



*Lee A. Ostness  
Product Manager  
Coating & Drying  
Davis-Standard, LLC*

## Coating Technologies for Adhesive applications

In the adhesive market, there are many uses for adhesive coated products. Some typical products are; labels, medical patches, protective covers, Band-Aids, sanitary, bumper stickers, tapes, etc... When a product is manufactured, an adhesive and a substrate(s) are combined to form the final product. In order to combine the adhesive and substrate, the proper coater needs to be determined. How does the manufacturer decide what coater is needed to produce the end product!

The best way to answer this question is to fully understand the entire process starting with the adhesive. What is adhesive? Adhesive is a liquid or form of liquid that exhibits tack, the ability to stick to another object. The properties of the adhesive include strength, flexibility, tack, toughness, and opacity. Changing the ingredients in the formulation can alter these properties:

- Tackifier            Increase or decrease tack
- Crosslinker        Increase or decrease strength
- Elastomer          Increase or decrease toughness
- Plasticizier        Increase or decrease flexibility
- Fillers              Increase or decrease opacity

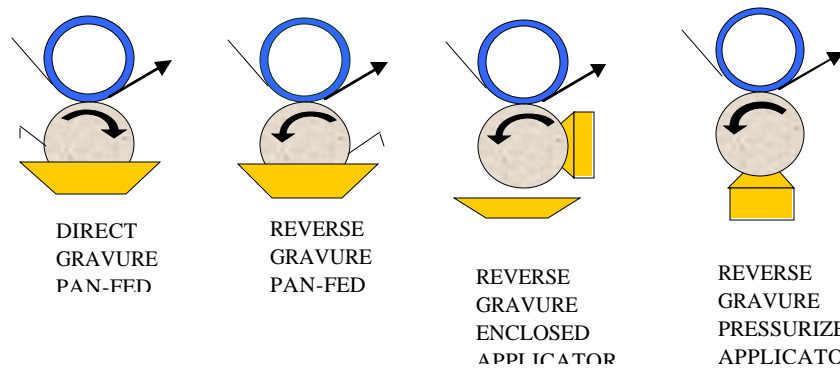
This is true for all types of adhesive whether they are acrylic or rubber based, water or solvent based, or even 100% solids like hot melts. In most cases these adhesives are transported on some type of substrate such as paper, metal, plastic, fabric, ceramic, etc.

Once the adhesive properties have been formulated and the substrate has been chosen, the type of coater can be addressed. In order to determine what type of coater to use, many parameters have to be considered. These parameters consist of the following;

- Operating Speed
- Coating Solids
- Coating Viscosity
- Final Appearance
- Coatweight
- Solvent or Water Based
- Hot Melt
- Substrate
- Shear Stability
- pH
- Run Time

The most common coaters used to apply adhesives consist of Gravure, Die, Rod, Reverse Roll, and Flex Bar. Each of these coaters has the ability to apply adhesive but also have different limitations.

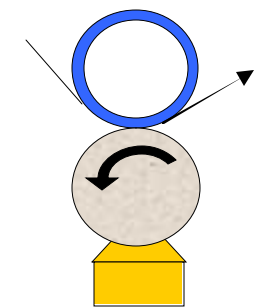
Adhesive	Gravure	Die	Rod	Reverse Roll	Flex Bar
Water Based	X	X	X	X	X
Solvent Based	X	X	X	X	X
Hot Melt	X	X		X	



## GRAVURE COATERS

A Gravure coater consist of an engraved gravure roll, a rubber backup roll, a pump, and an applicator. The gravure roll is engraved with a pattern that will deliver a set amount of adhesive to the substrate. An applicator such as a pan, enclosed applicator or pressurized head applies the adhesive to the gravure roll. The coating is doctored off the gravure roll flush with the top of the engraved cell and then transferred to the web. It is transferred to the web by pressure against the gravure roll by the rubber applicator roll. The pressure at the point the two contact creates suction and pulls the adhesive from the cells onto the web. The coatweight is adjusted either by the speed of the gravure roll or by the volume of the cells. See *sample chart*.

