Introduction to Activ8/Premix Acti8

Activ8 is a new generation of multi-functional performance additives for rubber vulcanization. The product has the capability to behave as an ultra-accelerator and activator but with unique capabilities to interact with filler particles.

The product Activ8 allows for a range of advantages in rubber vulcanization and formulation design. The first advantage of Activ8 is that the cure rate of the compound is increased and this is apparent for any curative system. This effect works as a drop in and will activate any accelerator and rubber system utilizing sulfur based curing.

The product allows for reduction of zinc oxide as the cure system is greatly enhanced by the Activ8 presence.

Normal dosage of the product is in the range of 1 to 2 phr.

The product Activ8 is a functionalised ethylene glycol terminated with a suitable silicate compound allowing interaction with silica and also carbon black surfaces.

Activ8 also contains a suitable, cure safe salt of dibenzyldithiocarbamate that provides good curing performance and works in a synergistic manner with the functionalised glycol carrier.

The product contains REACH approved ingredients and is nitrosamine and heavy metal free.

For improved mixing and ease of use Activ8 is available in a suitable POE and is sold as Premix Acti 8 in the EU market. The product is manufactured in Italy for the stringent requirements of the European rubber market.

DPG replacement

It became apparent during the first customer trials of Activ8 that the behaviour of the product had two main results in rubber systems. In silica filled compounds it was noticed that the addition of the product positively affected dynamic properties and boosted the curing of the compound significantly.

An interaction of DPG content and the product Activ8 was noticed and it was apparent that there was a competition for silanol sites on the silica surface between DPG and the Activ8. It was then investigated to remove the DPG and determine the properties of the vulcanizate.

The results were very interesting and significant. The addition of Activ8 as a direct replacement of the DPG content (1phr Activ8 for 1phr DPG used) achieved dynamic properties that were superior to the DPG added while also giving significant boosting to the actual cure performance. This curing boost is well beyond any other boosting accelerator normally used (like ZBOP or ZBEC).

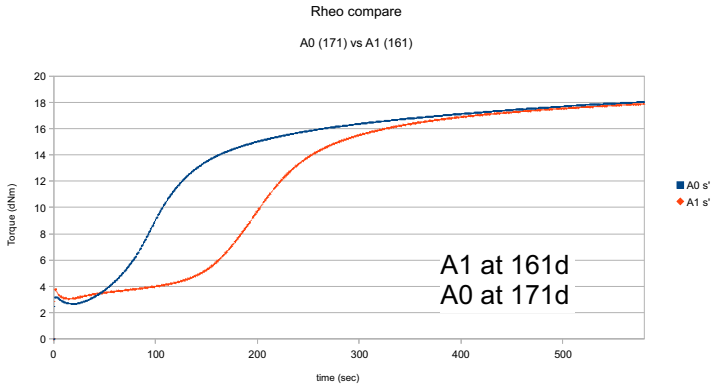
In the previously DPG containing systems the scorch time was improved with addition of the Activ8 and removal of the DPG content. The material has a longer induction period while the Activ8 is interacting with the silica surface and once this completes curing is rapid and efficient.

This compound is highly silica filled and normal for tyre manufacture (based on SSBR). It is a sulfenamide cure system and is boosted with ~2phr DPG.

Compound	S' Min	S' Max	TS 2 Scorch (min)	TC60 (min)	TC90 (min)	TC95 (min)	Peak Rate
A0 DPG	2.77	20.4	1.08	2.37	9.72	14.59	9.34
A1 Activ8 no DPG -50% ZnO	2.98	19.05	1.46	2.21	4.29	6.35	12.38

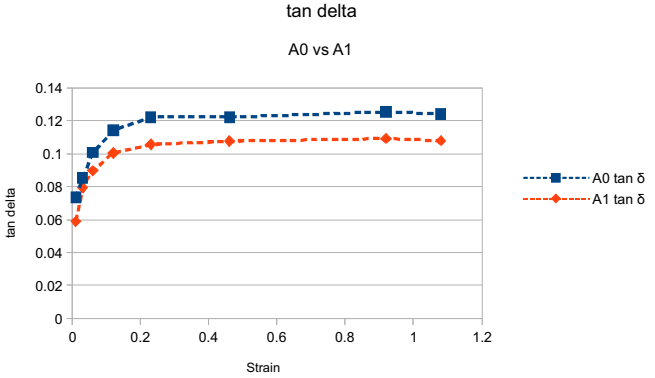
The immediate effect of adding Activ8 and removing the DPG is that the cure time is greatly reduced. The cure shape is different and does not have the long march normally apparent in SBR systems.

