

VulcaMix® vs Dithiophosphate accelerator

台翔耐黃變促進劑®和硫代磷酸鹽類促進劑的比較

Light fastness predicts a material's resistance to yellowing, fading, darkening or even physical degradation such as cracking or shrinking when exposed to sunlight. Laboratory tests in this application note compared the influences of VulcaMix#4®, VulcaMix#2®, dithiophosphate accelerator (KE-7699 Bayer®) formulations and industry commonly used DM accelerator system on light fastness test, vulcanization characteristics, and cured stock properties. The following compound was used:

耐黃變試驗檢測材料耐黃變性能。通常也能預測曝露於日光下導致的橡膠光老化。眾所週知橡膠老化黃變會使得製品的外觀和物理機械性能變壞。本實驗中我們測試台翔四號綜合促進劑® (VulcaMix#4), 台翔二號綜合促進劑® (VulcaMix#2), 硫代磷酸鹽類促進劑 (KE7699 Bayer®) 與傳統DM促進劑耐黃變功效。同時也比較使用這些促進劑於硫化系統中的硫化曲線, 硫化膠物性以及防吐霜特性。

Compound 實驗測試配方

	DM	VulcaMix#2®	KE7699	VulcaMix#4®
BR 9000	30	30	30	30
IR 2200	30	30	30	30
SBR	40	40	40	40
Ultasil VN3 Silica	40	40	40	40
DEG	4.0	4.0	4.0	4.0
Stearic Acid	2	2	2	2
ZnO	5	5	5	5
VulcaPellet®TiO ₂ -80	12	12	12	13
VulcaPellet®S-80	2.0	2.0	2.0	2.0
VulcaPellet®TS-80	0.3	0.3	---	---
DM accelerator	2.0	---	1.0	---
VulcaMix®#2-75	---	2.5	---	---

KE7699 (33% active ZPDB)	---	---	2.0	---
DPG			0.5	
New VulcaMix®-75	---	---	---	2.5

Cure Properties
硫化數據

	DM	VulcaMix#2®	KE7699	VulcaMix#4®
Scorch Time t2, min	4.00	2.48	1.40	3.59
Cure Time t90, min	5.10	3.37	2.18	5.27

Physical Properties and Light Fastness Test
耐黃變測試及硫化膠機械性能

	DM	VulcaMix#2®	KE7699	VulcaMix#4®
Tensile Strength, kg/cm ²	122	141	156	162
Elongation, %	914	1046	783	1130
Tear Strength, kg/cm	42	48	43	45
Shore Hardness A	67	62	63	61
Discoloration, ASDM D1148 higher is better	3.5-4.0	4.0	3.5-4.0	4.5-5.0

The data clearly demonstrates that polymer cured with VulcaMix® are all with a better yellowing resistance over traditionally DM cured accelerator system. Among them, the addition of VulcaMix®#4 obtained the highest level (level 4.5-5.0) in light fastness test, which shows very little yellowing after a long intensive high energy UV light exposure. In addition to a good light fastness property, polymer cured with VulcaMix® is equal or superior in cure characteristics and physical properties over the conventional cured accelerator system.

實驗測試顯示使用台翔綜合促進劑[®]藥膠的優點。相較於DM促進劑，台翔綜合促進劑[®]二號與台翔綜合促進劑[®]四號顯著地改善材料耐黃變性能。其中台翔綜合促進劑[®]四號耐黃更達 4.5 級以上。採用台翔綜合促進劑[®]生產的硫化膠同時能保有良好的物理性能。

We summarized here the characteristics among different accelerator system observed in this experiment:

1.	VulcaMix [®] can be used alone as a sole accelerator in outsole compounding formulation. By adjusting the dosage, the desired cure characteristics and physical properties can be obtained without using the secondary accelerator.	
2.	Processing Safety: (Scorch Time)	VulcaMix#4 [®] > DM > VulcaMix#2 [®] > KE7699.
3.	Light fastness:	VulcaMix#4 [®] (4.5-5.0) > VulcaMix#2 [®] (4.0) > DM, KE7699 (3.5-4.0).
4.	Blooming test:	VulcaMix#4 [®] , VulcaMix#2 [®] provides the least blooming.

各種促進系統的特性總結如下，

1.	台翔四號綜合促進劑 [®] 不需使用 TS 作為 2 次促進劑。酌量增減台翔綜合促進劑 [®] 四號的使用量可以調整操作硫化時間及所需物性要求。適應不同大底工藝需要。	
2.	耐焦燒特性:	台翔四號綜合促進劑 [®] > DM > 台翔二號綜合促進劑 [®] > KE7699。
3.	耐黃變等級:	台翔四號綜合促進劑 [®] (4.5-5.0) > 台翔二號綜合促進劑 [®] (4.0) > DM, KE7699 (3.5-4.0)。 (*使用台翔四號綜合促進劑 [®] 需酌量增加TiO2 用量以提高耐黃變等級。但對其他三種配方增加TiO2 用量未能提升耐黃變等級)。
4.	吐霜實驗:	台翔四號綜合促進劑 [®] 及台翔二號綜合促進劑 [®] 具備最佳防吐霜特性。