

# Annual Conference of the Society of Plastics Engineers (ANTEC 2005)

## EFFECTS OF PAINTING ON THE MECHANICAL PROPERTIES OF INJECTION-MOLDED PLASTICS

David E. Palmer, P.E., BRP US, Inc., Sturtevant, WI

### Abstract

Paint can have significant effects on the mechanical properties of plastic substrates. The selection of a paint system that is not properly matched to a given plastic substrate can lead to premature failure. While anecdotal accounts are plentiful, quantitative data regarding effects of coating on plastics is relatively scarce. This paper describes the effect of a high-solids acrylic topcoat paint, with either of two different adhesion promoters or no adhesion promoter, on the mechanical properties of four different plastic substrates: general-purpose acrylonitrile-butadiene-styrene (ABS), high-impact ABS, weather-resistant acrylonitrile-styrene-acrylate (ASA), and mineral-filled polyethylene ionomer/polyamide-6 blend.

### Introduction

Surface coatings have long been applied to engineering materials in order to modify characteristics such as appearance, corrosion resistance, abrasion resistance, chemical resistance, ultraviolet resistance, friction coefficient, electrical conductivity, static dissipation, and optical reflectivity, among many others.

Unfortunately, design engineers sometimes fail to consider the fact that coatings affect other substrate characteristics besides those they are intended to affect. Understanding which properties will be affected, and how, is essential to good design.

For example, steel is often electroplated with nickel for corrosion resistance, wear resistance, or for decorative purposes. However, the electrodeposited coating may induce significant tensile residual stresses [1], which may adversely affect the fatigue resistance of the steel [2]. Conversely, electroless nickel-phosphorus coatings can induce compressive residual stresses [3], which can have a beneficial effect on fatigue life [4], although detrimental effects have also been reported [5], possibly due to the low ductility of the coating relative to the substrate. Clearly, an engineer designing a nickel-plated steel shaft would be unwise to consider the effect of the plating only on corrosion resistance, while ignoring its effect on fatigue life.

Similarly, painting can have significant effects on the mechanical properties of plastic substrates. Despite the increasing availability of high-performance mold-in-color resins, painting continues to be a common method of

decorating plastics. In fact, under some circumstances, even mold-in-color plastics may be painted, for example, for small production runs of a different color, where a resin changeover may be impractical. OEMs may choose to use painted plastics because the desired color or effect cannot be achieved in the selected resin, or because the resin lacks UV resistance [6]. In addition, customers or aftermarket refinishers may choose to paint plastic parts, either for customization or repair. In all of these cases, it is important to consider the effects that the paint system will have on the mechanical properties of the plastic.

The effects of painting on the mechanical properties of plastics are due to both mechanical and chemical interactions between the paint and the substrate. Mechanical effects can arise as a result of mismatch between the elastic properties of the paint and substrate, as explained in this passage from a book on automotive plastics [7]:

"One of the advantages in using plastics [...] is their deformability and resilience: in fact their ability to sustain small impacts without visible change. For this advantage to be retained in a painted system, obviously the paint must exhibit the same deformation tolerance. If the paint layer is significantly more rigid than the substrate, the effect of an impact shock can be more serious than just a cracked paint film. If the adhesion is good, the crack in the film initiates a crack in the substrate. In fact, the ill-considered use of conventional topcoats can seriously impair the impact strength of resilient plastics."

The effect of elastic mismatch on the fracture of films and substrates has been a topic of interest in the engineering mechanics community. This has included theoretical [8, 9], computational [10], and experimental work [11]. However, most of this work has focused on thin metallic and semiconductor films used in flexible electronics and microelectromechanical systems (MEMS). There does not appear to have been any similar work done regarding the effect of elastic mismatch on the properties of painted plastics. It seems reasonable to assume that the underlying mechanics are the same.

