



COMPARATIVE STUDY OF RHEOMETRIC PROPERTIES FOR TIRE TRADE CAP COMPOUND FOR ECO-SSBR WITH LOW PCA AND HIGH PCA BASED FORMULATION

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Abstract: The Rheological behavior of the samples were studied using a parallel plate rheometer and the rheological material functions .The object of this study is to investigate the relaxation time, the viscosity index ,Min TQ and Max TQ of a tyre tread cap compound. For this work two types of low PCA and one regular high PCA Petroleum oils base tyre trade cap compounds were Rheologically analyzed . The rheological, properties of SSBR loaded with different LPCA & HPCA oils have been studied in order to obtain similar properties. Lubricant were used during the processing and production of rubber compounds for improving the dispersion of fillers and flow characteristics of the compounds¹⁻³

Keywords: low down PCA Oils, Polycyclic Aromatics, Carcinogenesis, PAH, Hazard Assessment

I. INTRODUCTION

In compounding rubber and rubber base compositions were used for pneumatic tires, it is common to utilize processing oils to soften and extend the rubber. Aromatic processing oils, having a certain content of poly aromatic compound have been used generally add as lubricating agent. Particular rheological behavior base applications of highly filled polymers in the ceramic and metallurgy industries are ceramic injection molding (CIM), metal injection molding (MIM), and fused filament fabrication (FFF)⁴⁻⁶

II. EXPERIMENTAL

Mixing of rubber compounds SSBR base having regular aromatic oil and SSBR having low PCA oils base formulations are mixed out by a two-wing rotor laboratory Banbury. Master batch mixing was done, setting the Temperature Control Unit (TCU) at 90°C and rotor speed at 60 rpm. After the power integrator (PI) indicated an achievement of 0.32 kWh, the master batch was dumped. The dump temperature of the master batches was found to be within 130 - 160°C. The master batches were sheeted out in a laboratory two-roll mill. Further mixing of the master batches were carried out after a maturing period of 8 hours. Final batch mixing, the TCU was kept at 600C and the rotor speed at 30 rpm. The earlier prepared master batch was mixed with sulfur, accelerator and scorch inhibitor.⁷⁻¹².

III. RESULTS AND DISCUSSION

The rheometric properties are showed in table No. 1 to 6 for different formulations LPCA oils and HPCA oils base or tyre trade cap compound

Table- 1: Rheometric Properties

Rheometric Properties @ 193^oC/2.5min for Compound-1			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	0.23	0.23	0.22
MAX.TQ.(lb-in)	1.19	1.84	1.82
Final TQ(lb-in)	13.61	13.18	13.26
tS1 (min)	0.49	0.49	0.48
tS2 (min)	0.66	0.64	0.63
tC10 (min)	0.53	0.51	0.50
tC40 (min)	0.83	0.80	0.80
tC50 (min)	0.88	0.84	0.84
tC90 (min)	1.19	1.15	1.14

Table-2: Rheometric Properties

Rheometric Properties @ 160^o C/30min (Final) Compound 1			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	2.45	2.67	2.76
MAX.TQ.(lb-in)	15.84	15.76	16.09
Final TQ.(lb-in)	14.56	14.21	14.57
tS1 (min)	4.10	4.09	4.22

tS2 (min)	5.07	4.94	5.08
tC10 (min)	4.59	4.47	4.64
tC40 (min)	5.69	5.58	5.77
tC50 (min)	5.87	5.77	5.97
tC90 (min)	7.79	7.66	7.85
Max-Min Tq.(lb-in)	13.39	13.09	13.33

Table 3: Rheometric Properties

Compound-2 Rheometric Properties @ 193⁰C/2.5min			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	0.23	0.23	0.23
MAX.TQ.(lb-in)	1.99	1.86	1.88
Final TQ(lb-in)	13.61	13.02	13.21
tS1 (min)	0.49	0.50	0.50
tS2 (min)	0.66	0.67	0.65
tC10 (min)	0.50	0.52	0.52
tC40 (min)	0.83	0.84	0.83
tC50 (min)	0.88	0.89	0.87
tC90 (min)	1.19	1.19	1.18

Table 4: Rheometric Properties

Compound -2 Rheometric Properties @ 160⁰C/30min			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	2.45	2.61	2.64
MAX.TQ.(lb-in)	15.84	15.36	15.75
Final TQ.(lb-in)	14.56	14.19	14.32
tS1 (min)	4.10	4.63	4.57
tS2 (min)	5.07	5.60	5.60
tC10 (min)	4.59	5.05	5.03
tC40 (min)	5.69	6.29	6.31
tC50 (min)	5.87	6.51	6.51
tC90 (min)	7.79	8.70	8.42
Max-Min Tq.(lb-in)	13.39	12.75	13.11

Table 5: Rheometric Properties

Compound-3 Rheometric Properties @ 193⁰C/2.5min			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	0.23	0.23	0.22
MAX.TQ.(lb-in)	1.19	1.84	1.82
Final TQ(lb-in)	13.61	13.18	13.26
tS1 (min)	0.49	0.49	0.48

tS2 (min)	0.66	0.64	0.63
tC10 (min)	0.53	0.51	0.50
tC40 (min)	0.83	0.80	0.80
tC50 (min)	0.88	0.84	0.84
tC90 (min)	1.19	1.15	1.14

Table 6: Rheometric Properties

Compound -3 Rheometric Properties @ 160°C/30min (Final)			
TEST	OIL-1	OIL-2	OIL-3
MIN TQ. (lb-in)	2.45	2.67	2.76
MAX.TQ.(lb-in)	15.84	15.76	16.09
Final TQ.(lb-in)	14.56	14.21	14.57
tS1 (min)	4.10	4.09	4.22
tS2 (min)	5.07	4.94	5.08
tC10 (min)	4.59	4.47	4.64
tC40 (min)	5.69	5.58	5.77
tC50 (min)	5.87	5.77	5.97
tC90 (min)	7.79	7.66	7.85
Max-Min Tq.(lb-in)	13.39	13.09	13.33

IV. CONCLUSION

LPCA oils 2 and 3 base tire trade cap formulations shows comparative values for Minimum torque , Maximum torque , Scorch safety time , Optimum cure time , as well as the Mooney viscosity for SSBR base tyre trade cap compound.

V. REFERENCES

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