

HIGH BARRIER METALLIZED PLA FILMS

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Pressure from governments and consumers around the world is forcing the use of sustainable packaging materials, of which PLA is one of the most advanced and market ready products. Our fundamental understanding of moisture transport mechanisms, crystallization and hydrolytic degradation reactions that can take place during production, processing, storage and use of PLA films is relatively limited. The fact is that moisture sorption can lead to irreversible hydrolysis and plasticization based mechanical instability of the PLA surface, which can mechanically damage metallized and clear barrier coatings. Extrusion coatings and laminations can resolve barrier degradation issues, but the protected PLA film will lose some or all of its sustainability value. Our approach to overcome this limitation is to apply a thin high quality acrylate polymer layer on the PLA surface that is unaffected by moisture, has superior mechanical properties, and a thickness that is comparable to barrier layers such as metallized aluminum and clear metal oxides. This does not alter the sustainability properties of the PLA film, while it provides a good foundation for the deposition of the barrier layer. Such mechanical isolation layer also functions as a superior nucleation surface for the barrier coating, promoting strong and permanent covalent bonds. The acrylate coating can be deposited inline with the metallization process, prior to the deposition of the metal layer. The PLA film is plasma treated prior to the deposition of the acrylate coating. The experimental results show that while the aluminum metal adheres well to the acrylate coatings, most acrylate polymer coatings do not adhere to the PLA film, regardless of the level of plasma treatment. A series of acrylate polymer formulations were tried until one was developed that had good adhesion to the PLA film. The Al metal adheres well to PLA, but the MVTR is in the range of 2-3gr/m²/24hr at 37°C, which is unacceptable for many dry snack food applications. The MVTR of all metallized acrylate coated PLA films, is in the range of 0.15 - 0.39 gr/m²/24hr at 37°C, regardless of the adhesion level of the acrylate coatings to the PLA polymer. This MVTR level is about an order of magnitude better than that of the control metallized films, which would qualify the metallized acrylate coated PLA films for use in a wider range of food packaging applications.