

Selecting plastic materials for machine guards and safety shielding

PLASTICS IN
SECURITY
AND SAFETY

by David Salyer

A key consideration for any engineer and machine designer must be the safety of the machine operator, as innovative form meets function and safety. While a machine or device may perform perfectly in its mechanical function, its design will fail to fulfill its most vital criterion if it operates at the expense of user safety.

Shielding and guards also create a protective barrier, preventing product or process contamination, pilferage, tampering, alteration and/or interruption. A shield can vary from the simplest sneeze guard to an extremely critical protective biological or radiological containment barrier. Historically, designing engineers relied on expensive and bulky fabricated metal and glass guards to prevent human contact with harmful and, often, lethal materials or environments. These include hot surfaces; moving devices; noise sources; and harmful dusts, liquids and gases in industrial environments.

Metal and glass

While metal shields and guards perform well, they are expensive to fabricate and are often very heavy. Metal guards also obstruct the observer's view of an ongoing process or product flow by restricting one's view of what is behind the guard or shield.

Safety and reinforced glass affords observation of a product or process, yet the hefty price and weight of glass are difficult to incorporate into a structural design plan. Glass also maintains a typically

limited scope to flat glazing applications. Safety or reinforced glass may perform well initially; however, it will likely require replacement once it is penetrated, chipped, over-stressed, or impacted and subsequently damaged.

Specialty plastics

Specialty plastic materials, including copolyesters and cellulosic polymers, have been used in machine guards and shielding for many years. These materials are versatile, easily handled and exhibit the remarkable toughness and strength required for guards and shielding.

Copolyesters are uniquely suited for exposure to low temperature environments, such as food processing operations and food packaging machines operating in a sub-zero environment. While certain plastics dramatically forfeit impact resistance at lower temperatures, copolyesters retain their plaque impact resistance in even the most extreme environments.

Used for over 50 years, cellulosic plastics are manufactured from renewable, cellulose-based resources, such as wood or cotton fibers, and are truly a "green" industrial material. Cellulosic plastic sheet is employed in unusually difficult applications in which other types of plastic cannot perform. For example, for many years, cellulosic plastic shielding and machine guards have functioned well in brutal mining operations that utilize extremely harsh, chemically aggressive drilling oils, hydraulic oils, greases, fuels and other fluids.



With its exceptional clarity and edge color, Eastman Chemical Company's SPECTAR Clear copolyester material creates a safe, unobstructed view around a work environment, as pictured here.

Specialty plastics satisfy many important considerations, providing a comprehensive solution at an affordable price, when compared to competitive materials. Plastics are more easily manipulated and formed into unique shapes and complicated structures than metal or glass materials. Unlike some metals, plastic articles formed from copolyesters and cellulose typically do not require continued repainting to reduce corrosion effects. Plastics also offer resistance to the common problems of metallic rusting and glass chipping and cracking. Copolyester and cellulosic plastic sheet are easy to heat bend and thermoform into unique shapes and forms. This allows the machine designer more design flexibility while creating attractive, safe and protective shielding.

Plastics are lightweight and are often available in assorted colors, tints, and with UV protection/screening additives. These features help the material color and clarity to remain stable over time and use. Certain plastics may be modified to enhance resistance to scratches and the adverse effects of repeated cleaning. Some plastics meet FDA food contact and NSF approval standards for a host of applications. Specialty plastics offer ease

Eastman Chemical Company's SPECTAR Clear copolyester is FDA approved for contact with foods in shielding and guarding applications surrounding food packaging and manufacturing equipment.



in fabrication, adhesive bonding, decoration, labeling and repair, while exhibiting a favorable toughness-to-weight ratio.

Key considerations

The designer must carefully gauge several factors when selecting the proper plastic for the industrial environment in which the guard or shield must function and survive. The machine designer can work with a plastics supplier to determine if the selected plastic is appropriate for the application. When specifying a specialty plastic application, preliminary performance tests in real-life environments will ensure that the plastic fulfills its functional criteria. These evaluations are especially imperative when injury and incident prevention is dependent on optimal performance of a machine guard or shield.

Environmental factors

Designers also must consider a host of environmental considerations that may affect the performance of a shielding material. For example, temperature and chemical exposure duration and concentration levels may alter the effectiveness of certain materials. Also, ultraviolet

(UV) light exposure can affect material color, transparency and toughness. Other key considerations include hydrolytic effects due to long-term moisture exposure; effects of oxidative solids, liquids or vapors; permeability/barrier behavior of the plastic to various substances; ionizing radiation exposure (gamma, X-ray, etc.); and resistance to fungi and mold attack.

Structural elements

Designers must factor in structural issues, such as maximum stress levels the plastic will experience, static and dynamic loads at temperature extremes and adverse effects of creep. Designers must also consider the impact of forces at low temperatures and thermal expansion and contraction issues. Materials must often endure vibration fatigue effects and satisfy vibration and noise attenuation requirements. Other considerations include determining the best method to attach the guard/shield to the machine. For example, designers must decide if a rigid fastening method is best, or a floating panel within a frame is a more effective design, as it relates to panel support spacing, stiffness and expected deflec-



Eastman Chemical Company's SPECTAR Clear specialty copolyester is easily shaped and designed without sacrificing its remarkable impact durability and chemical resistance.

tion loads. This collective set of key considerations guarantees that designers create the most productive and safe tools possible. ■

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