface activity.

Thus, to store rolls of film for a long time, it is preferable to maintain a constant, probably low, temperature and a controlled low humidity. Even then, a slow progressive decline in performance would be expected over time.

- Charles A. Bishop, C.A.Bishop Consulting Ltd.

Enercon Industries Corp. Menomonee Falls, WI USA
Tel: 262-255-6070 Fax: 262-255-7784
E-mail: info@enerconind.com

Enercon Industries, Ltd. Aylesbury, Bucks UK
Tel: 44 1296 330542 Fax: 44 1296 432098
E-mail: info@enerconind.co.uk