HOW TO CHOOSE A PRIMER FOR EXTRUSION COATING & LAMINATING

THE technique of applying molten thermoplastic resins, such as polyethylene or various copolymers, on paper, foil or plastic film provides a method to combine two substrates or to coat one substrate with a functional layer.

The manufacturer of flexible composites uses these processes of extrusion laminating or extrusion coating to replace laminating or coating by other means so he can utilize existing extrusion equipment, achieve faster line speeds and realize economic advantages in lengthy production runs. One study of the extrusion process cited low resin cost, minimal storage requirements, flexibility in coating changes and improved clarity as advantages.

Fig. 1 is a diagram of an extrusion coating operation with the use of an in-line extrusion primer. Fig. 2 shows an extrusion laminating process using an in-line extrusion primer.

For extrusion coating and extrusion laminating, the final product is only as good as the adhesion of the extrudate to the substrate. This adhesion may relate to mechanical factors, including the flow characteristics of the extrudate and the porosity of the substrate. For example, a PE resin with a high melt index will flow into the interstices of a paper or paperboard substrate and coat any protruding fibers, thereby providing physical anchorage.

Investigators have conducted numerous studies regarding the bond of PE to a substrate. They examined the variables both in the extrusion process and the PE resin and generally found that bond values increased with higher extrusion temperatures, higher coating weights and higher melt index resins. Processing conditions that exposed the PE to air for a longer time promoted the formation of carbonyl and hydroxyl groups by surface oxidation. These functional groups gave increased adhesion.

Copolymers of ethylene and acrylic acid and some other extrusion resins already contain reactive sites and may not need oxidation to promote adhesion.

The high odor levels and increased heat sealing temperature requirements that may accompany the higher bond values obtained by oxidation are often unacceptable when preparing the final package. Extrusion users are, therefore, interested in the higher bonds that chem-

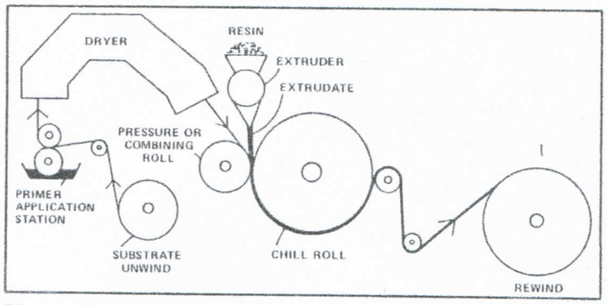

Fig 1. Extrusion coating.

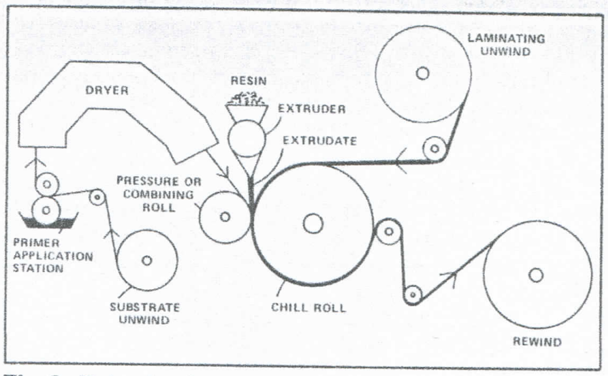

Fig 2. Extrusion laminating.

ical primers may offer at more acceptable operating conditions.

Because mechanical adhesion will not usually occur on smooth or nonporous surfaces, such as polyester film or aluminum foil and because PE resin oxidation may cause odor and heat sealing problems, it's often necessary to use other techniques to improve adhesion. These techniques involve some type of surface modification, such as flame ionization treatment and electrostatic (corona discharge) treatment that presumably function through the same chemistry involving oxidation, which may render a surface receptive to ink.

Another method is the use of chemical primers. This article will address such chemical primers, both to enhance adhesion and, in many cases, to contribute other desirable end-use properties. Frequently, electrostatic treatment accompanies the use of chemical primers.

