

## Phthalate Alternatives Comparison in Medium ACN Nitrile

### Introduction

Phthalate alternatives have existed for at least 30 years. Trimellitates, adipates, phosphates, benzoates, citrates, polymeric esters and many other chemistries can be used in place of phthalate esters. Initially, di-2-ethylhexyl phthalate (DEHP, DOP) came under attack several years ago when it was classified as a potential carcinogen. The natural progression for most compounders was to adopt di-isononyl phthalate (DINP) and di-isodecyl phthalate (DIDP). Now phthalates as a whole are coming under attack around the world. Our philosophy is not only to offer a phthalate alternative but to provide our customers with products that will improve performance. Hallstar has completed a study of different phthalate alternatives in medium acrylonitrile content nitrile to compare performance to DOP, DIDP and DINP.

In this study, Hallstar evaluated several of our phthalate alternatives, Plasthall® PR-A217, Plasthall® PR-A200, Plasthall® LCOA and our newest phthalate replacement, Plasthall® PR-A610. This ester plasticizer is based on 100 percent renewable raw material streams. Our products were compared against other phthalate alternatives, Hexamoll® DINCH® and Palatinol® DPHP from BASF and Eastman™ 168 (DOTP) from Eastman™, as well as industry standard phthalates, DIDP, DINP and DOP.

### Performance Study

The test formulation consists of 100.0 PHR of medium ACN nitrile, 5.0 PHR zinc oxide, 1.0 phr TMQ, 65.0 PHR of carbon black N660, 20.0 PHR plasticizer variable, with a sulfur cure system consisting of 0.4 PHR sulfur, 2.0 PHR MBTS and 1.5 PHR ZDMC. Compounds were evaluated using a battery of ASTM tests for physical properties, volatility, and extraction resistance.

Data for original physical properties indicate that all phthalate alternatives statistically perform equally in terms of efficiency and the reduction of hardness. When examining low-temperature brittleness, Plasthall® PR-A200 was found to offer the best low temperature (-42°C), with Plasthall® PR-A126 coming in second at -41°C.

Air oven aging results indicate Plasthall® LCOA has the best volatility characteristic, with Plasthall® PR-A217 performing second best. When looking at ASTM oil immersions, Plasthall® PR-A610 is the most permanent of the plasticizers in the study with minimal weight and volume change. With respect to other non-polar fluid immersions, ASTM Fuel C, Plasthall® LCOA and Plasthall® PR-A217 perform best.

If we were to assign a ranking to the phthalate alternatives with the best overall performance, the ranking would be as follows: Plasthall® LCOA and PR-A610, Plasthall® PR-A217, Plasthall® A-126, Plasthall® PR-A200 and Eastman™ 168 (DOTP) and Hexamoll® DINCH and Palatinol® DPHP.