TOTAL SOLUTIONS FOR THE DOMESTIC PRODUCTS INDUSTRY - TISSUE PAPER

The paper industry produces a multitude of household consumer products e.g. tissues, packaging, graphic papers as well as advanced products for fine art, inkjet and security applications. Maintaining a leading edge in these market sectors depends critically on in-house product development, process optimisation and close monitoring of competitor products. Surface analysis techniques, such as Secondary Ion Mass Spectrometry (SIMS), and X-Ray Photoelectron Spectroscopy have a key role in supporting these activities as shown in the case studies below.

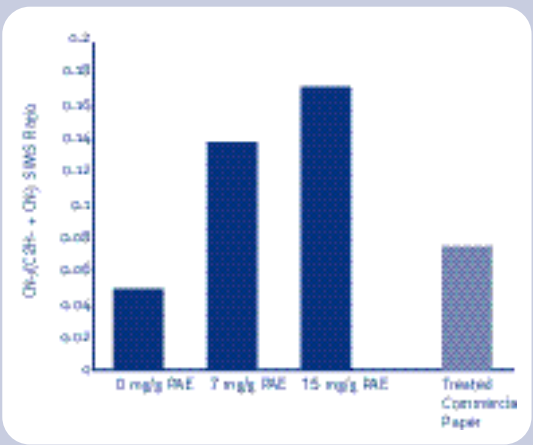
BENEFITS TO CUSTOMER

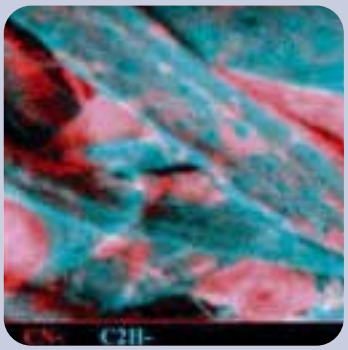
- Rapid solving of production - related problems
- Cost-effective support to research and product development
- Close monitoring of final and intermediate stages for process optimisation
- Reverse engineering and analysis of competitive products

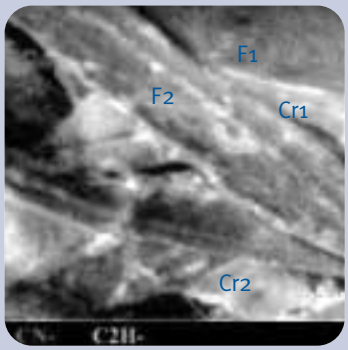
CASE STUDY ONE

Location of Wet-Strength Additive on Tissue Paper

The purpose of this work was to monitor the uptake and identify the location of a poly-aminoamide (PAE) wet-strength additive on a series of laboratory-prepared tissue papers using a combination of surface analytical methods. XPS and ToFSIMS were used to characterise the degree of uptake of the PAE on the tissue surface. A quantitative comparison of three PAE loadings, monitored by ToFSIMS, is shown right compared with a treated commercial paper. The presence of the PAE on the paper surface is established by the detection of N in the XPS spectrum and CN^- using ToFSIMS. However, the exact location of the wet-strength additive, with respect to the paper structure, can only be obtained by Imaging SIMS analysis. Prior to this analysis the theoretical studies had predicted that wet-strength additives act by accumulating at cross-over points in the tissue structure - thereby aiding adhesion between paper fibres. The SIMS image overlay below shows the CN^- (from PAE) in red and the paper fibre structure, monitored as C_2H^-, in cyan.







It is evident that the PAE accumulates in regions between fibres (cross-over points) providing clear confirmation of the theory of wet-strength additive location.
Further analysis by Retrospective SIMS Profiling of discrete areas of the fibre structure, marked as F1, F2, Cr1 and Cr2 below, confirmed that there is a three-fold increase in wet-strength additive concentration in cross-over point areas.

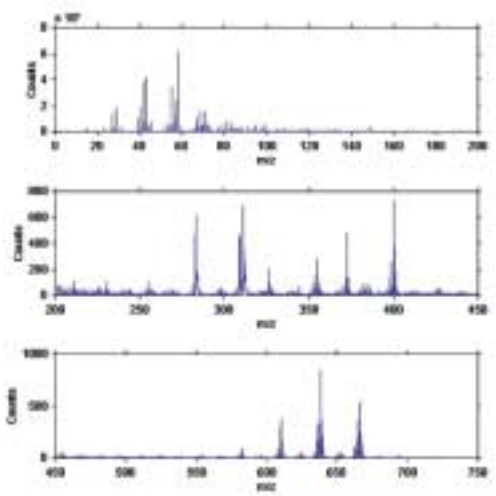
CASE STUDY TWO

Surface Additive Identification

The purpose of this analysis is to identify the surface treatment additives on a commercial tissue paper product. XPS analysis detects and quantifies the level of C, O, N, Ca, Si and Cl.

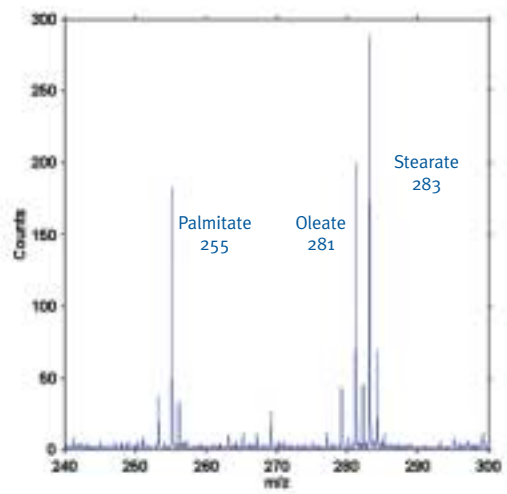
The positive ion ToFSIMS spectra of the paper surface show clear evidence for:

- a quaternary ammonium group
- glyceride - type pattern
- principal masses at 372, 398, 400 and 610, 636, 638, 664, 666 i.e. an odd number of N atoms present.



Positive ion ToF SIMS spectrum of the tissue paper surface

The negative ion ToFSIMS spectrum (below) confirms the presence of palmitate, oleate and stearate functionality. There is also no evidence for species containing two or more N atoms.



Part of the negative ion ToF SIMS spectrum of the paper surface showing palmitate, oleate and stearate functionality

Detailed interpretation of the ToFSIMS spectra, using a combination of library data, fragmentation rules and accurate mass analysis leads to the identification of the additive as a mixture of mono and di-basic esters with the structures:

$C_xH_yC(=O)O\text{-}CH_2\text{-}CH(OH)\text{-}CH_2\text{-}N^+(CH_3)_3$

and

$C_xH_yC(=O)O\text{-}CH_2\text{-}CH(O(O=)CC_xH_y)\text{-}CH_2\text{-}N^+(CH_3)_3$

where x is a mixture of C15 (palmitate) and C17 (stearate).

These compounds are used commercially as softening agents.

CSMA provides a complete surface analysis service to industry to accommodate every level of demand:

- rapid turnaround analysis (24 hours)
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