It's important to discuss theory of adhesion prior to any mention of the chemical primers because this background will contribute to a better understanding of the performance and to the proper application of the primers. The theory of chemical adhesion for extrusion priming isn't necessarily simple and not altogether thoroughly understood.

However, in simplified terms, the extrudate either contains or is processed so it will contain chemically reactive sites. In conjunction with this, the substrate must be readily wettable or reactive or both.

A primer appears to serve two main functions as the extrudate contacts the substrate. First, it helps to provide an uncontaminated surface so the extrudate will rapidly spread and uniformly wet out. Second, the primer joins to both the substrate and the extrudate by a covalent bond, hydrogen bond, van der Waals force, dipole interaction or some mixture of these effects. The ability of the primer to increase the number of reactive sites on the substrate and maximize intermolecular attractions is especially important with nonpolar surfaces.

Contaminated surfaces that can interfere with proper adhesion include those carrying dirt particles, residues of foil rolling lubricant, migrating additives like waxes and oils, and low-molecular-weight polymer fractions. These surface impurities are in themselves or cause the development of adhesively weak layers at the surface of the substrate.

Despite the probable existence of adequate surface energy on the pure substrate, these contaminating factors can restrict the number of actual contact points between extrudate and substrate as well as limit wetting out by the molten resin. This also leads to formation of tiny air pockets that act as stress points causing weakened bond strength. By avoiding these potential problems, maximum wetting provides maximum intimacy between extrudate and substrate. This, in turn, encourages the highest possible intermolecular attractions to develop at the interface.

Physical performance requirements of primers in the flexible laminating process depend on the machine configuration and the substrates. Adherability to the primary web is one consideration. Compatibility with the applicator system, which may consist of rotogravure, smooth roll with or without metering bars, or air knife, influences primer selection.

Considering the relatively high speeds of extrusion coating operations and the relatively low applied weights of primers, the manufacturer must be able to maintain the applicator station and drying equipment to produce a smooth and continuous layer of primer.

In virtually all packaging procedures involving flexible webs, heat plays an integral part in forming and closing the package. Conditions of time, temperature and pressure required for proper sealing and adequate productivity often expose the composite packaging substrates to stresses that would cause instability to or degradation of some of the component layers, if unsupported. Thus, the extrusion primers must maintain interfacial bonds through stresses applied later, such as heat sealing, hot filling, thermoforming, freezing and others.

The finished package won't function unless the combined layers provide both structural strength and product resistance. The latter property generally depends to the greatest extent on the first few layers nearest the product, including the heat seal layer, primer, and supporting or supplemental barrier layer.

The types of primer include:

- ☐ Shellac.
- ☐ Organic titanate.
- ☐ Polyurethane.
- ☐ PE imine.
- ☐ Ethylene acrylic acid.
- ☐ Polyvinylidene chloride.

Shellac is a natural, resinous product secreted by insects. It's suitable as a primer on aluminum foil. Almost all of the world's supply originates in the Indian subcontinent. Users are subject to the vagaries of climate, labor, world demand and similar restrictions. It has many years of history as a wash coating for foil.

Shellac is available in dried flake form or dissolved in alcohol. Normal application is to the exposed side of an aluminum foil surface in the course of wet bonding the foil to paper. Coating deposition is approximately .08 to .16 dry gsm. The coated product dries easily and requires no curing cycle.

PE extrudate will adhere to the shellac, although there is a severe limit to package performance. Based on its relatively poor heat, moisture and chemical resistance, shellac as a primer is only suitable for the containment of dry, bland products.

Alkyl titanates, such as tetraisopropyl titanate, titanium acetylacetonate and others, were among the earliest extrusion primers. These materials function by hydrolyzing on the coated web after drying to form a film of amorphous titanium dioxide. Application is from a very dilute solvent solution at about 5% solids to provide very low coating weights.

The hydrolyzed titanates provide good adhesion for an oxidized PE extrudate and give a product with a fair level of heat, chemical and moisture resistance. In actual use, the alkyl titanates often proved unsatisfactory because of their extreme moisture sensitivity.

