

**Rutting and Moisture
Resistance of Asphalt
Mixtures Containing Polymer
and Polyphosphoric Acid
Modified Bitumen**

**Asphalt Institute Spring Meeting
28 April 2004
Hyatt Regency Washington Capitol
Hill, Washington, D.C.**



Experimental

- Saudi - PG 64-22

 - PPA Modified to PG70-22

 - Polymer/PPA Modified to PG76-22

- Venezuelan - PG 67-22

 - PPA Modified to PG70-22

 - Polymer/PPA Modified to PG76-22

- California Valley – PG64-10

 - Polymer/PPA Modified PG76-16



Experimental

- Ph Study
- SuperPave Properties – O/RTFO DSR
- Mixture Boiling Strip Test
- Mixture TSR
- Hamburg Rut/Moisture Testing @ 50C
- APA Testing Dry No Anti-Strip
- Chemical Studies



PG76-22 from Saudi Asphalt

PG Grade Achieved	76-22	76-22	76-22	76-22
PPA %	0	0.2	0.4	0.6
Polymer %	4.75%	4.10%	3.75%	3.40%
Brookfield Vis.@ 135	2950	3870	3290	2230
ODSR	1.606	1.532	1.561	1.534
Phase Angle	67.1	64.5	66.2	69.2
Wt. Loss	-0.105	0.21	-0.053	-0.034
RDSR	2.378	2.613	2.569	3.03
PDSR	1198	1126	1422	1276
BBR S Value	125	142	148	143
BBR M Value	0.325	0.335	0.332	0.327
Elastic Recovery	87.50%	86.70%	85.00%	85.00%

PG76-22 from Venezuelan Asp

PG Grade Achieved	76-22	76-22	76-22	76-22
PPA %	0	0.2	0.4	0.6
Polymer %	4.25	3.75	2.9	2.6
Brookfield Vis.@ 135	2350	2030	1510	1360
ODSR	1.557	1.524	1.366	1.42
Phase Angle	68.7	68.6	78.3	79.4
Wt. Loss	0.012	-0.024	0.23	0.008
RDSR	2.472	2.802	2.281	2.58
PDSR	1424	2038	1804	1934
BBR S Value	138	150	163	172
BBR M Value	0.32	0.31	0.311	0.306
Elastic Recovery	80.00%	77.50%	69.00%	64.00%



