Elvaloy® RET &
Crumb Rubber Performance Relative
To New Potential SHRP Test Methods

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STUDY OF BINDER AND MIXTURE PROPERTIES OF CRUMB RUBBER MODIFIED BLENDS COMPARED TO A PG 58-28 UNMODIFIED CONTROL AND A PG 70-28 MADE WITH ELVALOY®

STUDY MATERIALS
BASE ASPHALT         PG 58-28
6% 80 MESH CRUMB RUBBER BLEND
12% 80 MESH CRUMB RUBBER BLEND
18% 80 MESH CRUMB RUBBER BLEND
1.5% ELVALOY 4170 BLEND

TO INVESTIGATE BINDER AND MIX PROPERTIES RELATIVE TO RUTTING RTFO RESIDUES OF BINDERS WERE EVALUATED FOR:
% CUMULATIVE STRAIN, DSR PROPERTIES (PHASE ANGLE & G*/SIN(d))

MIXES WERE EVALUATED FOR HIGH TEMPERATURE RESISTANCE TO PERMANENT DEFORMATION USING A TORSIONAL FLOW TIME PROCEDURE DEVELOPED FOR USE ON A DSR
DH123B & 124A, MIF 58-28, 6% Rouse GF-80AE, 58°C, 300PA, CUM CRT

FROM TOP TO BOTTOM
6% CRM BLEND
12% CRM BLEND
18% CRM BLEND
1.5% ELVALOY BLEND

Elvaloy® RET
reactive elastomeric terpolymer
DH123B & 124A, MIF 58-28, 6% Rouse GF-80AE, 58°C, 300PA, CUM CRT

FROM TOP TO BOTTOM
STRAIGHT PG 58-28
6% CRM BLEND
12% CRM BLEND
18% CRM BLEND
1.5% ELVALOY BLEND
DH147C & 148A, MIF 58-28, 1.5% 4170, .5% SPA (105), 58°C, 300PA, CUM CRT

FROM TOP TO BOTTOM
18% CRM BLEND
1.5% ELVALOY BLEND
COMPARE PG 58-28 & MODIFIED BLENDS @ 58°C, 300PA, TOTAL CREEP

FROM TOP TO BOTTOM
STRAIGHT PG 58-28
6% CRM MODIFIER
12% CRM MODIFIER
18% CRM MODIFIER
1.5% ELVALOY
Crumb Rubber Mix Testing
Elvaloy® RET
reactive elastomeric terpolymer

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Elvaloy® RET
reactive elastomeric terpolymer

MIF 58-28, 18% ROUSE, 1-1, THICK, 20,000 PA, 58°C
Elvaloy® RET
reactive elastomeric terpolymer

MIF 58-28, 18% ROUSE, 1-1, THICK, 20,000PA, 58°C

CRS 1.5% ELVALOY MIX @ 58 C @ 20000 Pa-0001c
NOTE: THIS PLOT COMPARES FAILURE OF ELVALOY MIX AT 50,000 PASCALS OF STRESS TO THE FAILURE OF 18% CRUMB RUBBER AT 20,000 PASCALS OF APPLIED STRESS
Elvaloy® RET
reactive elastomeric terpolymer

MIF 58-28, 0% ROUSE, 4-1, THICK, 20,000PA, 58°C

% strain vs. global time (s)
BINDER % CUMULATIVE STRAIN AS A FUNCTION OF BINDER RTFO RESIDUE PHASE ANGLE

Log10(Y) = -0.746789 + 0.0546626X
EMS = 0.00544431
$R^2 = 0.991$

LOWER LEFT HAND REGION OF PLOT REPRESENTS BINDER WITH LOWER PHASE ANGLES AND LOW CUMULATIVE STRAIN
CRUMB RUBBER STUDY: TORSIONAL FLOW TIME AS A FUNCTION OF RTFO RESIDUE PHASE ANGLE

Log_{10}(Y) = 11.0171 - 0.114393X
EMS = 0.0498232
R^2 = 0.981

UPPER LEFT HAND REGION OF PLOT IS MIX WITH GREATER RESISTANCE TO PERMANENT DEFORMATION

1.5% ELVALOY®
12% CRM
18% CRM
6% CRM
CONTROL 58-28

TORSIONAL FLOW TIME, SEC'S, OF MIX AT 58 C
PHASE ANGLE RTFO RESIDUE AT 58 C
TORSIONAL FLOW TIME OF MIX @ 58 C AS A FUNCTION OF BINDER % CUMULATIVE STRAIN

Upper left hand region represents material with improved performance characteristics. Longer flow times = greater resistance to permanent deformation.

Comparing 12% CRM & 1.5% ELVALOY®. The ELVALOY® has 2 orders of magnitude greater resistance to deformation.

In terms of cost, the 12% CRM blend is about $15/ton of AC more expensive than the ELVALOY® blend.

Log10(Y) = 9.43746 - 2.08695Log10(X)
EMS = 0.0400973
R² = 0.985

18% CRM produces an unconstructable blend. 12% CRM could be tank blended and pumped.
Elvaloy® RET & Crumb Rubber Formulation Cost Estimates for PG76-22 for Florida

- Crumb Rubber Formula Example
  - 12% GTR @ $0.17/lb = $40.80/Ton*
  - 1% SBS @ $0.72/lb = $14.40/Ton
  - 0.25% Stabilizer @ $0.50/lb = $2.50
- Total Estimated Cost Per Ton = $57.70

- DuPont Elvaloy® RET Example
  - 1.2% Elvaloy 4170 @ $1.75/lb = $42.00/Ton
  - 0.4% Catalyst @ $0.65/lb = $5.20/Ton
- Total Estimated Cost Per Ton = $47.20

Better Performance & Formulation Costs With
Elvaloy® RET Polymer Modifier
Florida Specification
Path Forward?

- Should Florida Have Access To Other Performing Polymer Modifiers That Demonstrate Better Performance Than GTR?
- New Research & Testing Is Showing New Innovative Technology That Can Provide Longer Lasting Roads
- Increased Competition Drives Lower Costs And Greater Technology
- Let SHRP Performance Tests Be The Judge of PMA’s