Because hydrolysis to the titanium dioxide stage occurs with traces of water encountered in the atmosphere, particles that didn't adhere to either the substrate or extrudate tended to form in the liquid. The variabilities in adhesion and performance of the alkyl titanates have resulted in the virtual abandonment of such systems.

One of the largest classes of extrusion primers in use today is the curing type based on polyurethane chemistry. This covers a wide range of products, including: single-component polyurethane prepolymers that cure by reaction with moisture, two-component systems where an isocyanate terminated prepolymer reacts with a hydroxyl compound, two-component systems where an isocyanate compound reacts with a PET and amine-terminated polyurethane prepolymers that react with epoxy resins. Organic solvents, such as ethyl acetate, methyl ethyl ketone and toluene, generally are the solvents for these primers except for the amine-terminated system, which uses alcohol.

The polyurethanes are often laminating adhesives used at somewhat lower coating weights for extrusion applications, although there are some having extrusion priming as their primary use. Typical coating weights range from .8 to 1.6 dry gsm. The solutions of primers, although reactive, usually have 12- to 24- hour pot life after being mixed for use.

Bond strengths immediately after extrusion are sufficiently high to prevent adhesion problems. A large percentage of the cure occurs in 24 hours. Total cure is complete in five to seven days. A primer with more than 20 years commercial use is PE imine. The earliest forms were simple solutions of the polymer in alcohol, which were further diluted with alcohol or alcohol and water mixes. Later, aqueous forms became available.

Unformulated PE imine solution primers contribute basic adhesion enhancement but provide little chemical or moisture resistance. Formulated versions of PE imine provide chemical and moisture resistance partly because of improved cohesive strength.

The coating weight for PE imine is about .03 dry gsm. These primers wet out effectively on paper and corona discharge treated films. After wetting and spreading, the PE imine adheres to the carbonyl and hydroxyl groups on the base substrate. Then, other reactive primer sites react with the oxidized sites on the extrudate.

Theoretically, a monomolecular layer of primer should function on the fairly smooth and uniform surface of a plastic film. While this is mechanically impossible, the primer deposit is kept to a minimum because this type of molecule has limited cohesive strength. Thus, an excessive layer of PE imine-based primer can negate the entire effort.

Another reason for exercising care to limit applied weight is a tendency of PVDC-coated films to take on a faint yellow discoloration in the presence of PE imine primers as well as some other adhesive systems. This condition becomes more apparent as primer weight increases.

Drying is important. However, when papers are being

General Guide To Extrusion Primer Performance

Type of Primer	Adhesion Characteristics: Paper	Metal	Plastic Film	Performance Characteristics: Heat Resistance	Moisture Resistance	Chemical Resistance
Shellac	Poor	Excellent	Poor	Poor	Poor	Poor
Organic Titanate	Good	Good	Good	Fair	Fair	Fair
Polyurethane	Very Good	Excellent	Excellent	Excellent	Excellent	Excellent
Polethylene Imine	Very Good	Good	Excellent	Excellent	Fair	Poor
Ethylene Acrylic Acid	Excellent	Excellent	Fair	Fair	Excellent	Good
Polyvinylidene Chloride	Excellent	Fair	Excellent	Good	Very Good	Fair

coated, a portion of the diluent will migrate into this porous substrate. Despite the presence of large amounts of water in many of the formulas rather than the more volatile organic solvents, drying is easy due to the relatively low total weight applied.

With adequate extrudate temperature (315° to 325°F for LDPE or MDPE) on equipment properly programmed relative to air gap versus line speed, PE imine primers should provide off-machine destructive bonds on the typical PE/paper or PE/film constructions. Heavier constructions for certain industrial applications should impart tensile peel readings of 500 g or more per 25 mm width.

PE-imine based primers require no curing cycle. A marginally low extrudate temperature may compromise initial bond and a subsequent increase might develop over the next few days. Attention to proper processing conditions will negate this aberrant behavior.

