

Is Your COVID-19 Cleaning Protocol Harming Your Plastic Parts?

Not Every Cleaning Solution Is Compatible with All Plastics

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The COVID-19 pandemic is prompting a marked increase in the use of sanitizing and disinfectant cleaning sprays, gels, and wipes. In efforts to maintain safe and virus-free facilities, many hotels, airlines, grocery stores, and other businesses where customers and employees routinely share space are intensifying cleaning procedures and increasing their use of cleaning products. These products, whether produced commercially or at home, are intended to remove and/or inactivate bacteria and viruses but are not necessarily formulated to be compatible with plastics. Many of the ingredients in these solutions, such as fragrances, humectants, and preservatives, may damage certain types of plastics, potentially leading to unexpected cracking and part failure in components made from polymers such as polycarbonate, polystyrene, polyvinyl chloride, and polymethyl methacrylate. While human health and safety are of primary importance, businesses should also evaluate the potential long-term impact of cleaning solutions on plastic components and devices to help mitigate the risks and costs associated with premature cracking and failure.

Understanding Environmental Stress Cracking

When certain plastics are simultaneously exposed to a foreign chemical compound (e.g., cleaning solution) and a moderate level of stress, environmental stress cracking (ESC) may occur. The rate and severity of cracking is highly dependent on the molecular structure of both the foreign chemical compound and the plastic material. Importantly, ESC can be notoriously latent, such that there may be relatively long delays between the application of a foreign chemical and the formation of cracks in the plastic article.

Although the duration of contact with cleaning solutions is often relatively short, the combination of repeated use, moderate stress levels, and the ability of mobile chemical compounds in cleaning solutions to diffuse into and remain in the plastic may enable ESC long after use, compromising the service life of the product. In the future, there may be an increase in insurance and warranty claims associated with unexpected ESC in plastic materials caused by exposure to incompatible cleaning solutions and moderate levels of residual or applied stress. While the majority of incurred costs will likely be related to part replacement, the additional consequences of underperformance or failure could be considerable for high-demand devices and components, such as those used in the healthcare, consumer products, transportation, and manufacturing industries.

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Proactively Evaluating a Solution's Impact on Plastics

Businesses can take proactive steps to understand and evaluate the potential long-term implications of the use of a specific cleaning solution on susceptible plastics. Oftentimes, labeling or technical data sheets provided by the cleaning solution manufacturer give guidance to users regarding compatibility with a particular material, including plastic materials. It is important to note, however, that ESC incompatibility can be driven by moderate levels of stress in the polymer and exposure to minor additives in the cleaning solution formulation, such as fragrances, humectants, or preservatives, and these may not be included on a product's label or technical literature. Homemade cleaning solutions can also cause concern, especially if essential oils or other fragrances have been added.

To reduce the risk of premature ESC failure due to incompatible cleaning solutions, Exponent can assist concerned clients by performing targeted testing designed to screen for ESC incompatibility. This screening process requires understanding key attributes of the plastic, such as chemical structure and molecular weight characteristics, along with the chemical composition of the fluid in question and the application of stress to the polymer test sample. These tests can be performed by identifying incompatible chemical/polymer pairs and by accelerated exposure testing. By coupling laboratory exposure studies with mechanical testing and an understanding of the likely stresses the part will encounter in use, Exponent can help facilities determine whether a particular plastic is at risk of developing an ESC problem in the future.

Identifying the Root Cause of a Plastics Failure

In the event a business experiences a plastic failure, our team at Exponent can help. We routinely utilize fractography (the study of fracture surfaces) and other material characterization techniques to assist clients in identifying the cause of cracking in plastic parts. These types of analyses can help businesses, insurance investigators, and other interested parties understand whether a failure was a result of exposure to a cleaning product or an unrelated factor associated with the design, manufacturing, or service conditions of the plastic article.

How Exponent Can Help

Exponent's multi-disciplinary team of polymer scientists and materials chemists can help clients perform complex evaluations of chemical/plastics compatibility in both proactive and reactive settings.



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