REPLACING ANTIMONY TRIOXIDE WITH SANTICIZER® PHOSPHATE ESTERS

Reformulating flame-retardant formulations is considerably more complicated than many other reformulations. This is because flame retardant additives vary in a number of important ways. Some are solids and some are liquids. Some have plasticizing ability and others do not. They can vary in chemistry and their mode of flame action. These differences are important considerations when planning your reformulation strategy.

In this example, we will be replacing antimony oxide (ATO) with a combination of two Santicizer® Phosphate ester plasticizers. When replacing ATO with Santicizer® Phosphate esters, both the ATO and some general purpose plasticizer will be removed.

- ATO is removed, reducing the flame-retardant properties of the material.
- Santicizer® Phosphate esters are added to restore flame-retardancy.

Sounds easy, right? But remember that the Santicizer® Phosphate esters are also plasticizers and so the new formulation will likely be too soft. We must remove some of the general purpose plasticizer to restore the formulation to the appropriate hardness for the intended application. In addition to hardness, we want to check all the mechanical properties to ensure the performance is not degraded.

An example of a successful ATO replacement is shown below. In this example we remove the ATO and replace it with (2) Santicizer® Phosphate esters. In addition, we decrease the level of DOTP from 80 phr to 15 phr. This decrease in DOTP level was determined by a combination of experience and empirical testing.

The impact of the changes are shown in the tables below. Removing the ATO decreases the fire-retardant properties and reduces the hardness. The addition of the Santicizer® Phosphate esters improves fire retardancy and smoke suppression. It also improves the physical properties because they are both plasticizers. Finally, removing the DOTP works to improve the fire properties because DOTP is a fuel for fire. Removing DOTP also balances the plasticizer content after the Santicizer® Phosphate esters were added.

	A	B	Δ
ATO	15		-15
Santicizer® 141		25	25
Santicizer® 154		25	25
DOTP	80	15	-65
PVC Resin	100	100	
$CaCO_3$	15	15	
ATH	20	20	
Stabilizer	3	3	

Effect of Change	Fire	Physical
ATO ↓	-	+
Santicizer® 154 ↑	+	+
Santicizer® 141 ↑	+	+
DOTP ↓	+	-

The results of this reformulation are shown on the next page.

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As you can see, the Shore A hardness has been balanced and both the LOI and the Vertical burn results are equal to the control.

We have also included a Cost Analysis that shows that a reformulation will not necessarily be more expensive when considering the total formulation cost. The costs in the Table are illustrative and are not meant to be actual costs, but we can confirm in many reformulations that the total formulation cost is close to neutral and sometimes slightly cheaper. The justification for reformulating is generally due to new regulations or new performance targets. It is nice to know that reformulation does not necessarily result in a higher cost.

Development Test Results

	A	B
Hardness, Shore A	66	66
LOI (%)	20	20
Vertical Burn	VTM-0	VTM-0

Formulation

	A	B
ATO	15	
Santicizer® 141		25
Santicizer® 154		25
DOTP	80	15
PVC Resin	100	100
$CaCO_3$	15	15
ATH	20	20
Stabilizer	3	3

Cost Analysis*

	A	B
ATO	$100	
Santicizer® 141		$64
Santicizer® 154		$64
DOTP	$64	$12
Cost	$164	$140
FR/Plasticizer		**-15%**

*Illustrative prices, not a reference for current or future pricing trends

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Customer Service & TDS Requests
For more information about our plasticizers visit our plasticizer portal.

Valtris Overview

Valtris is a global leader in specialty chemical additives and precursors, offering innovative solutions and products to customers around the world. With strong technical expertise and best-in-class formulation capabilities, we develop products that provide essential performance properties to plastics, coatings, adhesives and sealants, pharmaceuticals, flavor and fragrance, and personal care products. For more than 75 years, we have served as a trusted partner for customers by providing exceptional service and high-quality products. www.valtris.com

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