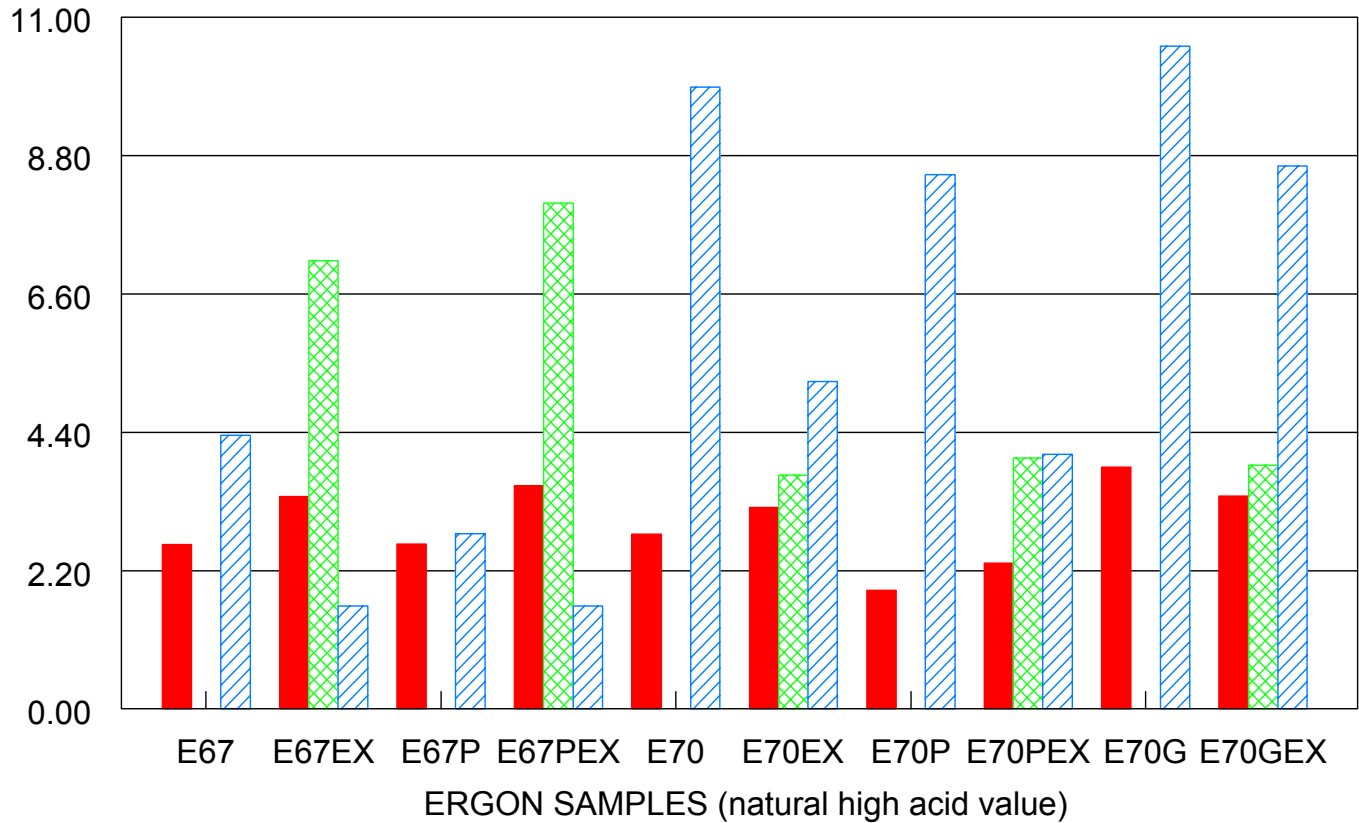
PG76-16 from CA Valley

PG Grade Achieve	76-16	76-16	76-16	76-10
PPA %	0	0.2	0.4	0.6
Polymer %	5.5	4.4	3.8	3.25
Brookfield Vis.@ 135	2060	1450	1310	1140
ODSR	2.092	1.595	1.414	1.253
Phase Angle	55.8	61.5	67.3	72.2
Wt. Loss	0.11	0.24	0.127	0.049
RDSR	2.327	2.521	2.335	2.296
PDSR	1959	2203	2782	1719
BBR S Value	211	286	291	115
BBR M Value	0.337	0.317	0.312	0.425
Elastic Recovery	85.00%	87.50%	85.00%	82.50%

ACID TREATED ASPHALT PROJECT

Asphalt pH, water pH, acid no.

