

# Lamination Suitability for Flexible Packaging Application (A Case Study Of “UFLEX Ltd”, Noida)

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**Abstract:** Lamination is the process of bonding a plastic film to a printed sheet by means of heat and pressure for protection of the work or to improve the appearance of the work. The printed cover of books, record cover, jacket etc. laminated with a thin clear transparent acetate film which protect from moisture scratch, wear and tear and also provide a high gloss. Lamination protects paper from tears; spills, wrinkles, and any other substance that could alter the text or graphic were it to make contact with the original paper. It also intensifies colors and improves the overall appearance of printed document and signs. Different projects require a different weight of lamination film, depending on use and location of the item to be laminated, and finishes are available in matte, gloss, or satin.

## 1. Types of Laminations -

Different methods of lamination are classified as below:

**Heat & Pressure Lamination-** In this process heat & pressure are applied to join two substrates. One of the substrates has to be a good conductor of heat and the other could be a plastic film such as Polyethylene which has been corona treated. A corona treating system is designed to increase the surface energy of plastic films, foils in order to allow improved wet ability and adhesion of inks, coatings and adhesives.

- a) **Adhesive Lamination** - The process where a solution or emulsion of low molecular weight polymer adhesive material is coated on to the surface of one substrate, before joining the second substrate is typically called adhesive lamination.
- b) **Hot melt lamination** - The molten wax is roller coated on to the substrate and the other substrate is laminated under nip pressure and passed over a chill roll immediately. Wax impregnation is carried out by entirely dipping the substrate in molten wax tray. Wax coated or laminated or impregnated papers are widely used in biscuit and confectionery industry
- c) **Extrusion Coating lamination** - The material in the barrel is heated, molten and extruded through a flat die in the form of thin layer. This thin layer is coated on to the other substrate and passed immediately through the chilled roller and wound in a reel form.

## Research objectives

To study & determine lamination suitability and degree/amount of adhesive coating needed for lamination on different flexible packaging products.

- To identify problems and their possible remedial actions need to be taken during lamination process.

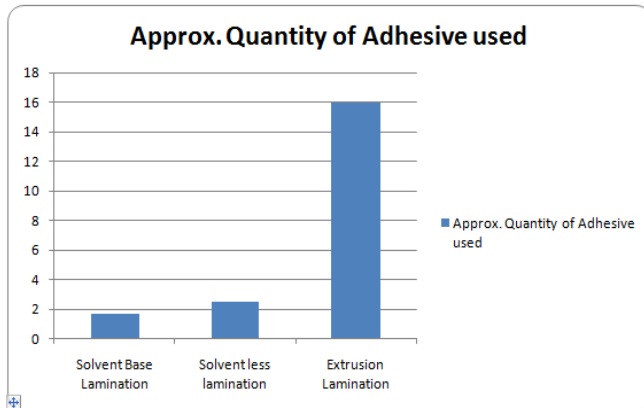
## Data analysis:-

As there are many factors which are discussed during study of shelf life of biscuits. On the basis of these factors data is recorded and charts are created. These are shown below with their values. These charts will show how the shelf life of biscuits affected by these factors and changes in values will extend shelf life or retard it. For all this analysis data is plotted in charts and shown to realize values to check shelf life of biscuits. These factors are firstly discussed and then, charts are plotted to show them literally.

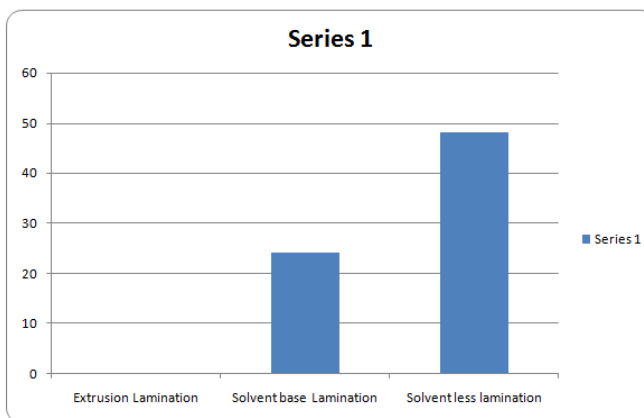
1. **Suitability for product packed inside:** Lamination process for different product is selected on the basis of characteristics of product packed in side. we find that solvent base lamination is suitable for all type of lamination like laminate for food products, metalize film lamination, chemicals, petroleum products etc. Solventless lamination is less preferable for metalized film laminations. Solvent less lamination is suitable for all type of juice packaging and in some packaging where ethyle solution is not required in solvent. Solvent less lamination is suitable for ready to eat products and for light weight products. Extrusion lamination is used for all bulk products packaging which require more strength in lamination. In all type of laminated woven BOPP bags we will use extrusion lamination. Wet lamination is used where one of the laminating substrate is paper or any porous substrate. Suitable for all type of light weight product packaging.

