Eco-Friendly Automotive Plastic Seat Design

D. Barpanda, P. Naughton, P. Shembekar

The Dow Chemical Company

Abstract

The performance and design criteria for seat systems require that the seat be lighter for reduced fuel consumption while still meeting the safety requirements as required by legislation. The safety requirements for seats include headrests and seat back static and dynamic structural performance, seat belt anchorage and luggage retention capability, child seat anchorage and top tether requirements as defined by pertinent regulation. The interior space constraints require that the seat be thinner. The seat design is expected to address the growing concern for environmental friendliness. In addition to these main criteria, various additional features such as adjustable and stow-able design are required for customer delight. All these design objectives should be met within a given cost target.

Conventional seating systems include a steel frame, with springs attached to provide support and flexibility to foam cushions. The steel frame is made up of several parts welded together. Weight of the seating system can be 80% of the weight of the interior of the vehicle.

This paper deals with plastic front and rear seat designs that provide more than 20% weight reduction. The lighter seat improves the vehicle fuel efficiency, reducing CO₂ emissions and the material of construction includes recyclable plastics and “green” polyurethane foam, making this design eco-friendly. Low cycle time of molding, reduced part count and assembly time, optimized contours for comfort and reduced material consumption lead to cost competitive design. The optimized structural properties and processability of various thermoplastics and thermoset polymer systems offer good stiffness and impact properties at fast cycle times. The combination of ease of processing, excellent mechanical behavior, dimensional stability and a wide operating temperature window make these materials a suitable choice for construction of seat systems. It is critical to combine the seat structure design with the appropriate choice of foam to provide comfort to the passenger, while minimizing weight and costs.

Various implicit and explicit finite element analyses codes are used to simulate the process, structural and crash behavior in order to optimize the design, minimizing weight while meeting various regulatory requirements. This paper deals with the design, process, materials and the development methodology for plastic seats to meet various structural regulations and help fulfill the environmental demands on emissions and fuel consumption.