The effects of plasticizers on solvent bond strength in flexible PVC tubing

Solvent bonding is a common processing technique used in the medical industry for connecting flexible tubing and rigid parts. The strength of this bond is an extremely important variable to consider when selecting materials for sensitive applications needed in the medical market. These materials should reinforce the strength of the bond between flexible tubing and rigid medical part housings and connectors such as plastic luers. Developing new data around these materials and their effect on solvent bonding is important for medical OEMs as they look for cost-effective non-DEHP options.

A solvent bonding study was conducted to determine whether there are any differences in bond strength associated with the plasticizer choice in flexible PVC tubing, specifically between DEHP and Eastman 168™ SG non-phthalate plasticizer. This study was also used to determine how solvent and plastic choice affects bond strength between flexible PVC tubing and the plastic luer. The three factors tested were the plasticizer used in making the tubing, the plastic used to make the luers, and the solvent used for bonding. The tensile force required to cause bond failure was monitored over time. Initial bond (two days) strengths were measured along with accelerated aging at 57°C and 50% RH to represent a 1, 1.5, 2, and 3 year shelf life. For this study, tubing with an ID of 0.084″ and OD of 0.134″ was used.

The table below displays the different bonding scenarios which were studied. The solid circles signify the solvent/plastic combinations leading to tubing failure which is desired as they represent a strong solvent bond. The half circles indicate samples that started out with solvent bond failure and finished the accelerated aging with tubing failure.

Bonding scenarios*

Bonding solvent	Eastman Tritan™ copolyester MX731	Eastar™ copolyester DN003	Medical grade ABS (MABS)	Poly methyl methacrylate (PMMA)	Polycarbonate (PC)	High impact polystyrene (HIPS)
Cyclohexanone (CH)	●	●	○	●	○	◑
Methyl ethyl ketone (MEK)	●	○	●	○	○	◑
Cyclohexanone/ Methyl ethyl ketone (50/50)	●	●	○	●	○	◑
Tetrahydrofuran	●	●	○	●	○	◑

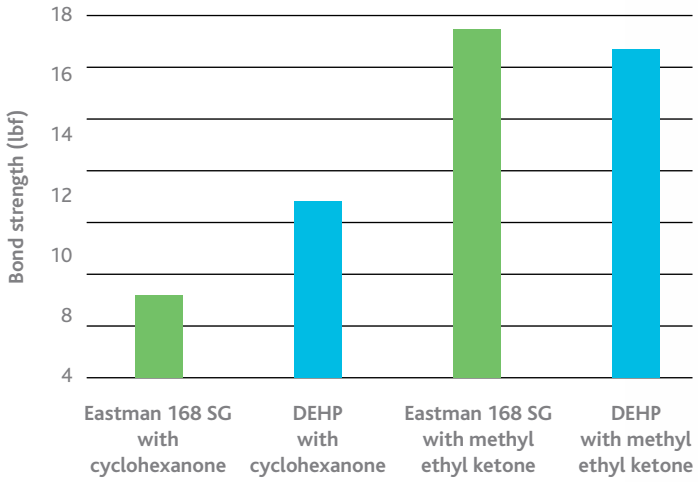
**Data in the table is representative of tests using PVC tubing made with DEHP and PVC tubing made with Eastman 168™ SG non-phthalate plasticizer.*

● = Tubing failure
◑ = Mixed mode failure
○ = Solvent bond failure

This study concluded that there is little difference in bond strength between tubing made with Eastman 168 SG and DEHP when bonding to copolyesters, PMMA, PC, and HIPS. The bond strength chart on the back page shows good bond strength was achieved when bonding PVC tubing made with Eastman 168 SG and DEHP to MABS using MEK as the solvent. The choice of solvent and plastic have the biggest influence on bond strength. Eastman 168 SG allows you to switch from traditional phthalate plasticizers while maintaining good bonding performance in your medical devices.

The data for the following bond strength chart shows that Eastman 168 SG had similar bond strength than DEHP when using MEK to bond to MABS. For this study, represented data is from tubing with 3 years accelerated aging at 57°C and 50% humidity when bonded with CH and MEK.

Bond strength of PVC tubing bonded to MABS



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