Foils exhibit an entirely different chemical surface from plastic films. Acid functional groups bond to metal surfaces. Accordingly, ethylene acrylic acid copolymers are the base for a group of aqueous primers for aluminum foil, other metallic substrates and various polar materials.

Coating weight for ethylene acrylic acid copolymer primers varies between .16 and 1.2 dry gsm, depending on the particular formulation and the need for product resistance in the final package. This primer system can provide bonds with good resistance to water, grease, oil and many chemicals.

Ethylene acrylic acid copolymers further possess the intrinsic property of flexible toughness due to a lack of crystallinity. Because some foils that are fully annealed (dead soft) and supposedly completely wettable occasionally have oily residues at random locations in a roll, many processors will use small amounts of alcohol as a codiluent with water in ethylene acrylic acid primers to ensure consistent wetting.

Emulsion copolymers of PVDC offer high-barrier properties because of their low permeability to water vapor and oxygen. Combined with their resistance to fats and oils, this makes such copolymers a suitable choice for an extrusion coating or laminating primer. Various materials are available. Some even provide barrier performance as low as 9 cc oxygen/sq. m/24 hours under proper coating conditions.

The primers will promote adhesion at coating weights of 2 dry gsm, although very high barrier properties may require a coating weight of 3.2 to as much as 4.8 dry gsm. Optimum barrier is only possible with a continuous film. Applying two passes of primer is one method to ensure this. Although PVDC copolymers adhere to a variety of substrates, best adhesion occurs on PVDC copolymer films.

The primer will provide a modest initial bond value that will age in one to two days to a high percentage of its ultimate bond. Full strength only occurs after one to two weeks while the PVDC copolymer undergoes cold flow, internal cross-linking and crystallization.

Handling of PVDC copolymer emulsions is critical because the pH is in the range of 1.5 to 2, making them extremely corrosive. Therefore, the coating head that deposits the primer and all of the materials for the primer handling system must be a suitably corrosion-resistant material like 316 stainless steel.

Acrylic copolymers, ethylene vinyl acetate copolymers, propylene copolymers, melamine/formaldehyde resins and other chemical types contribute to rounding out the collection of available primers. These groups comprise a smaller amount of the commercial volume. They provide specific performance, economic or other requirements for certain uses. Due to a host of governmental and economic pressures, including environmental and workplace legislation, many of these miscellaneous primers are aqueous systems.

Much information undoubtedly exists on the performance properties of various primers on different substrates. Unfortunately, the primer users themselves probably have compiled the most useful data, and they keep it private for competitive reasons. Occasionally, there may be reports from extrusion primer manufacturers or extrusion resin suppliers.

The accompanying chart offers a generalized description of the adhesion that various primers will provide on paper, metal surfaces and plastic films as well as the heat, moisture and chemical resistance that might result. It's only a guide. Specific end-use requirements for adhesion or environmental resistance will only result from evaluation of a given primer with the extrudate of choice in the actual application.

Some general comments regarding extrusion primers are obvious from this tabulation:

☐ The polyurethane systems generally offer the best resistance properties and the widest range of adhesion.

☐ The PE imine, ethylene acrylic acid and PVDC types of polymers provide good adhesion and selected resistance characteristics.

☐ Shellac and the organic titanates don't offer high performance characteristics and only limited adhesion properties. This obviously accounts for their rather small use today.

☐ The miscellaneous primers absent from the table can frequently offer excellent adhesion and resistance because their actual development often was for very specific end-use applications.

Despite the specialty performance aspects of each primer type, none will provide panacean performance. Consistent results depend on consistent conditions. Proper standards for each type of run—including extrusion temperature, air gap and web speed—are necessary.

Application by gravure cylinders generally provides the heavier lay down necessary for PVDC, polyurethane and most ethylene acrylic acid primers. This technique also suffices for shellac priming. For example, a 200 quadrangular roll will deposit approximately .8 gsm using a 25% solids primer solution.