CELL COUNT LPI	TOOL REF.#	CELL DEPTH MICRONS	THEORETICAL VOL. BCM	LBS. PER REAM	
				25% SOLIDS	50% SOLIDS
110 TH	69	72	23.0	1.64	4.36
64 TH	84	125	40.2	3.22	8.56
45 TH	12	200	64.8	4.60	12.24



### Example: Protective Film

Pressure Sensitive Adhesive

Reverse gravure with "PGH"

Coater Setup:

Backup Roll - 65 Shore 'A' Buna N

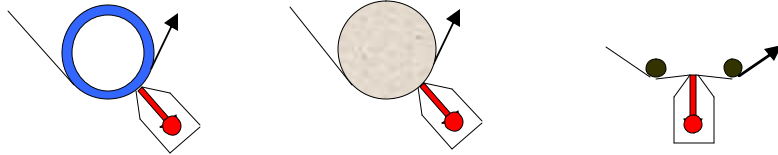
Gravure Roll – 110 TH with volume 23.0 BCM

Backup / Gravure nip – 1/8"

Gravure speed – 110% of linespeed

Coatweight – 3 Lbs. / Ream  
Substrate - Film

The example used is a Protective film that is utilized to cover TV screens, monitors, new cars, etc. The product is manufactured on a machine in the following order, the substrate is unwound, coated with adhesive at the reverse gravure coater, dried, cooled, slit, and rewound.



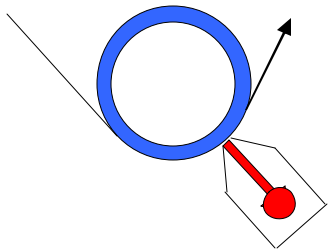
## DIE COATERS

The die coater consists of a die, a backup roll and a precision pump. The adhesive is pumped through the die and transferred to the web supported by the backup roller. The coatweight is controlled by the pump speed. The backing roll for a paper web will be of a rubber construction, for a film web in most cases the backup roll will be chrome plated, steel construction and for non-wovens or any porous web structure a kiss coating arrangement can be utilized.

The lip design is based on the viscosity, speed, shear stability, and which backup roller is utilized.

The appearance is dependent on the die angle, lip design, vacuum, linespeed, and substrate.

Crossweb profile is achieved by die lip adjusting bolts located every 2-3" cross web. Another option is a fixed lip die design where the die internals are machined to provide crossweb uniformity.



### **Example: Label product.**

Pressure Sensitive Adhesive 56% solids

Substrate – 40# SCK Release Liner

Laminate web – Face Stock

Coater setup:

70 shore 'A' backing roll

Die slot height .010"

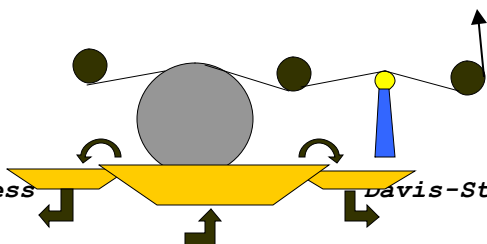
Bottom lip step .005"

Die lip width .025"

Die Angle - (-3) degrees from tangent

Die to web gap -.003"

The example of a label product demonstrates how the adhesive is applied to a release liner with a direct die coater and laminated to a face stock. The process to dry the adhesive removes moisture from the carrier web, which affects the webs' physical properties. Thus the release liner is coated and the Face stock is laminated after the drying process to preserve its integrity. The release liner is the disposable part of the product and the face stock is the printable web that creates the label.



## ROD COATER

The rod coater consists of an applicator roll, a rod(s), a pump and a multi chambered pan. The coating is supplied to the center pan at a constant rate. The coating fills the center pan and overflows into the two side pans. This overflow action removes any air and/or debris floating on top of the pan and prevents it from being transferred to the applicator roll. The applicator roll picks the coating from the pan and transfers the coating to the web. The web carries the excess coating to the rod where it gets metered to the correct coatweight. The coatweight is determined by the wire size of the rod. The rod size (wire size) is determined by the wet film thickness based on coatweight and solids. **See sample chart**

ROD #	WIRE SIZE	WIRE DIAM. (inches)	WET FILM THICKNESS (mils)
30	30	.030	3.0
32	32	.032	3.2
34	34	.034	3.4
36	36	.036	3.6
38	38	.038	3.8