Please note that the normal application of Activ8 results in ZnO being reduced.



The cure time was chosen to be 9,72 min for both the A0 (DPG control) and the A1 (DPG free with 2phr Premix Acti8). It is apparent that the rheometry is the same shape and cure profile at and after the cure time. Note that this is done with a 10 deg reduction in cure temperature on the A1 material.

This is proof that the Premix Acti8 is a cure booster and is superior beyond what the DPG boosting effect is in this sulfenamide cure system.



The above comparison of tan delta of the two vulcanizates cured to Tc90 demonstrates the dynamic property improvement capability with DPG elimination.

Improved dynamic properties

The behaviour of the product in terms of dynamic properties is now investigated for systems that do not contain DPG. A range of tyre type formulations (with low silica content 15phr) are investigated to determine effects on rubber filler interaction (Payne Effect at 60 deg).

NR Compound	
NR	80
BR	20
N550	35
Stearic	2
PEG4000	1
Antioxodant	2
Antiozonant	1
VN3 Silica	15
TESPT	1
TOTAL	157

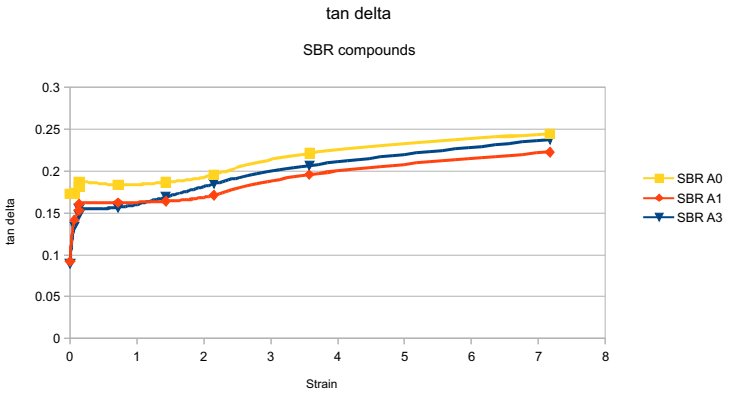
SBR compound	
6PPD	2.2
Microwax	2
Stearic Acid	1
PEG4000	1
N330	20
TDAE oil	8
SBR 1500	100
N220	20
VN3 Silica	15
TESPT	1
TOTAL	170.2

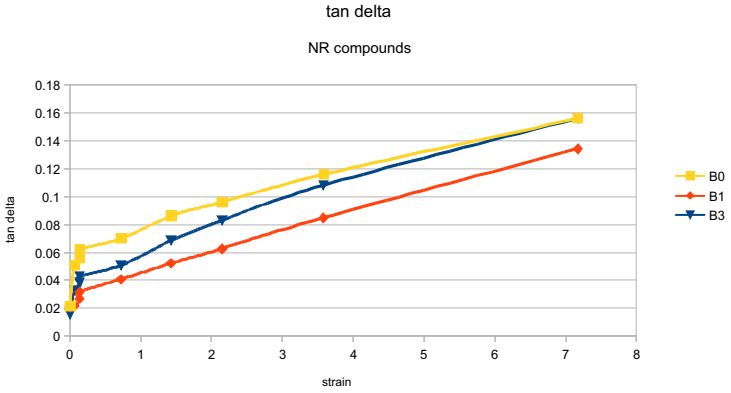
The following NR tread base and SBR LTT formulations were trialed.