End Use	Solventless Lamination	Solvent Base Lamination	Water Base Lamination
Snack Food	✓	✓	✓
Confectionery	✓	✓	✓
Meat and Cheese	✓	✓	✓
Stand Up Pouch	✓	✓	+/-
All Plastic Lamination	✓	✓	✓
Barrier Plastic Lamination	✓	✓	✓
Metal Lamination	✓	✓	✓
Fresh Produce	✓	✓	✓
Medical	✓	✓	✓
Hot Fill and Boilable	✓	✓	+/-
Retort	✓	✓	No
Agricultural Chemicals	✓	✓	+/-

2. **Adhesive GSM:** By analyzing the data from above tables it is quite evident that GSM of adhesive used is more in solvent base lamination as compare to solvent less lamination. This is because some amount of solvent in adhesive evaporates in the environment. In extrusion lamination the amount of LDPE extruded is much higher but that LDPE is used as a film as well as adhesive in laminate.



3. **Curing Time:** From the above data collection, we find that curing time in solvent base lamination is more. Because in solvent base adhesive, there is less solid content as compare to solventless adhesive. In extrusion lamination there is no requirement of curing because during lamination when laminate comes in contact with chilling roll then molten LDPE transforms in solid form.



4. **Green Bond:** Green bond is that bond in laminate till the adhesive dried completely. It is more in solvent base lamination as compare to solventless lamination because more curing time is require in solvent base lamination. There is no green bond in extrusion lamination because when molten LDPE come in contact with chilling roller, it becomes solid.
5. **Eco-Friendly:** From the above data, we find that there is volatile content in solvent base lamination. The volatile content evaporates in environment during processing that is environment hazards. Such types of volatile contents not

evaporate in solventless lamination and extrusion lamination.

### Problems during lamination and their remedial solution-

#### 1. Accurate and Reliable Web Tension Control:

The tension of the substrate- from unwind to rewind- should be precisely regulated to avoid formation of creases, wrinkles, curl etc. and obtain a good finished roll of laminated material. The winding pressure must also work uniformly over the whole web width as otherwise there will be risk of telescoping.

#### 2. Regular and Uniform Adhesive Application

In the solvent process, the speed differential, temp determines the adhesive quantity. and gap between the coating rolls. These variables should be monitored and controlled accurately as this will not only influences the overall properties of the final laminate but also affect the economies of the process.

#### 3. Nip Pressure and Temperature Control

The adhesive coated web is combined to the corona treated secondary web at 50°C to 70°C, by heating the nip roller. The nip pressure must be worked evenly over the web. If the pressure is too low the air will get entrapped. If pressure is too high it will lead to squeeze.

#### 4. Corona Treatment

While some films may be treated to the proper level, other films may need additional treatment on the laminator to promote adhesion. Poly principally has to be treated above 38 dyne/cm. In case of additional treatment in the machine i.e. online corona treatment on the backside must be avoided (sealing weakness).

#### 5. Roll Stage

The rolls are stored in hot room (48°C) to accelerate curing which result in better bond strength and visual characteristics. To avoid the rolls taking a set during the curing process, they should be suspended horizontally and the store in a track.

#### 6. Speckling

This occurs when there are white spots in the laminate at various positions. This is due to incorrect gsm of adhesive used in the process of lamination

#### 7. Delamination

This is the problem where the two webs which were laminated together are somehow not adhered properly. This problem arises whenever lamination machine is to be stopped for any defect or some other reason and this then has to be removed while slitting.

#### 8. Blocking in the Laminate

The problem of blocking in the laminate results if the adhesive application is such that some portion of adhesive is not entirely in between the two webs due to which one web tends to stick over the other one which during storage over a period of time, with the pressure of rolled laminate tends to block the laminate.

