

Selection Criteria For Plastics Materials

By Ashish Shah

Plastics have become an essential necessity in all aspects of today's modern life. Plastics are replacing most of the materials due to good mechanical, thermal and chemical properties. Plastics have enormous applications. Plastics have found an enormous space in Industrial Products, Mechanical, Electrical, Electronic and Electro-mechanical products. Plastics are influencing on various products ranging from telecommunication equipment, transportation, housing and FMCG appliances, clothing and commercial market.

Plastics are generally categorized in three parts – Commodity, Engineering and Specialty. Plastics have a wide range of application in different types from thermoplastics, thermosets, elastomers, FRP (Fiber Reinforced Plastics) and are formed using various techniques like injection molding, compression and transfer molding, blow molding, rotational moulding, vacuum forming, thermoforming.

The selection of plastics material for a specific application is always a challenging task. After careful consideration, the possibilities may be lessened to few and the final selection is then determined by testing. A complete and in detail understanding of material properties, behavior, flow properties has to be considered. It requires comprehensive knowledge of the part design, process limitations, advantages and disadvantages, success and failure effects with a collective practical significance of design and manufacturing process. Wrong material selection leads to product failure.

In a study of over more than 5000 plastics product failures at Smithers Rapra Technology, the product failures have been classified on the basis of primary failure mode as shown in Figure 1.0. A further breakdown of plastics product failure due to human causes is given in Figure 2.0 of which 45% are due to material mis-selection and poor specification.

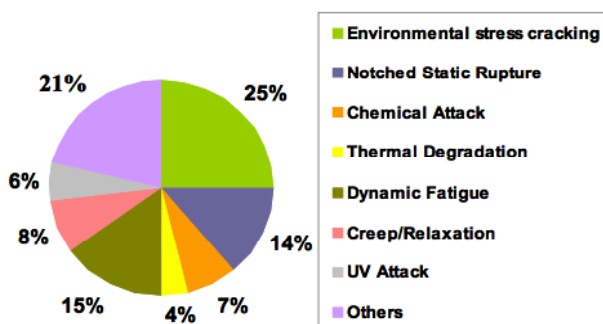


Figure 1.0 Material / phenomenological causes of failure

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Innovative Design Engineering Animation

US office: 866-480-IDEA (4332)

India office: +91-79-40205555

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FINDING OUT OF THE BOX SOLUTION

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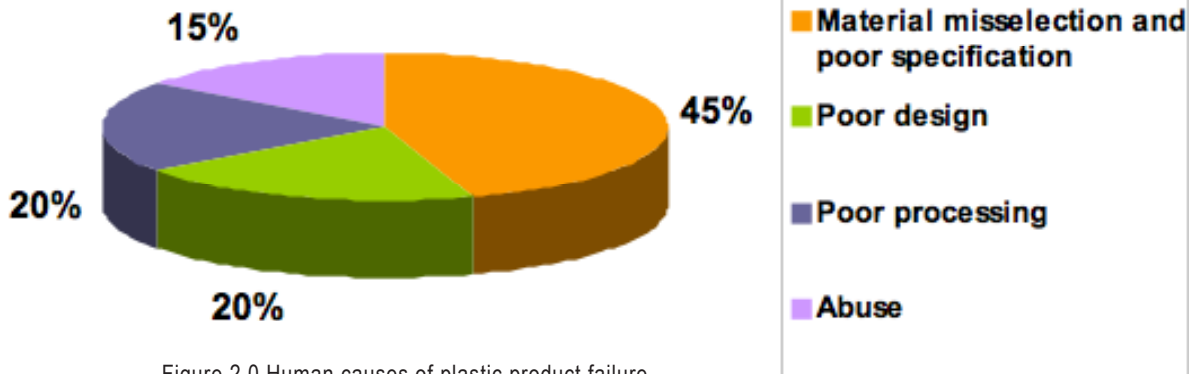


Figure 2.0 Human causes of plastic product failure

It's crucial for designers and engineers to understand the basic nature of plastics. Poor material selection results into product failures which are very much frequent in the plastics design and engineering due to lack of awareness and understanding of plastics properties.

The most important step in selecting a plastics material from the broad range of available materials (i.e., acrylic, polycarbonate, UHMW, Delrin, nylon, etc.) is to cautiously classify the requirements of the application, the various properties required and the environment in which the material will perform.

There are certain considerations like physical and mechanical properties, thermal and chemical properties, wearing and bearing properties and some standards, which should be used to define the application as completely as possible before selecting a perfect and particular plastics or an entire family of plastics. The more accurately the application is defined, the better the chance of selecting the best material for the exact requirement.

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Physical & Mechanical Considerations

- Overall part dimensions (length, width, thickness)
- Load the plastic part carry
- Duration and times the plastic will carry higher loads
- Maximum stress on the part
- Type of stress (tensile, flexural)
- Dimensional shape retention
- Projected life of the part or design

Thermal Considerations

- Temperatures the plastic part see and its duration
- Maximum temperature the material must sustain
- Minimum temperature the material will sustain
- Will the material have to withstand impact at the low temperature
- What kind of dimensional stability is required
- Is thermal expansion and contraction an issue

Chemical Considerations

- Exposure to chemicals
- Duration the plastic might be submerged in water
- Exposure to steam
- Plastic material painted and/or glued? If so, what kind of paint and/or adhesive will be used
- Plastic material exposed to chemical or solvent vapors? If so, which ones?
- Exposure to other materials that can outgas or leach detrimental materials, such as plasticizers or petroleum-based chemicals?

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Bearing and Wear Considerations

- Will the material be used as a bearing?
- Will it need to resist wear?
- Will the material be expected to perform as a bearing? If so, under what condition?
- What wear or abrasion condition will the material see? If so, under what condition? Materials filled with friction reducers (such as PTFE, molybdenum disulfide, or graphite) generally exhibit less wear in rubbing applications.

Standards

- Regulatory requirements
- Is UL94 Flame retardant rating required and at what level (5VA | 5VB | V-0 | V-1 | V-2 | HB)
- Materials color and/or appearance?
- Material be used outdoors
- UV Resistance needed

In order to pre-empt product failure it is strongly advised to make an independent material selection course. Even the selection of the right kind material can be left to the materials supplier which is an alternative, and the advice given is generally of excellent quality but it will certainly be limited to the grades available in their own product range.

About Author:

Ashish Shah, is a plastics product design expert and has designed more than 100 plastic moulds. Ashish has a Post Diploma in Plastics Mould Design and a Bachelors in Industrial Engineering. Ashish can be reached at ashishs@ideaproductdesign.com

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