MB 170.2	LTT formulation		
	A0	A1	A3
ZnO	3	3	1.5
TBBS	1	1	1.5
S8	1.8	1.8	1.8
Activ8		1	1

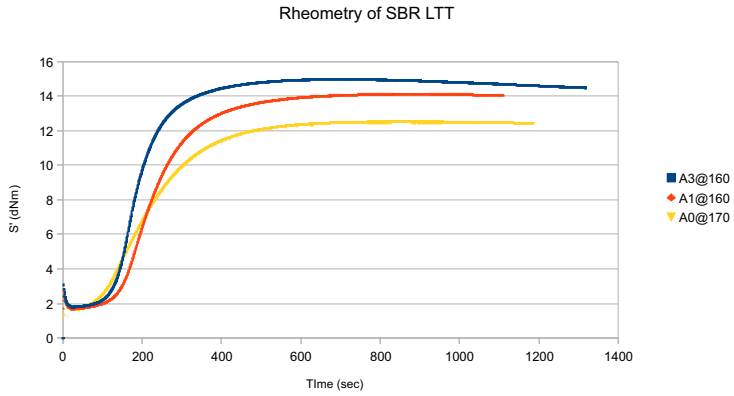
Cure package NR Tread base 157 phr	A1	A2	A3
ZnO	5	5	2
CBS	1	1	1
S8	1.5	1.5	1.5
Activ8		1	1

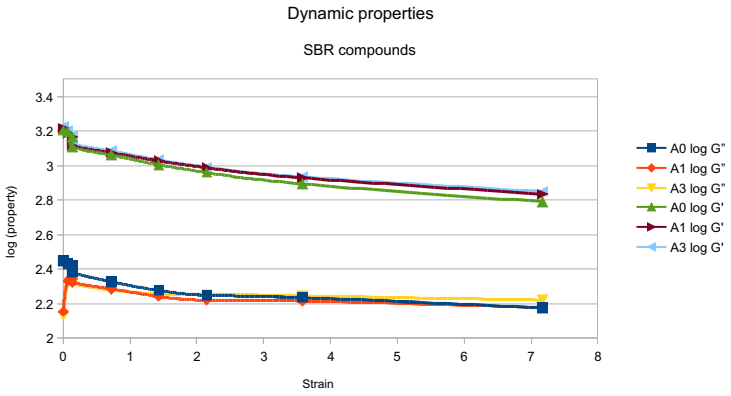
Note that the formulations all demonstrated the zinc reduction potential of Activ8.

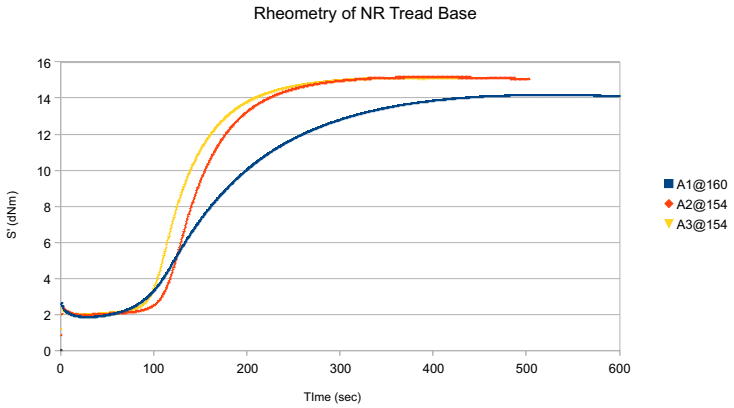


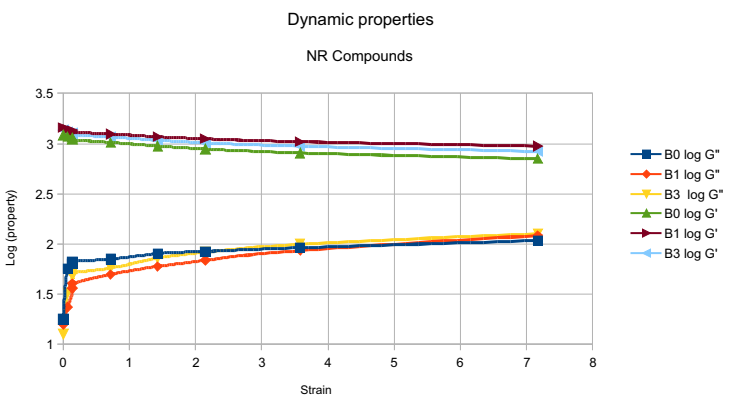


It is apparent that the addition of Activ8 into these compounds positively improves the tan delta property of these vulcanizates









