Tinplate surface property effects in lacquer coating of steel packaging

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Epoxy phenolic coatings are commonly used to prevent substrate corrosion in metal food packaging. The base steel substrate is hexavalent chromium passivated electrolytic coating tin for the production of tinplate which is then roller coated with the epoxy phenolic polymers. Following cutting, these coated parts are then formed into a variety of common container shapes. The integrity of polymer coating is key to insulating performance of the coating required for long term food storage(1) and this in turn is dictated by the adhesion of the polymer coating to the substrate. The surface finish of the metal packaging material is often manipulated for aesthetic reasons through the use of a series of temper rolls at the end of the material coating manufacturing processes. Anecdotal evidence suggests that this plays a role in adhesion, although there is a dearth of scientific literature providing evidence or postulating sound adhesion mechanisms(2).

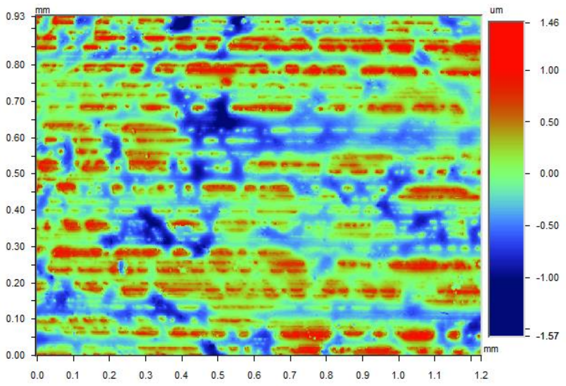

Figure 1 Surface Roughness of a Heavy Stone Tinplate

An experimental study was therefore carried out where tinplate samples were produced with a range of surface textures in a commercial plant(3). The substrates were characterized by optical microscopy, XRD, XPS, surface energy and white light interferometry. Samples were subsequently coated and cured with a commercial polymer coating in the lab. The adhesion was measured using a sheen scratch tester under a constant load, which allowed the point of coating delamination to be directly correlated to the force applied to a hardened tungsten carbide tip.

Figure 1 shows the typical surface roughness obtained for a heavy stone finish tinplate measured using a WYKO NT9300 at Swansea University. This is provided via a temper mill roll which had been prepared to a commercially agreed finish. The electrodeposited tin surface follows a preferentially (-2,0,0) orientation, with secondary peaks showing orientations and presence of an Iron-Tin intermetallic system and due to porosity in the coating system, peaks of the base Iron substrate were also observed.

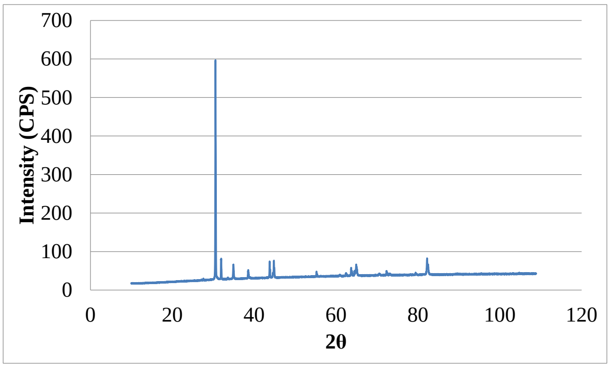

Figure 2 XRD Spectra of a Heavy Stone Tinplate

The study highlights that the base substrate topography impacts on the orientation of the tin coating which has a subsequent effect on the surface chemistry and thus wetting and dry adhesion performance.

References

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3. *More information can be found in: http://www.tatasteelpackaging.com/assets/files/Manufacturing_route_for_tinplate_products.pdf*