The typically low application weights for PE imine primers encourage use of a smooth roll with very dilute solutions or the use of a very fine gravure cylinder. Thus, the primer user may apply a 1% to 3% solution simply by flooding with a smooth roll or with a 200 or 300 quadrangular roll.

The coating weight range of ethylene acrylic acid primers makes gravure cylinders or wire wound rods a suitable choice for higher depositions and smooth roll transfer the choice for the lower depositions. The smooth roll transfer is only suitable for the lower range of applied weight if the high pressure for metering at the applicator nip doesn't have adverse effects on the end bearings of the applicator system. Also notable is the fact that an increase of the hydrokinetic pressure of a primer at faster operating speeds could tend to force the metering rolls apart and, thereby, defeat the efforts to limit coating weight.

With the exception of some paper substrates, extrusion laminating operations involve combining relatively impervious layers. Some coated papers fall into this category as well. Drying the applied primer is essential to effective bond performance. Therefore, it's necessary to establish adequate drying conditions through control of temperature, air volume and air velocity. In addition, don't use recycled air in the final zone with solvent-borne primers.

The typical machinery configuration consists of the primer application station and drying tunnel located immediately preceding and in-line with the extrusion coater. From the aspect of chemical primer function, this is most effective and most reliable. Also, there is little possibility of abusing or upsetting a primed surface before extrusion coating. When using primers with residual tackiness after drying, however, minimize or eliminate contact with idler rolls.

Many manufacturing operations involve out-of-line priming for a number of reasons. One configuration is the use of the last station of a press during the printing process. In such out-of-line operations, thorough drying and low tension rewind are necessary to minimize blocking or picking of even dry primers. Limited holding time before the next unwind minimizes contamination if potentially migratory components are present.

Aluminum foil can react with ingredients in paper to develop a weak boundary layer on its surface by the formation of extraordinary aluminum salts. This phenomenum is known as poisoning. Coating the aluminum surface of a foil/paper composite with shellac or a vinyl wash coat will prevent poisoning.

In some instances where high-performance requirements aren't necessary, these coatings provide the dual function of preventing contamination while offering adherence. In any event, processing procedures and machinery configuration can influence the use of different primers in order to obtain optimum chemical resistance in a composite using aluminum foil.

There are a number of difficulties that can arise during an extrusion coating or laminating operation to hinder trouble-free operations. Many of these relate directly to the extrudate or the extrusion equipment. However, there are problems that may sometimes arise from the primer itself or its application.

The user must know all of the instructions applicable to the extrusion primer and follow all of the recommendations regarding storage, mixing and the need to avoid contamination with certain materials. For example, aqueous products are prone to freezing and may not be freeze/thaw stable. Certain two-component primers require given mixing orders and specific mixing ratios. Alcohol will contaminate isocyanate-cured systems and will inhibit their cure. Water will decrease their pot life. Therefore, such systems require the use of solvents designated as urethane grade.

Dilute the extrusion primer with a material which won't attack inked or otherwise coated substrates. Methyl ethyl ketone or ethyl acetate readily attack PVDC-coated films with resultant loss of some anchorage of the coating and possible odor problems in the packaged item. Surfaces like nylon and cellophane, which are hydrophilic, require special care.

Use the primer at the correct coating weight deposition. Apply PE imine-based primers at extremely low coating weights, since they might not function at higher weights. Conversely, apply most of the other primers at higher weights.

Uniform deposition is important for all primers, but it's vital for PVDC copolymers that won't provide barrier properties if there are pinholes or other irregularities due to foaming, poor wetting or cracking of high coating thickness films during drying. Of course, PVDC copolymer weights directly influence barrier and product preservation. Product containment performance also relates to the amount of deposition for polyurethane and ethylene acrylic acid primers.

When coating a primer onto a porous substrate like paper, exercise care so all of the primer isn't absorbed into the material. Enough primer must remain on the surface to contact the extrudate.

