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Q&A: WHAT IS STRESS WHITENING, AND HOW CAN YOU PREVENT IT?

Have you ever thrown a dog a Frisbee and noticed the surface area around newly formed tooth marks has turned white, though the Frisbee was colored? This is a phenomenon called stress whitening, and it's an ongoing challenge for manufacturers of polymeric materials. We sat down with Chris Miller, research scientist, from Americhem to learn a bit more about what stress whitening is, how it's caused, and how to avoid it.

Editor: Thanks for taking the time to chat. Can you tell us a bit about yourself?

Chris Miller: Sure. I'm a research scientist for Americhem, where I've worked since 1993.

Editor: Great. So, today we are talking stress whitening. For those who don't know, what is it?

Chris: Stress whitening happens when stress is created by impact or tension upon a polymeric surface. While you can't feel or necessarily see them, there are tiny cracks being formed called "microcrazes" or "microvoids" on the plastic's surface when that surface is stressed. What you can see, however, is the effect of those cracks: localized whitening. It is worth noting, too, that you don't always see the whitening immediately; it may take a day or more for all stress whitening to become evident.

Editor: At a high level, can you tell us why we see the whitening occur?

Chris: It has to do with light refraction off the plastic item's surface. When certain plastics are stressed, however, the microcrazes I mentioned change the refractive index of the surface. Light is scattered when it hits the microcrazes, and as a result, we see color discrepancies around affected areas—i.e., whitening.

Editor: That makes sense. Is this a problem that applies universally across plastics?

Chris: No, not necessarily. We see stress whitening in some polypropylene (PP) copolymers. PP homopolymer usually doesn't exhibit stress whitening, but when you combine it with elastomers to give it more flexibility and impact resistance, a side effect may be stress whitening.

Editor: What affects the likelihood of stress whitening in a given plastic?

Chris: There are a few factors that affect this. Masterbatch formulation can make a difference, based on pigment type, particle size or pigment levels. Copolymer resin choice also makes a big difference with regard to stress whitening potential. Manufactured part thickness can play a role in stress whitening, as can the degree of force required to eject parts from molds during manufacturing or during part assembly.

Editor: How can we best prevent stress whitening?

Chris: The good news is there are a number of ways you can test materials early in the design process to minimize the risk of whitening. Based on your findings, you can tweak the copolymer composition, processing methods or product design.

Editor: Thanks, Chris. Any final advice for readers?

Chris: Be thorough with your product design. Consider the resin, colorants and process. The more comprehensive you are when tackling stress whitening, the better. Consider every possible factor that may affect it, and that way you can feel confident you're finding the best solutions.

For more information, contact Scott Blanchard at sblanchard@americhem.com.

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