Laminated Aluminum Foil

Laminating consists basically of combining a web or sheet of aluminum foil with one or more other materials, such as paper and plastic films, using an adhesive, pressure, and usually heat for controlling adhesive viscosity, drying and/or thermo-setting the bonding agent. The resulting product is a sandwich of three or more layers, e.g., foil/solidified adhesive/and another material. For the most part, aluminum foil is laminated on web-fed, rotary equipment (Fig. 1) which also frequently includes a coating unit for coloring or otherwise pre-coating the aluminum foil.

The laminating process requires that the rolls of foil and other material be unwound and that a controlled application of adhesive be applied to one or the other, or occasionally to both of these webs. This combination of foil, adhesive, and other material is then brought together when it passes through the nip of the combining rolls; (Usually one steel and one rubber roll). These apply just enough pressure to marry the materials into a single web.

Frequently, one or more coatings are also applied to the foil side, to the film or paper side, or to both sides of the lamination. This may be done in-line where practical, or subsequent to combining. Such coatings are typically decorative, protective, or are priming or anchor & coatings for printing inks or other converting materials. Thus, the converter is able to color
or otherwise coat the web at the same time he laminates it, achieving the obvious economies of performing two or more operations at once or in one pass through the machine or line. Some basic characteristics of typical foil laminating are given in Table 6.

Most modern aluminum foil laminating machines are built on this unit, or station, principle. A typical in-line sequential arrangement is depicted in Fig. 2. A five unit arrangement is common, with unit variations depending upon the particular process. The basic five are two unwind units; an adhesive applicator; a combiner or pressure rolls; and a rewind. Additional units often included are another coater and a dryer. Some laminators also include combining rolls after the drying unit for laminations made by applying the adhesive to a web and drying it before combining the materials. The steel roll of these combining units is most often heated to reactivate the dried thermoplastic adhesives so that the lamination can be accomplished.

From the standpoint of the types of adhesives and the bonding process used, there are four main methods of laminating aluminum foil.

- **Wet-bonding** – combining is done before adhesive (water-based or solvent) is dry, usually with combining rolls.
- **Dry-pressure or thermoplastic-bonding** – combining is done after adhesive is dry; the steel roll is usually heated to help reactivate the adhesive.
- **Extrusion bonding** – combining is done simultaneously with application of hot adhesive; in this case, the hot plastic, such as polyethylene, which is deposited from an extrusion die located at the combining roll nip, formed by a rubber and a steel roll. The steel roll is chilled to affect the bond by setting or solidifying the plastic quickly.
- **Hot-melt bonding** – combining is done shortly after the adhesive (waxes and other thermoplastic compounds) is applied. Both reservoir pan and application rolls can be heated. Sometimes combining rolls are used, but the adhesive bond is achieved by chilling the hot adhesive, either with a chill roll, air blast, or by other means.

Heated driers are used in laminating aluminum foil:

- In wet-bonding, to remove the solvent or diluent (in this case, water), by evaporation through the porous web, after combining but prior to rewind.
- In dry-bonding, to evaporate the solvent from the adhesive film before combining. This method is most used when laminating two non-porous webs, where removal of solvent after combining would be difficult and impractical.

In extrusion and hot-melt laminating, no dryers are required because no solvents are involved. Instead, cooling rolls, a chill drum, a chilled atmosphere or cold bath are employed.
to solidify or set the melted adhesive.