

AlO_x-enabled dual technology

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Bobst Manchester used a standard Aluminium metallising machine as a foundation for its high-refined Aluminium oxide process – the result was the dual-technology Bobst General K5000-2850. Equally suitable for standard Aluminium metallising and AlO_x transparent barrier processes, the new machine has been unveiled to potential customers from around the world at the Heywood/GB site. PACKAGINGFILMS joined Bobst Manchester on one of its three Open-Houses held on October 10–12.

Bobst Manchester has refined the technology for an Aluminium oxide (AlO_x) solution to produce a very thin coating which can retain oxygen and water barrier of film with stretch or post conversion better than other ceramic barrier deposition techniques. A second »unique« offering of the *Bobst General K5000* is the capability to continue to produce standard Aluminium metallised films.

The company's first customer Open-House in its new, dedicated demonstration centre revealed a versatile machine designed to be »easy to run« with minimum operator intervention. *Bobst* told a large contingent of potential customers from around the world that the ability to produce both processes interchangeably on the same machine will help reduce the commercial risk and justify the capital investment of an AlO_x machine based on this developing market for transparent barrier films.

At this stage, prospects look good for the AlO_x market, meeting demand from the food sector and growing at double the rate of Aluminium according to latest figures. The application is suitable for coating a wide range of films including PET, BOPP, CPP and PLA. The coated film can be used for baked goods and microwaveable products, and can be retortable. It gives good product visibility and is suitable for use with metal detectors.

Key features of *Bobst Manches-*

ter's solution are the optimised gas delivery system and a »unique« optical beam system for precision control that enables the AlO_x process to be used for long runs on rolls of more than 50,000 m (164,041 ft) with stable and consistent results.

AlO_x technology uses the controlled injection of oxygen into the Aluminium vapour stream causing a reaction between the two elements. This compound can be transparent if the process conditions are correctly controlled.

A detailed technical presentation on film properties and barriers and adhesion listed the advantages over polymer-based transparent barrier films with PVdC and EVOH constructions. There is no barrier loss at high relative humidity levels; a very thin coating means use of raw material is reduced leading to lower costs. The film as a single-layer material is easier to recycle.

Key to quality control is a monitoring system that at full metalliser speed is able to detect, count and categorise pinholes and other defects from 100 micron upwards at speeds up to 1000 m/min (3281 fpm). Developed internally, *Bobst General Registron Hawkeye*, which gives optical density and pinhole control, is believed to set a new benchmark for in-process control that increases process speeds and improves final product quality.

The first machine demonstration illustrated the process steps required to create Aluminium oxide trans-

parent barrier films on a *K5000* coating platform with a maximum coating width of 2.85 m (112"). The *K5000* is designed for the film producer where production speed and output are the main drivers. The *K5* platform has a width range from 2.45–4.5 m (96.5"–177.2"), and a top mechanical speed of 1000 m/min (3280 fpm). The machine can accept 1200 mm (47.2") diameter rolls; the large 600 mm (23.6") process drum allows for higher deposition rates and associated collection efficiencies.

The pumping group on the machine is split into the winding zone and the evaporation zone. The backing pumps consist of three variable-pitch, dry screw pumps, three inverter-driven first stage mechanical, roots-style booster pumps, one inverter-driven second stage large mechanical booster. In the evaporation zone, for high vacuum there are two large 889 mm



(35") diffusion pumps and a polycold cryogenic pump with a theoretical pumping speed up to 200,000 litres/sec (7062 cbft/s) is for water catchment during pump down and process running.

The web transport system is *Bobst Manchester's* latest offering: an additional driven roller prior to the coating zone has created a six-drive system for optimised winding and finished roll results. The machine has two cooled rollers, namely the main process drum and DTR (drum tensioning roller) No 1, and the ability to control the temperature of the rollers down to -15 °C

The Hawkeye optical beam system is key to precision control of optical density and pinholes in the AlO_x system developed by Bobst Manchester.

(5 °F) dependant upon substrate requirements.

Unlike conventional standard Aluminium metallising where small variations in optical density or opacity are almost imperceptible by the eye, a challenge for Aluminium oxide production is achieving and maintaining good optical uniformity in both the MD (machine direction) and TD (traverse direction) direction. Small variations in optical properties through the film can clearly be observed in the finished roll where thousands of wraps of the film are wound on top of each other.