**To determine the wet film thickness use the following formula;**

$$\frac{\text{DRY COATWEIGHT}}{\% \text{ SOLIDS}} = \text{WET COATWEIGHT}$$

$$\frac{\text{WET COATWEIGHT}}{16} = \text{WET FILM THICKNESS (mils)}$$

**Example: Packaging Tape**

Solvent Based Natural Rubber Adhesive @ 45% solids

Substrate – Paper or Film

Coater Setup:

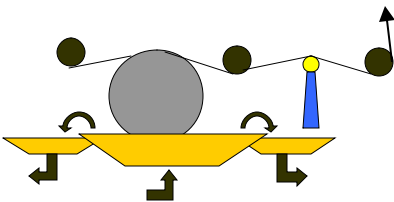
Backup Roll – Kiss Coat w hold-down rolls

Applicator Roll – Precision Chrome Plated

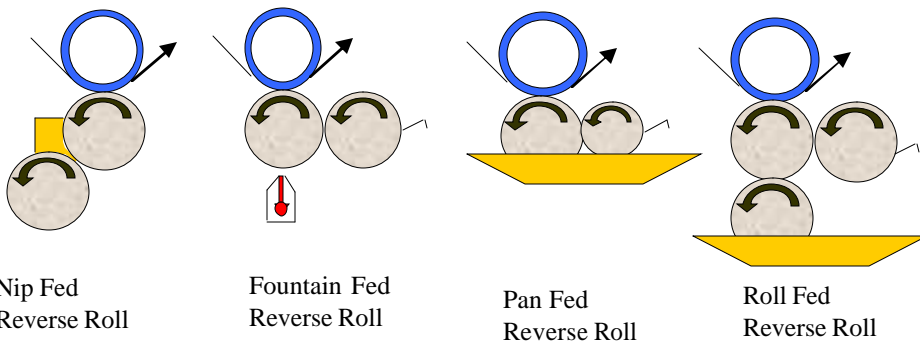
Pan Fed

Coatweight 25 #/ Ream

Rod size #34 Rod



High speed and viscosity can adversely affect the performance of the rod coater. The faster the speed or higher the viscosity, the greater the hydraulic forces at the rod. These forces affect coatweight control. To remedy this, a second rod or higher tension over the rod will bring the coatweight back into control. However there is a point where the rod coater can no longer control coatweights. This point varies with different products. Speed can also affect the ability of the applicator roll to wet out the web. The ability of the roll to pick up coating is based on dwell time the roll surface is in the pan. A point where the dwell time is reduced too much creates voids, uncoated sections of the web, that cannot always be filled in at the rod. In order to achieve better coverage a fountain applicator can apply the coating to the web and then metered off at the rod(s). The fountain applicator can help reduce the amount of flash off by solvent coatings. With an open pan feed system and solvent-based adhesive, the solids must be measured continuously due to the solvent flash point.



# REVERSE ROLL COATERS

The Reverse Roll Coater consists of a rubber covered backup roll, precision chrome plated applicator roll, and precision chrome plated metering roll and an applicator. The coating is applied to the applicator roll from a (pond, fountain, pickup roll, or pan). The coating is metered off at the gap between the applicator and metering roll. The gap is determined by the wet film thickness formula. Then the coating is applied to the web from the applicator roll at the nip between the applicator and backup roll. The nip is just tight enough to wipe the applicator roll clean. The speed of the metering roll is adjusted to produce a smooth coating on the applicator roll. A general rule is the higher the viscosity the slower the metering roll speed and the lower the viscosity the faster the metering roll speed. When the ratio between the applicator and metering rolls are determined then the speed of the applicator to the web can be set. The applicator speed is in most cases is from 90 to 120% of linespeed.

Several variations of the reverse roll coater are available. They include the Nip-Fed Reverse roll, Pan Fed Reverse roll, Fountain Fed Reverse roll and the Roll Fed Reverse roll coaters.