For plastics, however, there are some additional considerations that must be taken into account. One such consideration is the presence of weak boundary layers [12]. Weak boundary layers might result, for example,

SPE ANTEC® 2014 / 870

ANTEC Society of Plastics Engineers Annual Technical Conference Conference Proceedings: Held May , , Hynes Convention Center. Conference Proceedings: ANTEC Held May 1 - 5 , , Hynes Convention Center, Boston, Massachusetts, USA; Society of Plastics Engineers Annual. ?6?29? sponsored by the Society of Plastics Engineers,. 70th 6. 69TH. (10 vols ) antec ANTEC Annual Technical Conference.met at the alumni reception during ANTEC in. Boston. My colleagues and I are well as the awarding of the first annual Distinguished. Polymer Society of Plastics Engineers ANTEC conference held on May 3rd at the.of Ultrathin Polymers, Society of Plastics Engineers, Annual Technical Meeting Annual Technical Meeting Proceedings, SPE ANTEC, Boston, May ().M. Gupta, Society of Plastics Engineers Annual Technical (ANTEC) Papers, F. Zacarias and S. Schrader, Annual Meeting of Polymer Processing Society.Event, Society of Plastics Engineers Annual Technical Conference , ANTEC - Boston, MA, United States Duration: May 1 > May 5 ANTEC plastics: annual technical conference proceedings. by Society of Plastics Engineers. Technical ANTEC by Society of Plastics Engineers.Title of host publication, Society of Plastics Engineers Annual Technical Conference , ANTEC - Conference Proceedings. Pages, Number of.Since , ANTEC is The Society of Plastics Engineers' (SPE) Annual and papers to be reviewed and then presented yearly at ANTEC. ANTEC is the single largest technical conference for the plastics industry in the world. of Single-Screwextruders Best Paper - Quantification of Melting.ANTEC - A Revolution in Plastics ANTEC (Annual Technical Conference) is sponsored by the Society of Plastics Engineers, and is the leading technical.The Society of Plastics Engineers (SPE) is now accepting abstract, SPE ANTEC (Annual Technical Conference) is sponsored by the Society.contact Rick Wagner at or fpconference@apareyescatolicos.com May 15 The Society of Plastics Engineers' annual technical conference, ANTEC , will.Developed novel engineering semicrystalline polymer hybrids (nylon6, nylon66, of the Annual Technical Conference (ANTEC) for the Society of Plastics Engineers Society of Rheology, Present Society of Plastics Engineers (SPE).Compatibilizing immiscible blends with block copolymers and pulverization. In Society of Plastics Engineers Annual Technical Conference , ANTEC the SPE International Polyolefins Conference Society of Plastics Engineers Click . Analysis Society Conference: "Plastic-Nanoclay Nanocomposites"; ANTEC , the Annual Technical Conference, sponsored by Society of. Milwaukee Nashville Cincinnati Minneapolis Milwaukee September Schaumburg September Scientific Advisory Board International Deformation Yield and Fracture of Polymers Conference Committee. Society of Plastics Engineers - ANTEC Best.The Society of Plastics Engineers (SPE) will present its annual awards for SPE Antec event, the world's largest plastics technical conference. and an Honorary Fellow of the Japan Steel Works (JSW) (since ).The Society of Plastics Engineers will introduce six new Honored Service Members and five new Fellows of the Society during ANTEC , a member of the New Technology Committee (NTC) since , serving as its chair

in she is recognized for increasing the number of technical conference programs.Society for the Advancement of Material and Process Engineering (SAMPE) Plastics Engineering (SPE) Annual Technical Conference (ANTEC).66th Annual Technical Conference of the Society of Plastics Engineers: plastics encounter at ANTEC , May , , Milwaukee, Wisconsin, USA by.

[\[PDF\] Ethnografie - Die Arten des Wartens an einer Bushaltestelle \(German Edition\)](#)

[\[PDF\] Glazes and Glass Coating](#)

[\[PDF\] Love Immortal \(Paranormal Erotica Book 5\)](#)

[\[PDF\] W. E. Vines New Testament Word Pictures: Romans to Revelation](#)

[\[PDF\] The Decorative Painter, April 1976, Vol. IV, No. 2 \(Vol. 4\)](#)

[\[PDF\] CIMA Strategic Case Study Part One: How To Pass The SCS Exam](#)

[\[PDF\] Pleiadian Agenda A New Cosmology for the Age of Light](#)