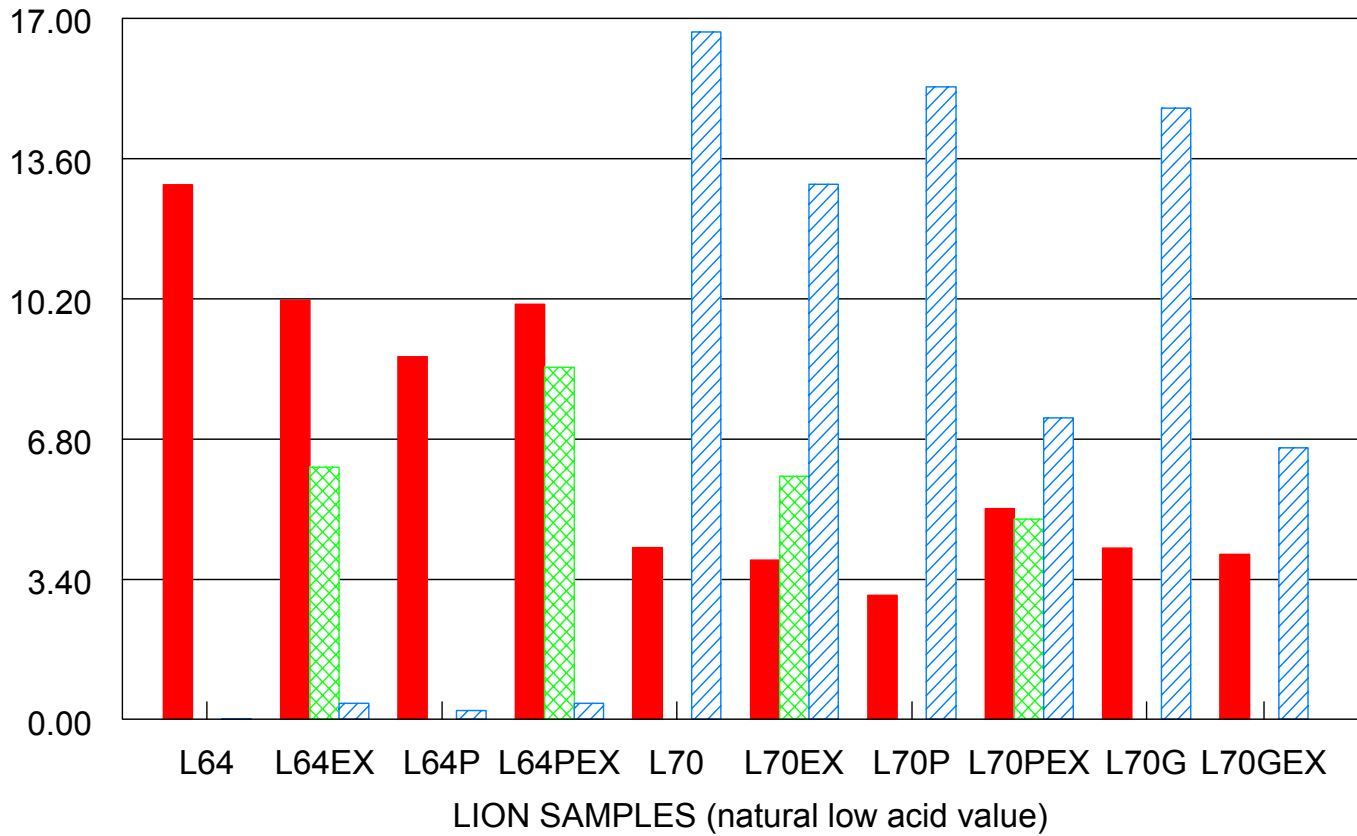
AC pH Water pH Acid No



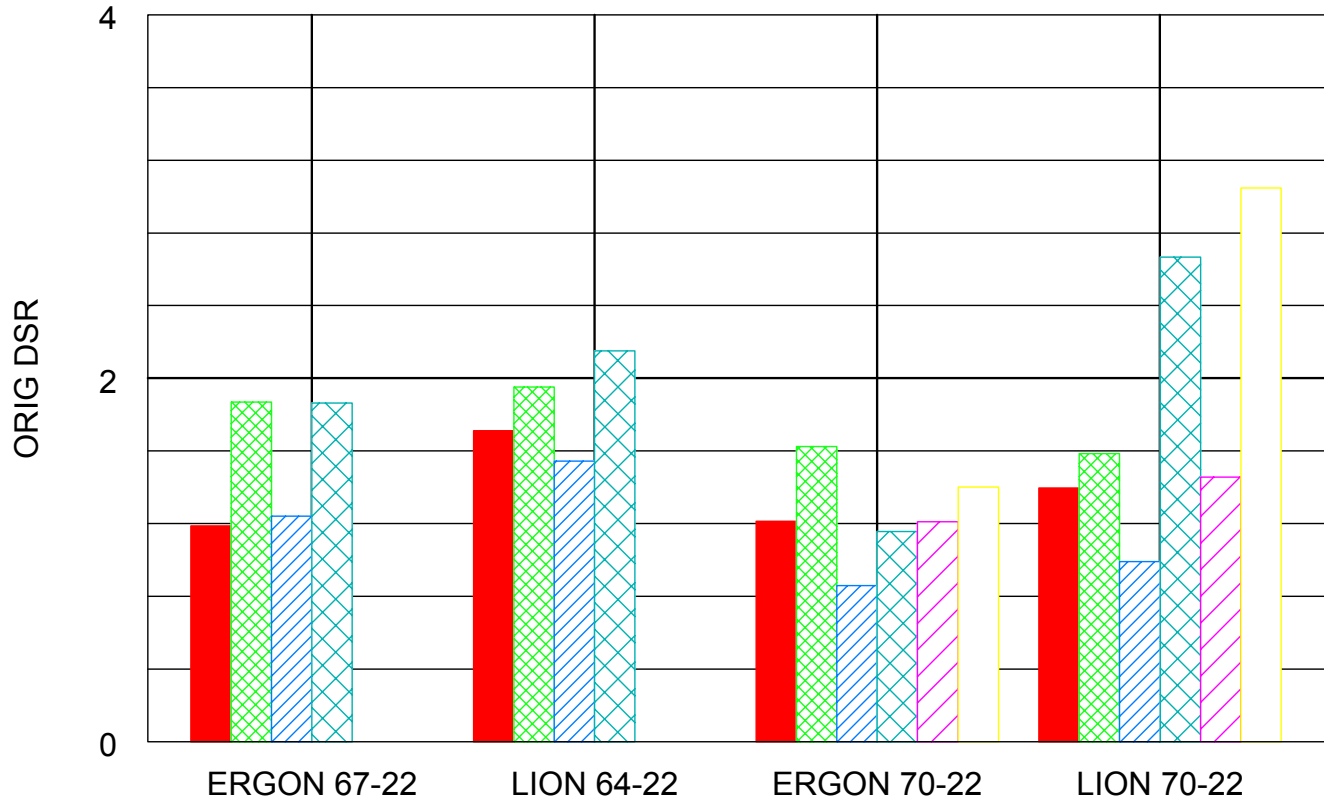
ACID TREATED ASPHALT PROJECT

Asphalt pH, water pH, acid no.