Using a smoothing bar to wipe the surface uniform, corona discharge treating the substrate or using specific diluents in the primer will often remedy poor wetting of a primer. In the case of waterborne primers, alcohol is usually an excellent diluent to improve wetting. Adding more diluent to reduce viscosity should help solve the problem of a primer that doesn't flow on the substrate.

Pattern marks from the application of the primer that are evident in the final product may be the result of too rapid drying before the primer can flow sufficiently. Increasing the time prior to drying or adding a diluent that evaporates more slowly will remedy this situation.

Two-component primers that cure on reaction sometimes don't exhibit their normally high bond values if precuring occurs in the drying operation before the extrusion process. Lower oven temperatures or faster line speeds are solutions. Drying is a critical step in the extrusion priming process. No volatiles should remain in the primer because this can lead to blistering on application of hot extrudate. Minute amounts of solvent can also cause odor problems in the final package.

Finally, when there is still a poor bond even after investigating all of the above items, the use of some detective work can usually lead to a ready explanation. The mode of failure of the bond is the basic piece of information that will give the clue to the problem.

Adhesive failure of the primer from the substrate could mean contamination of the substrate by foreign matter, improper coating weight or, simply, the use of the wrong primer. Adhesive failure from the extrudate could also mean insufficient coating thickness, the wrong primer or improper processing of the extrudate.

Cohesive failure of the primer is indicative of excessive coating thickness, insufficient time to cure, the need for a curing rather than a thermoplastic primer or the presence of a contaminant that retards or inhibits the cure. Failure of an ink or a coating is often not related to the primer but is a function of the ink or coating component itself.

Extrusion coating and laminating have existed for almost 40 years. At the time of its inception, PE was the prime resin choice for the extrudate. Through the years, this material has continued to be one of the most popular resins for extrusion. Today, however, many other resins also find use. A given primer may not work for all of the available resins.

Depending on the particular properties and performance necessary, one of the wide array of primers mentioned above will function as an extrusion primer for PE. Thus, one might use a primer based on PE imine for a construction where PE is extruded onto paper for a dry food packaging application, a primer based on a two-component curing polyurethane for a construction where PE is extruded onto PET for making inexpensive liquid-containing pouches or a primer based on a PVDC emulsion for a construction where PE is extruded onto paper for a snack food package requiring moisture and oxygen barrier properties.

The ionomer resins generally function with any of the primers suitable for PE. Ionomers generally adhere well to clean foil without the assistance of primers, although ethylene acrylic acid primer will provide security, especially with contaminated foil. Polypropylene resins present some problems with adhesion because they are more difficult to oxidize than PE. If there are satisfactory conditions to achieve sufficient oxidation, then the two-component curing polyurethane primers will function to enhance adhesion with a PP extrudate.

The maximum melt temperature for extrusion of ethylene vinyl acetate copolymers is about 232°C. Due to this relatively low temperature, many of the primers discussed above won't function with these extrudates. One workable approach involves modified EVA copolymers dissolved in organic solvent and cross-linked with an isocyanate-containing curing agent. Specially formulated ethylene acrylic acid based primers also might fulfill these needs.

Another method of accomplishing low-temperature extrusion coating is the utilization of generated ozone to contact the molten extrudate as it passes from the extruder die lip to the combining rolls. Delivery of this highly oxidative gas to the intended side of the melt contributes to adequate oxidation that wouldn't otherwise occur at the given temperature. In addition to enabling extrusion of low-temperature resins, ozone generation also permits temperature reduction when processing conventional PE. A manufacturer may perform these operations with the regularly used primers.

Other extrudates enter into extrusion coating to a lesser extent. Ethylene acrylic acid resin provides effective adhesion on foil without primer assistance. Ethylene ethyl acrylate resin extruded onto plastic film requires a chemical primer as well as special handling techniques. The same requirement applies to extrusion coating with nylon resin.

The producer of flexible composites should select primers for any other extrusion coating and laminating resins based on consultation with the resin and primer manufacturers. This should be followed by performance trials.