## 9. Lamination Wrinkles

Two different forms of wrinkles can occur: those which form in the lamination nip, and those which appear some time after lamination (also known as post-lamination wrinkles). Both of these wrinkles are closely associated with the polyester base film which supports the photopolymer layer but are caused by factors independent of the base film.

## 10. Adhesive Line

Foreign particles like dust, dirt and some unwanted matter may stick to the engraved cylinder which makes a continuous line in the laminate .this problem arises time to time hence it is important to clean the cylinder within specified time to eliminate the problem.

## 11. Curling

The cause of curling during drying is two sidedness and therefore non uniform dimensional changes when exposed to temp and humidity. Due to this shrinkage takes place in the coating side and curling occurred.

## 12. Tunnelling

Web tension of the two substrates should be proper otherwise this problem can come. Second reason may be the ratio of the adhesive can be different or some different grade of adhesives.

## 13. Blister and Speckling

It may formed during drying,

- Entrapment of liquids under the adhesive layer, it evaporates when exposed to a higher temp.
- Introduction of air trapping.

## Conclusion

The entire analysis shows that suitability of lamination for different product depends on the property of product inside packed. As regard we are choosing lamination process we have to check product properties and process characteristics like adhesive used, curing time, solvent used etc. Also during lamination process we have to take proper care so that to avoid defects occurs during process.

## Literature cited

- i. **Chen, Mai, Deitch, Jeffrey Harold.** "Solvent Less Laminating Adhesive with Barrier Properties"
- ii. **Takashi Uemura, Shigetoshi Sasano, Yasuhiko Kataoka.** "Solvent Less Laminating Adhesive and Process for Production of Composite Film"
- iii. **Randy A. Johnson.** "Solvent Less Laminating Adhesive for Flexible Packaging Laminations and Laminated Structures Made with Adhesive"
- iv. **Peng Zhou, Lincoln Young, Zongyuan Chen.** "Weak Solvent Based Chip Lamination and Characterization of on-chip Valve and Pump"
- v. **Suppakarn, Nitinat, Cawley, James D. Ishida, Hatsuo.** "Roles of Poly(propylene glycol) During Solvent-Based Lamination of Ceramic Green Tapes"
- vi. **Malecha, Karol, Jurków, dominik, golonka, leszek j.** "Comparison of Solvent and Sacrificial Volume-Material-Based Lamination Processes of Low-Temperature Co-fired Ceramics Tapes"
- vii. **Nitinat Suppakarn, Hatsuo Ishida, James D. Cawley.** "Roles of Poly(propylene glycol) During Solvent-Based Lamination of Ceramic Green Tapes"
- viii. **Akihiko Funamoto, Noriyuki Kobayashi.** "Water-dispersion Adhesive for Extrusion Lamination"
- ix. **Dr. Eldridge M. Mount II.** "Adhesion of Aluminium Foil to Coatings – Stick With it"
- x. **Ling Lv, Wencai Xu, Guangshen Zuo.** "Characteristics Research about Coating System of Solvent Less Laminator"
- xi. **Brewis, D.M., and Briggs, D.( 1985)** "Industrial Adhesive Problems, John Wiley & Sons, New York"
- xii. **Mausar, J.( 2005),** "Manufacturing Pressure Sensitive Adhesive Products: A Coating and Laminating Process."
- xiii. **Petrie, E.M.( 2004.)** "Trends in Adhesive Primers / Surface Treatments",
- xiv. **Voss, P.A.( 1998)** "WB, 100% Solids Adhesives for Flexible Packaging Provide Solvent Alternative."
- xv. **Smith, D.A(2001),** "A Cure for Laminating Adhesives", Adhesives Age, August.
- xvi. **Hanser (2007).** "Handbook of Plastic Technology"
- xvii. **Kipphan, H. (2001).** "Handbook of Print Media", Technologies and Production Methods. (1sted.).
- xviii. **http://www.patentstorm.us/patents/6589384.html**
- xix. **www.google.com/patents/US8377508**
- xx. **http://www.scirp.org/proceeding/PaperInformation.aspx?paperID=13562&bookID=1032&bookTypeID=2**
- xxi. **http://www.freshpatents.com/-dt20111229ptan20110318552.php**
- xxii. **http://link.springer.com/article/10.1007%2Fs10544-010-9436-z**