rubbernano PRODUCTS

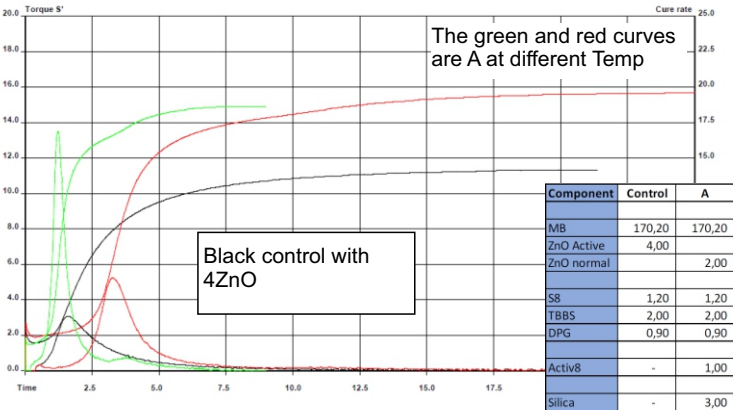
Premix Acti8
Activ8

Zinc rationalization

The capability of lowering ZnO has been demonstrated in many different systems with Activ8. This is particularly useful in situations where compounders have many different forms of ZnO and desire simplification and rationalization of the ZnO. Since the Activ8 material is a superior activator and offers physical and dynamic property additions it is quite common to allow a compound formulation to use a simple (or more cost effective) form of ZnO (ie from activ to normal green seal) and also use less of that amount of ZnO.

This allows for good zinc rationalization and we commonly offer reductions of at least 40% of ZnO content.

The demonstration to the right is an M class conveyer belt compound.



Component	Control	A
MB	170,20	170,20
ZnO Active	4,00	
ZnO normal		2,00
S8	1,20	1,20
TBBS	2,00	2,00
DPG	0,90	0,90
Activ8	-	1,00
Silica	-	3,00

Superior physical properties

In this conveyer belt vulcanizate it allowed for an improvement of significant tensile property and in combination with the dynamic properties it is a useful performance additive to conveyer belt formulations.

The reduction in ZnO and the addition of Activ8 had some further advantages in the above system. This result has been demonstrated in many different vulcanizates and is typical of the addition of Activ8.

Note that dosage is 1phr of pure active content and hence 2phr of the Premix Acti8.

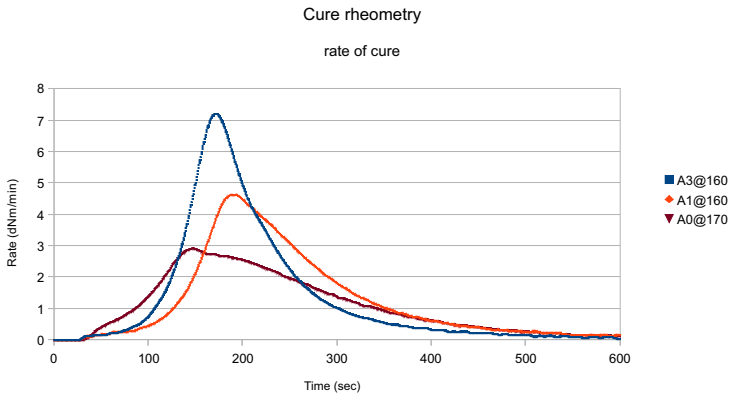
Compound	TS2	Tc90	Cure Temp	ZnO Content
Control	1.58	7.18	170	4 phr ActivZnO
Activ8	1.78	6.07	160	2 phr ZnO Green Seal

Compound	UTS (Mpa)	EAB%	Mod50 (Mpa)
control	25.8	631	1.4
Activ8	28.1	635	1.5

Energy efficiency and production advantage

In many different applications of Activ8 we have the opportunity to lower cure temperature to achieve greater scorch safety at curing temperature. As long as we ensure the workability of the compound and its scorch profile at 135 deg we have a large opportunity to reduce energy consumption in the manufacture of the product. This in many cases comes with the ability to increase the silica content if desired (as dynamics are improved) and increased silica content improves scorch profile.

In Activ8 curinig is is common for the cure to start slow but end very rapidly. This has great application and advantage in general rubber articles. This phenomenon is well demonstrated in an SBR formulation (LTT type) to the right. The cure actually starts slower (at reduced temperature) and ends faster. This is a trend that is commonly repeated in different rubbers and with different accelerator packages.



Where to get the product

The product is currently available in the EU via

RDC srl

http://rdcsrl.com/contacts/

The product is available in Asia currently via

Anyking

http://www.anyking.com.tw/en/contact.php

We are currently expanding our distribution network