Flexible laminate manufacturers handle paper in diverse ways due to its porous nature and polar functionality. For some relatively low-speed, low-demand applications on some uncoated papers, no primers are necessary for the extrusion coating operation.

Likewise, no primer is used for parts of some extrusion laminating operations involving a combination of paper/PE/foil/PE for pouch stocks for dry product packaging, even though this usually isn't a low-speed converting operation. The foil barrier prevents contact by the contents with the outer paper which, in addition to being the decorative surface, provides strength by minimizing the possibility of foil cracking or tearing. Many converters will extrusion laminate the paper/PE/foil portion with no primer assist.

In some situations involving carton stock for liquid packaging and other paper or board applications, flame or corona treatment of the substrate will increase the number of oxidized sites, negating the need for any chemical primer.

On the other hand, the use of primers achieves the ultimate speed and efficiency in extrusion coating and laminating. An example is a lightweight paper/PE combination for pouch stock where reduction in quantity of extrudate occurs with concurrent increase in speed. PE imine-based products are the major primers for paper use, while melamine/formaldehyde resins and ethylene acrylic acid systems are secondary.

There are a number of different ways to handle aluminum foil. A limited amount of laminate comprising foil/PE for totally dry, bland end uses requires only corona treatment of the foil enroute to the extruder lip. This removes any residues and ensures wet out of the extrudate. Some extruders use ozone to further oxidize the molten extrudate before application to clean foil.

Solvent-based polyurethanes satisfy the highest demand applications, although environmental pressures have prompted the development of acrylic and other aqueous systems to supplant some of this consumption.

A large volume primer class in foil service consists of the ethylene acrylic acid copolymers. Ease of handling, economic yield and broad demand performance enables users to make lengthy runs by scheduling successive jobs capable of using this type of primer.

The use of PE imine primers in some low demand foil applications may provide marginal containment performance, especially where some moisture resistance is necessary. Special formulations based on EVA and ethylene acrylic acid are available for application of low-temperature extrudates to foil.

In the case of plastic films, the ability of corona treatment to develop carbonyl and other oxidized sites on an otherwise nonpolar surface allows PE imine primers to fulfill many applications. However, high demand applications often require solvent-based polyurethanes.

Another system for this use is melamine/formaldehyde primers. Note that the usual relationship of extraordinary primer for extraordinary end use may be less rigid with film usage.

Alternately, PE imine-based primers have qualified for boil-in-bag (PET/MDPE), thermoformed meat packaging (nylon/LDPE/EVA copolymer) and ethylene oxide sterilizable surgical packaging (PET/LDPE). Extruders should consult primer suppliers regarding applicability of their products and carefully evaluate all new end uses or substrate combinations.

When using coated substrates, the ability of the primer to wet on and bond to the particular coating must be considered. Avoiding disruption of the anchorage or adhesion of the coating to the substrate—for example, by solvent attack—is equally important.

Probably the most common coated surface encountered in extrusion processes is PVDC copolymers on films and papers. In this instance, PE imine primers have an affinity for the halogen portion of the PVDC molecule. However, potential wetting problems, caused by the offsetting of jaw release agents, slip additives and other nonadherable materials must be considered and accommodated through judicious use of codiluents or corona treatment. Primer suppliers can often provide valuable assistance.

Quest for the Perfect Extrusion Primer (PAPER, FILM & FOIL CONVERTER, July 1984) describes the attributes of a perfect extrusion primer. While the primer manufacturer may never succeed in developing this perfect primer, two factors will influence research efforts. The first will be to supply primers that conform to the various environmental concerns that are becoming more and more stringent as each day passes. Secondly, the customer will influence the primer manufacturer to provide products that offer better performance and/or better economics.

Primers in water or other environmentally agreeable forms will undoubtedly be the materials of the future. They will apply easily to the substrate and will offer adhesion to a wide variety of substrates with suitable heat, water and chemical resistance. Finally, all of this will occur with low cost materials that are readily run at rapid coating line speeds. ■