To achieve good optical control of the film, *Bobst Manchester* has optimised the gas delivery system and developed a high precision, in-line transmission monitor called *Hawkeye*. The result is a very uniform coating with comparable off-line barrier properties to standard Aluminium metallised substrates, according to the manufacturer.

Based on the reactive nature of the oxygen gas, oxygen safe lubricants have been used on the machine where required. An automatic dilution system limits the percentage of oxygen being pumped from the machine.

Sample AlO_x production rolls from a customer in the Middle East showed what can be achieved with a coating thickness around four times less than required from a metallised equivalent: in this case, it was 12 micron commodity grade PET with a light transmission of > 90% and with barrier levels of below 1 $\text{gm}/\text{m}^2/\text{day}$ tropical (37.8 °C [100 °F], 90% RH) for water and below 2 $\text{cc}/\text{m}^2/\text{day}$ (23 °C [73.4 °F], 50% RH) for oxygen.

»This makes the process economics very attractive from a consumable materials and running energy perspective«, says R&D Manager NICK COPELAND, who led the machine demonstration.

The »wet down« process involves the Aluminium wire being transported onto each evaporator boat used. A normal procedure for Aluminium metallising, but due to the reduced wire being used for Aluminium oxide the associated boat temperature is significantly lower and all the more critical to optimise.

With all boats checked across the width of the machine for tempera-

ture and pool uniformity, the web can be accelerated to the desired speed set-point, in this case 720 m/min (2362 fpm) ready for coating. During the acceleration period, the shutter protecting the polymer substrate from the Aluminium vapour cloud is opened and the machine runs at the desired metal set-point for AlO_x .

The operator's screen display shows the cross-web uniformity of the AlO_x coating by using the *Hawkeye* optical monitor beam which displays the OD (optical density) every 25 mm (0.98") across the substrate width which allows the optical profile to be observed over and between the evaporator boat positions. This is of great importance when running the AlO_x process where good transverse direction uniformity is required. »Based on the optimisation of the gas delivery system, combined with the precision closed loop control using the *Hawkeye* optical beam, we have found that the developed process allows for long duration running on rolls >50,000 m (164,041 ft) with stable and consistent results«, COPELAND confirms. »The process is extremely easy to run and very little intervention by the operator is required similar to a standard Aluminium metallising process.«

The fast rate of the AlO_x market growth, attractive selling prices and production flexibility add up to a tempting offer for operators of Aluminium metallising systems. According to *Bobst* and latest world-market data, Aluminium coating stands at 500,000 to (1102 million lbs), AlO_x at 20,000 to (44 million lbs) and PVdC, for which AlO_x is a possible alternative, at 280,000 to (617 million lbs). The growth rate of Al is 4% per year compared with AlO_x at 8% per year. The selling price for Al coating is USD 0.5 per kg and for AlO_x

coating USD 1.25 per kg.

The operational capabilities of *K5000* highlight the outstanding advantages of switching to the AlO_x solution. AlO_x speeds can reach 720 m/min (2362 fpm) compared with 1000 m/min (3281 fpm) for Al. The machine offers »instant« change-over between the two techniques.

Analysis of revenue against running cost suggests that AlO_x offers 3.5 times the potential return of the Aluminium solution.

Bobst Manchester aimed to satisfy a highly technical audience and presented very detailed findings of AlO_x trials, a thorough *K5000* demonstration and step-by-step explanation of the workings of *Hawkeye*.

ERIK BOTHOREL, Head of the Web-Fed business unit of *Bobst Group* stressed the commercial importance for customers to be able to use the same platform for Al and AlO_x processes. He confirmed there is currently only one competing system.

Interest in the dual technology brought potential customers from the USA, India, China, Indonesia, Turkey and elsewhere for a closer look.

AlO_x -capable *Bobst General* machines are operating in India (*JBF*) and Egypt (*Uflex*) with a further two in the Middle East and another in Japan. *Bobst* says it is dealing with requests to retrofit *K4000* models already installed for existing customers on a case-by-case basis, with consideration given to machines less than three years old.

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The new technology centre of Bobst Manchester in Heywood/GB.

