TECHNICAL UPDATE

Dymalink® 709 Enables Zinc Reduction in Accelerated Sulfur Vulcanization Through More Efficient Activation

ore recentl , environment l concerns re r in t e ultim te te o un oun inc s ecies in ru er rticles s le to incre sin ressure on m nu cturers to re uce t e mount o n or ot er inc com oun s in ormul tions. e incre se ctivit o D m link 09 llows or l r e re uction in t e inc concentr tion use to c ieve simil r ultim te sic l ro erties. Re uctions re c ieve t rou com in tion o incre se e cienc o cure lower r inc s lt re uire n i er itive molecul r wei t. or ex m le, even t e uiv lent r lo in s, D m link 09 cont ins rou l 1 2 t e mount o inc s n .

Results rom mo el ormul tions re rovi e elow, inclu in tire si ew ll, i er orm nce silic tre , wireco t com oun , n mo el ru er roll. n e c o t ese stu ies, t e level o D m link 09 w s o timi e suc t t t e r eometer ro le n o tim ll cure sic l ro erties were simil r to t e n control. e resultin re uction in mol r inc concentr tion is i li te .

Sidewall Formulation & Performance

Component / Property	ZnO-Based, phr	Dymalink® 709-Based, phr
Cis BR	50.0	50.0
NR	50.0	50.0
Carbon black	50.0	50.0
DAE oil	12.0	12.0
IPPD	2.0	2.0
TMQ	1.0	1.0
Stearic acid	0.8	0.8
ZnO	**5.0**	**--**
Dymalink 709	**--**	**2.0**
Sulfur	2.5	2.5
TBBS	0.7	0.7
t_2, mins.	3.62	3.21
t_{90}, mins.	6.31	5.85
ML, dNm	4.1	3.4
MH, dNm	30.9	30.3
MH-ML, dNm	26.9	26.8
Shore A	51	56
Tensile strength, MPa	22.8	23.2
Elongation @ break, %	738	758
Modulus, 100%, MPa	1.7	1.7
Modulus, 300%, MPa	6.5	6.5
Die C tear, kN/m	86.1	84.6
Moles Zn/100 gms. Polymer	**0.063**	**0.012**

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Resin Solutions

Silica Tread Formulation & Performance

Component / Property	ZnO-Based, phr	Dymalink® 709-Based, phr
Cis BR	25.0	25.0
HVSSBR	75.0	75.0
Silica	65.0	65.0
Silane (50%)	10.4	10.4
DAE oil	25.0	25.0
IPPD	2.0	2.0
Stearic acid	1.0	1.0
ZnO	**5.0**	**--**
Dymalink 709	**--**	**2.5**
Sulfur	1.4	1.4
CBS	1.7	1.7
DPG	2.0	2.0
t_2, mins.	2.11	2.84
t_{90}, mins.	10.4	6.6
ML, dNm	5.6	5.8
MH, dNm	32.9	33.8
MH-ML, dNm	27.4	28.1
Shore A	53	52
Tensile strength, MPa	18.2	17.5
Elongation @ break, %	450	385
Modulus, 100%, MPa	2.1	2.6
Modulus, 300%, MPa	10.1	12.4
Die C tear, kN/m	43.9	38.0
Moles Zn/100 gms. Polymer	**0.063**	**0.015**

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Wirecoat Formulation & Performance

Component / Property	ZnO-Based, phr	Dymalink® 709-Based, phr
NR	100.0	100.0
Carbon black	65.0	65.0
DAE oil	3.0	3.0
TMQ	1.0	1.0
Stearic acid	2.0	2.0
ZnO	**5.0**	**--**
Dymalink 709	**--**	**5.0**
Sulfur	3.5	3.5
CBS	0.8	0.8
IPPD	1.0	1.0
t_2, mins.	0.86	1.05
t_{90}, mins.	3.06	5.36
ML, dNm	6.3	4.9
MH, dNm	50.7	56.4
MH-ML, dNm	44.5	51.5
Shore A	66	69
Tensile strength, MPa	26.4	25.1
Elongation @ break, %	518	481
Modulus, 100%, MPa	4.4	4.6
Modulus, 300%, MPa	16.0	16.5
Die C tear, kN/m	133.0	157.0
Moles Zn/100 gms. Polymer	**0.063**	**0.030**

Rubber Roll Formulation & Performance

Component / Property	ZnO-Based, phr	Dymalink® 709-Based, phr
NBR	100.0	100.0
Carbon black	50.0	50.0
DAE oil	10.0	10.0
IPPD	2.0	2.0
Stearic acid	0.8	0.8
ZnO	**5.0**	**--**
Dymalink 709	**--**	**2.0**
Sulfur	1.0	1.0
CBS	1.2	1.2
t_2, mins.	2.75	3.68
t_{90}, mins.	4.92	6.46
ML, dNm	3.5	3.3
MH, dNm	22.5	21.3
MH-ML, dNm	19.0	18.0
Shore A	62	64
Tensile strength, MPa	19.7	18.8
Elongation @ break, %	957	1005
Modulus, 100%, MPa	1.6	1.6
Modulus, 300%, MPa	5.1	4.6
Die C tear, kN/m	64.1	62.8
Moles Zn/100 gms. Polymer	**0.063**	**0.012**

Concluding Remarks

It is notable that application of the demonstrated technology will provide the most benefit in conventional and semi-efficient sulfur vulcanization systems. Available sulfur is a prerequisite to formation of the active sulfurating agent. It has been proposed that zinc sourced from the activator plays a central role in this reaction intermediate. It has also been proven that zinc monomethacrylate does not contribute to additional non-sulfur crosslinks when applied. Dymalink 709 should be considered in any zinc rationalization study, as the potential for significant reductions in zinc concentration exists.

About Resin Solutions

Resin Solutions is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemical, and liquid and power tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings and other materials. Resin Solutions has pioneered the development of these advanced technologies, introducing products that enhance the performance of products in energy, printing, packaging, construction, tire manufacture, electronics and other demanding applications. For more information, please visit www.resinsolutions.com

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