

Characterizing Rubber's Resistance Against Chip and Cut Behavior

Radek Stoček,^{1,2} William V. Mars,³ Reinhold Kipscholl,⁴
and Christopher G. Robertson^{3,*}

¹ PRL Polymer Research Lab, Zlín, Czech Republic;

² Centre of Polymer Systems, Tomas Bata University, Zlín, Czech Republic;

³ Endurica LLC, Findlay, Ohio, USA;

⁴ Coesfeld GmbH & Co. KG, Dortmund, Germany;

ABSTRACT. Tires in service - especially in rough terrain - show a behavior which is well known as the cut and chip (CC) effect. This work describes unique analytical methods to characterize the fracture in rubber occurring during lab-simulated operation of the tire tread in rough terrain. The new test device controls and records multiple applied loads and displacements during cyclic impact to the surface of a solid rubber wheel to mimic and quantify the cut and chip damage experienced by tire tread compounds on off-road and poor road conditions. To demonstrate the testing capabilities, characterization results are examined for carbon black filled rubber compounds suitable for tire tread applications. The instrument provides a reliable method for evaluating the resistance of rubber against CC damage, and it can also be used in full contact mode for measurement of friction and wear.

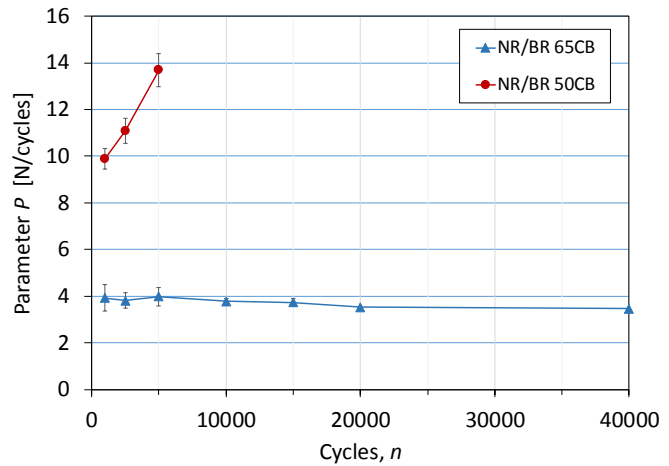
*Speaker; email: cgrobertson@endurica.com

Citation: R. Stocek, W. V. Mars, R. Kipscholl, and C. G. Robertson, "Characterizing Rubber's Resistance Against Chip and Cut Behavior", Presented at the Fall 192nd Technical Meeting of the Rubber Division, ACS, Cleveland, Ohio, October 10-12, 2017 (Paper #E20).

This is a synopsis. See citation source for full paper.

List of Parameters for the Instrumented Chip & Cut Analyser (ICCA)

Parameter	Range	Unit	Parameter Type			
			Defined	Measured	Controlled	Calculated
Rotation speed, ω	100 to 1500	rpm	✓	✓	✓	
Impact frequency, f	0 to 10	Hz	✓	✓	✓	
Number of impact cycles, n	0 to undefined	-	✓	✓	✓	
Time of sliding, t_s	20 to permanent	ms	✓	✓	✓	
Normal force, F_n	0 to 500	N	✓	✓	✓	
Friction force, F_f	0 to 900	N		✓		
Resulting force, F_c	calculated	N				✓
Depth of indentation, a_i	0 to 20	mm		✓		
Friction distance, a_f	measured	mm		✓		
Normal energy, E_n	calculated	J				✓
Friction energy, E_f	calculated	J				✓
Friction coefficient, c_f	calculated	-				✓
Chip & cut propensity, P	calculated	N/cycle				✓



LEFT: Photograph of Instrumented Chip & Cut Analyser (ICCA), showing expanded view of impacting device and sample. RIGHT: Plot of chip & cut propensity (P) versus number of impact cycles for NR/BR(75/25) compounds reinforced with 50 phr and 65 phr of N339 carbon black.

This is a synopsis. See citation source for full paper.