20 Reflection-Polarizational Characteristics of Car-Bodies: Why are Water-Seeking Insects Attracted to the Bodywork of Cars?

20.1 Attractiveness of the Bodywork of Cars to Certain Insects

Figure 3.4 demonstrates that light reflected from the shiny bodywork of cars may be strongly linearly polarized. The smooth surface of bodyworks reflects the whole spectrum of light, while the paint beneath it returns light only in a certain spectral range, apart from the case when this paint is grey. The light returning from the underlying paint becomes vertically polarized after refraction at the surface. This vertically polarized light reduces the degree of linear polarization p of the horizontally polarized light reflected by the surface itself. Thus, the net p is low or even abolished in that spectral range in which the pigment reflects light efficiently. The bodywork of cars possesses regions, from which strongly and horizontally polarized light is reflected. These regions are very attractive to polarotactic water-seeking insects, because they mimic a water surface. There are many observations (e.g. Fernando 1958; Popham 1964; Watson 1992; Mizera et al. 2001) that insects associated with water are deceived by and attracted to the shiny bodywork of cars.

20.2 Automotive Clearcoat Damage by Dragonfly Eggs

Stevani et al. (2000a,b, 2001) observed that certain common Brazilian dragonflies are attracted by the reflecting surface of cars and lay eggs on them. At the high temperatures of the car surface exposed to sun the eggs can cause damage (Fig. 20.1), the chemical mechanism of which is similar to that caused by acid rains. In experiments on resin-coated plates, Stevani et al. (2000a,b, 2001) showed that cysteine and cystine residues present in dragonfly eggs are oxidized during the egg hardening process (sclerotization) which releases hydrogen peroxide, a cysteic acid derivative, a strong acid capable to catalyse the hydrolysis of acrylo/melamine clearcoat polymer. Cysteic acid was indeed identified in

dragonfly egg extracts submitted to oxidation by H_2O_2 followed by acid digestion. These acids, destroying the clearcoat above 70°C, originate from proteins of the egg-shell, chorion, as products of chemical reactions. The temperature of car-bodies can often rise above 70°C in sunshine. Then, eggs laid onto the car surface can damage the resin just like acid rain (Fig. 20.1).

20.3 Influence of Colour of Paint

Beyond the polarization of light reflected from the bodywork of cars also the colour of the paintwork may strongly influence the attractiveness of the automotive clearcoat to insects. The light reflected from cars with shiny, smooth clearcoat and red paintwork, for example, is less polarized in the red but highly in the blue and possibly also in the UV part of the spectrum, if the paint layer absorbs UV light. Many insects do not perceive red but UV light. Their colour sensitivity is shifted towards the shorter wavelengths in comparison with the human colour sensitivity. Thus, red cars are highly attractive to water-seeking polarotactic red-blind insects, due to the high degree of polarization of reflected light in the blue and UV spectral ranges. The bodywork of cars with metallized paint reflects light with low p in a wide region of the spectrum, where the metall particles reflect light efficiently.

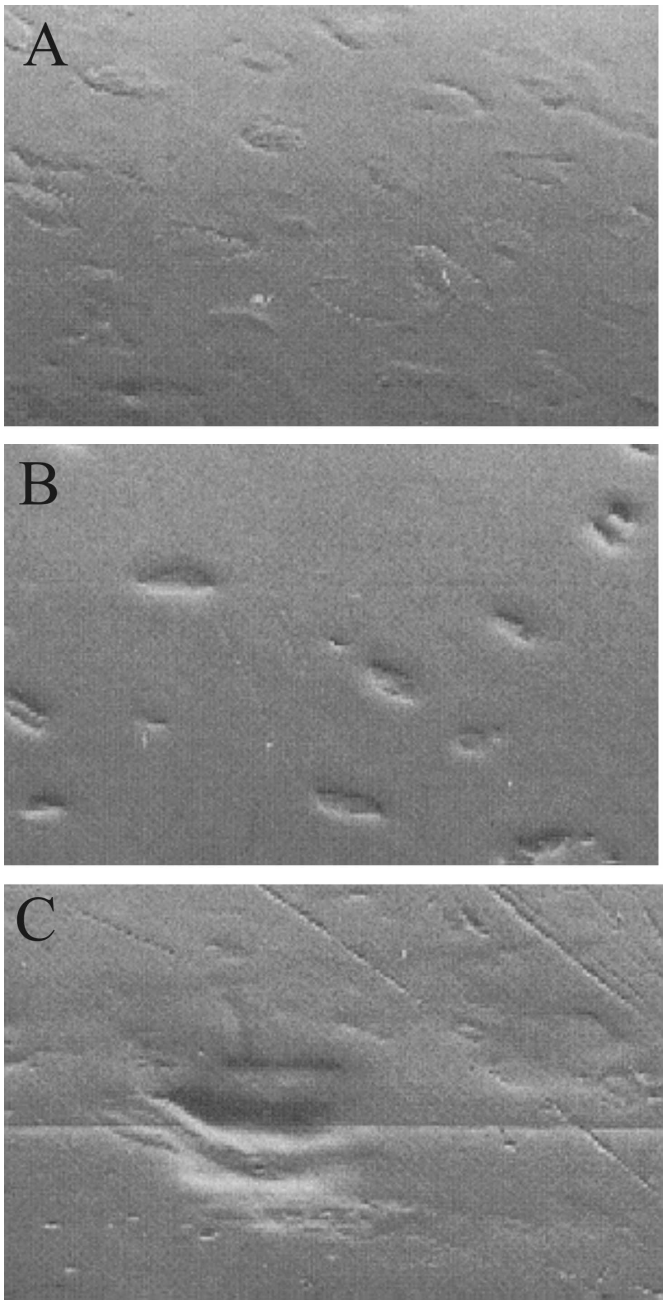

Fig. 20.1. Scanning electron-microscopic photographs of the acrylic/melamine resin after 3 h at 90 ^{o}C in contact with dragonfly eggs (A), cysteine of 10 mmol/L (B), and cystine of 10 mmol/L (C) (after Fig. 3 of Stevani et al. 2000b, p. 1636).