The nip fed reverse roll coater is good for medium to high viscosity coatings. The viscosity needs to be high enough to keep the coating from flowing out the applicator/metering gap. The nip fed system is also good for short runs or varying web widths. The pan fed reverse roll coater is good for low to medium viscosity coatings. If the viscosity is too high, the applicator roll has a tendency to pump the coating out of the pan. Another limiting factor is the speed of the applicator roll in the pan. The faster the roll turns the more slinging of the coating becomes a problem. With solvent-based coatings in an open pan, solvent flash point becomes an issue. The operator needs to deal with increased solvent fumes and must constantly monitor the solids level of the coating. The fountain fed reverse roll coater is very good for solvent borne coatings, because it helps contain the solvent until it is applied to the applicator roll. The fountain is also excellent for applying coatings in high-speed operations. The fountain is good for low to high viscosity coatings. The limiting factor for viscosity is the ability to pump the coating through the fountain at a rate sufficient enough to coat the applicator roll.

### **Example: Label product.**

Pressure Sensitive Adhesive 56% solids

Substrate – 40# SCK Release Liner

Laminate web – Face Stock

Coatweight 16lbs./3000sqft

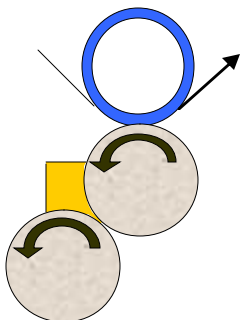
Coater setup:

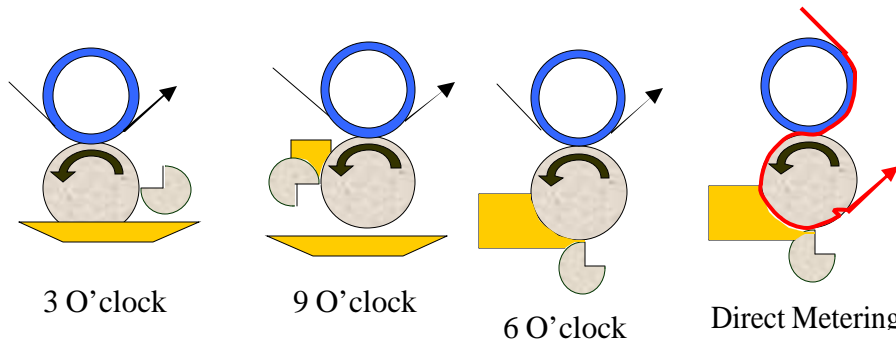
70 shore 'A' backing roll

Precision Chrome Applicator Roll

Precision Chrome Metering Roll

Applicator / Metering Gap .002"



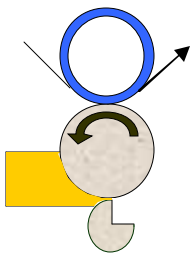


## FLEX BAR COATER

The Flex Bar Coater consists of a Backup roll, Applicator roll, Flex Bar, and a pond/pan arrangement. The coating is picked up from the pond/pan by the applicator roll and metered between the applicator and flex bar gap. Then the coating is applied to the web at the backup/applicator nip. The coatweight is controlled by the solids, applicator speed, and the gap between the flex bar and applicator roll. The gap is determined by the wet film thickness formula. The appearance is controlled by the speed of the applicator roll.

The flex bar coater is sometimes referred to as the poor mans reverse roll coater. The flex bar coater eliminates the cost of another precision roll, motor and drive. The ability to adjust the speed of the metering roll enlarges the operating window for a good-coated appearance. The flex bar is a fixed member and thusly limits the ability of the coater to affect the final appearance. A benefit of the flex bar is it has the ability to contour the metering lip across the web. Similar to the die, the flex bar is equipped with adjusting bolts every three inches cross web.

A variation of the flex bar is the Direct Metering Flex Bar coater illustrated in the 6 o'clock position. The direct metering can be operated with the bar in any of the locations. The direct metering applies the coating directly onto the web and meters the coating at the gap between the web and flex bar. This option is good when the coating does not wet out the web when applied by the applicator or when the coating does not wet out the applicator roll.



### **Example: Tape**

Solvent Based Adhesive @ 37% solids

Substrate – Film

Coater Setup:

Backup Roll - 65 Shore 'A' Buna N

Applicator Roll – Precision Chrome Plated

Flex Bar @ 6 o'clock position

Coatweight 22.9 Lbs. / Ream

Flex Bar / Applicator Roll gap – .004"

