PPQ Resin Bottles for High-Purity Chemicals

The need for innovative packaging solutions to contain the highest purity chemistries with reduced particle levels has fostered the evaluation of new resin systems and the subsequent design and development of a new family of bottles. 2.5-liter and 4-liter containers, extrusion blow-molded with one such polymer, PPQ Resin, are now available from Dodd Corporation, Chandler, AZ.

The targeted application of the 2.5-liter bottle is for packaging 70% Nitric Acid in other than the current combination packaging of 9-pint glass bottles, inside an expanded polystyrene outer packaging, inside a fiberboard box.

The benefits sought and achieved are 1.) to improve safe handling by replacing glass with a plastic bottle. Even coated glass is not leakproof, merely shatter resistant; 2.) to provide an inner wetted surface with immeasurable cation, anion and particulate contributions as the extractability of soda lime glass impurities limits the chemical quality that can be maintained in 9-pint glass bottles; 3.) reduction of the package physical size by elimination of the expanded polystyrene outer packaging and thereby improving freight and warehouse efficiency; 4.) reduction of package weight. While bottles of 70% Nitric Acid are packaged as 7 pounds net, 9-pint glass bottles have a tare weight of 1,166 grams compared to 208 gram 2.5-liter PPQ bottles. 5.) Elimination APHA color change of the packaged liquid and container. Exposure of 70% Nitric Acid, packaged in PPQ Resin bottles, to white light for a period in excess of seven months has demonstrated absolute clarity retention; 5.) conformance to DOT/ UN Regulations. *Non-bulk, Packaging for Hazardous Materials Other Than Class 1 and Class 7*, 49 CFR, Chapter 1, Part 173.158(e), Nitric Acid, defined as Packing Group 2, UN 2031, states *"Nitric acid of less than 90 percent concentration, when offered for transportation or transported by rail, highway, or water may be packaged in 4G fiberboard boxes or 4C1, 4C2, 4D or 4F wooden boxes with inside glass packagings of not over 2.5 L (0.66 gallon) capacity each."* The 9-pint glass bottle has a capacity of 2.625 L (0.69 gallon) which is 125 ml greater than is permissible. The 2.5-Liter PPQ bottle has an overflow capacity of 2.5-liters and is compliant with the regulation. Its' 45 mm neck finish has a molded-in drip lip and is capped with a tamper evident, Teflon lined, Menshen closure.

Extensive testing has demonstrated that this container exceeds the requirements of 49 CFR, Chapter 1, Part 173, Appendix B: *Chemical Compatibility and Rate of Permeation in Plastic Packaging and Receptacles*. Whereas the subsequent drop test in this procedure requires that the aged test containers be emptied, rinsed with water, filled to a minimum of 95% capacity with water and dropped, at room temperature, without any outer packaging, onto a rigid surface such as concrete, from a height in meters equal to the specific gravity being certified. For 70% Nitric Acid, that height is 1.42 meters (56 inches). 2.5-liter PPQ bottles, aged with 70% Nitric Acid, survive multiple 15 foot (180 inches) drops without failure.

For chemicals intended for air transport, in accordance with IATA, 2.5-liter PPQ bottles exceed the requirements of 49 CFR, Chapter 1, Part 178.605 *Hydrostatic Pressure Test* when tested for certification at 300 kPa (46.5 p.s.i.). Whereas the test pressure must be applied continuously and evenly, and it must be kept constant throughout the test period of 30 minutes, 2.5-liter PPQ bottles exhibit no failure over a continuous 12 hour test period. And, the containers return to their exact original shape and size following release of the water pressure.

Certification to use the 2.5-liter PPQ bottle for packaging 70% Nitric Acid is not yet authorized. Favorable consideration by US DOT of an exemption request to allow a combination packaging consisting of 2.5-liter PPQ bottles inside a fiberboard box would facilitate safe handling of 70% Nitric Acid and enable packaging of high-purity grades for use in Laboratory Standards and Electronics Manufacturing.

The 4-liter PPQ Beta bottle, while enjoying the same resin characteristics of the 2.5-liter PPQ bottle, was developed for products that are typically packaged in 1 gallon/ 4-liter bottles. This container will primarily benefit Mixed Acid Etchants (silicon etchants containing nitric acid), Anhydrous Etchants (containing no water) and strong oxidizing mixtures. Several coextrusion (multi-layer) versions of this bottle have been developed specifically for photosensitive liquids by including colorant in the outer layer while providing a natural PPQ wetted inner layer. This container can be certified as a single packaging for liquids having a specific gravity of 1.9 or less and could be provided as a translucent bottle for light sensitive products and single packaging with the addition of a hindered amine light sensitive (HALS) to the outer layer as a coextrusion container.

Samples are available and we invite interested companies to contact us for further information.

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