

Freshure[®] Coatings: INNOVATION IN CLEAR BARRIER COATINGS

1. PATENTED INNOVATION

Freshure[®] Coatings are produced using SymPhase[®], a patented technology from Royal DSM, now ready for licensing for various applications (www.symphase.com). This presentation outlines the use of Freshure[®] Coatings, both in flexible packaging as a single coat to produce clear barrier coatings (**Freshure[®]-Single Coat**), and as an in-line top coat to protect metallized films (**Freshure[®]-Top Coat**).

2. VAPOR DEPOSITION TECHNOLOGY

SymPhase[®] technology is based on the vapor deposition of melamine. Melamine is a well-known raw material component of adhesives used in the production of various wood and paper related products, such as decorative and floor laminates. Because melamine is safe and FDA-approved for direct food contact it is also used as an ingredient in molding powders for the production of lightweight heat resistant tableware and picnic-ware. Melamine is biodegradable and recyclable, and thus environmentally friendly. DSM Melamine is, worldwide, the largest producer of melamine.

Melamine is evaporated in a vacuum under relatively mild conditions, i.e. source temperature $\pm 300^{\circ}\text{C}$ and pressure around 10^{-2} mbar. To demonstrate the industrial feasibility of this technology, an existing vacuum metallizer has been

successfully retrofitted with a melamine evaporator. A brand new metallizer has also been recently commissioned, equipped with a 1.6 meter wide melamine evaporator. Evaporation occurs at speeds higher than 10 m/s and with optimum uptimes.

Two technologies are available.

2.1 Functional Barrier Coatings

The **Freshure[®]-Single Coat** application finds its origin in the advances in nanotechnology and supramolecular chemistry. In fact it is one of the few examples today where these two scientific tools have joined forces to create functional coatings. Upon vapor deposition, melamine crystallizes as a transparent nano-layer on various substrates such as polymeric films. Because of its ability to undergo hydrogen bonding interactions, during vacuum coating the melamine molecules form an infinite supramolecular network covering – in a fraction of a second – large surface areas. This, in combination with the crystalline character of the coating, gives the melamine nano-layer its unique properties, including a very high gas barrier. On 12 μm PET, the oxygen transmission rate (OTR) decreases from 110 to 1 cc/m²/day and on 23 micron BOPP from 1600 to values below 20 cc/m²/day. It is possible to maintain these OTR values at a relative humidity above 85% and temperatures exceeding 40°C. Because of the hydrogen bonding structure, the coatings are self-healable and much less brittle with respect to inorganic oxide materials. Typical applications for the technology would include barrier flexible packaging materials; microwavable packaging; etc.

2.2 Protection of metallized packaging films

The **Freshure[®]-Top Coat** application has been developed for the production of in-line coating to protect deposited aluminum or oxide coatings on vacuum coated packaging films. For this application, the evaporator is placed after the oxide coating or metallizing unit so that the oxide coated/metallized film is top coated with melamine in one machine pass. In-line coating of oxide coated/metallized films with melamine offers the following advantages:

- **Increased Barrier:** Melamine provides “active” protection of the oxide coated/metallized layer, resulting in improved barrier performance, at three levels:
 - In the vacuum chamber
 - During conversion
 - In food packaging
- **Increased Shelf life:** Surface tension (ST) of standard metallized films usually drops from ~50 to below 37 dyne/cm within 60 days after metallization. With melamine top coating, however, ST remains above 50 dyne/cm for 6-12 months. The potential advantages are:
 - No need for in-line corona treatment before conversion
 - Lamination speed increased by at least 30%
- **Printability:** Melamine coating on metallized films confers instant printability, in contrast to other metallized films, which require additional off-line primers with the following disadvantages:
 - Off-line priming damages the metallized layer
 - Primers are usually gray colored
 - Additional production steps and extra cost for the primer

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