AC pH Water pH Acid No

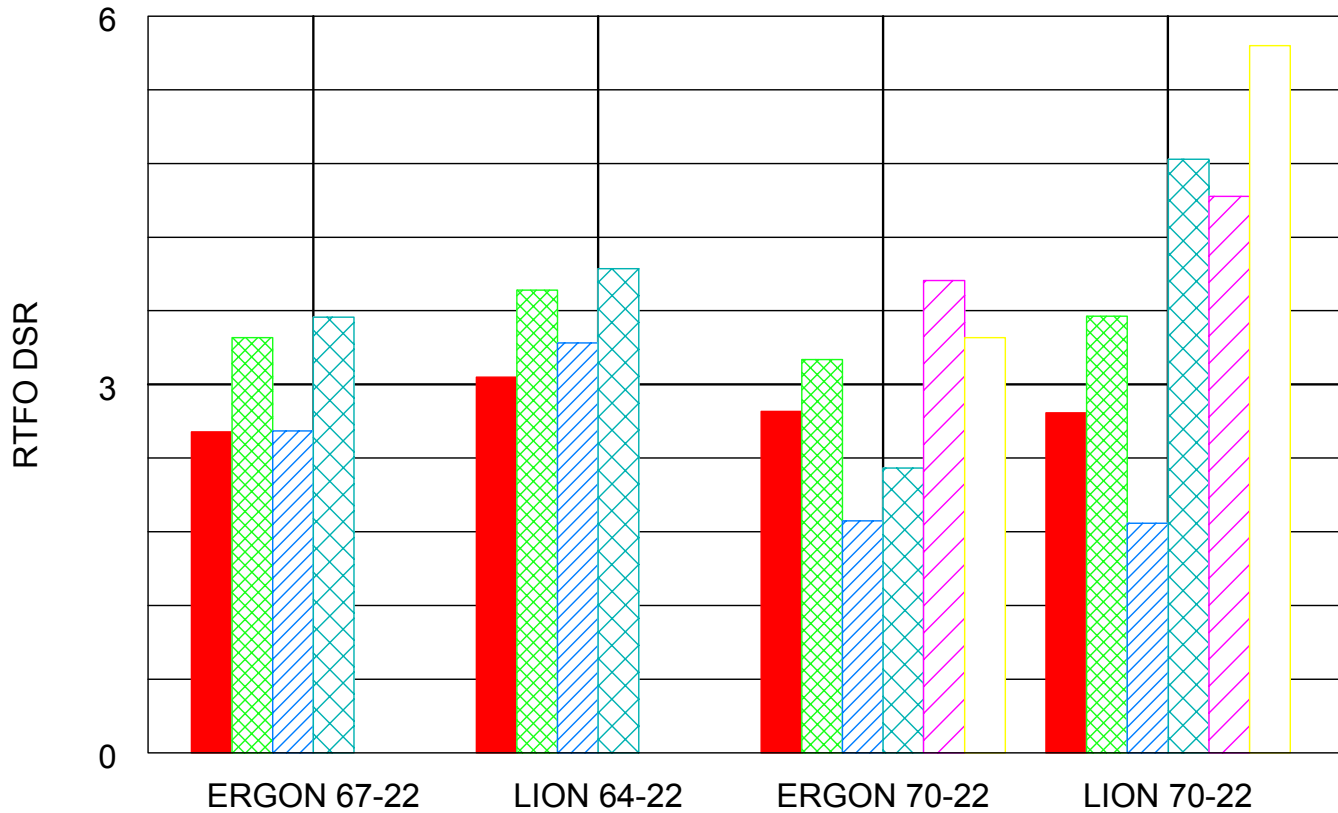


ACID TREATED ASPHALT PROJECT



ACID TREATED ASPHALT PROJECT

AC EX P PEX G GE

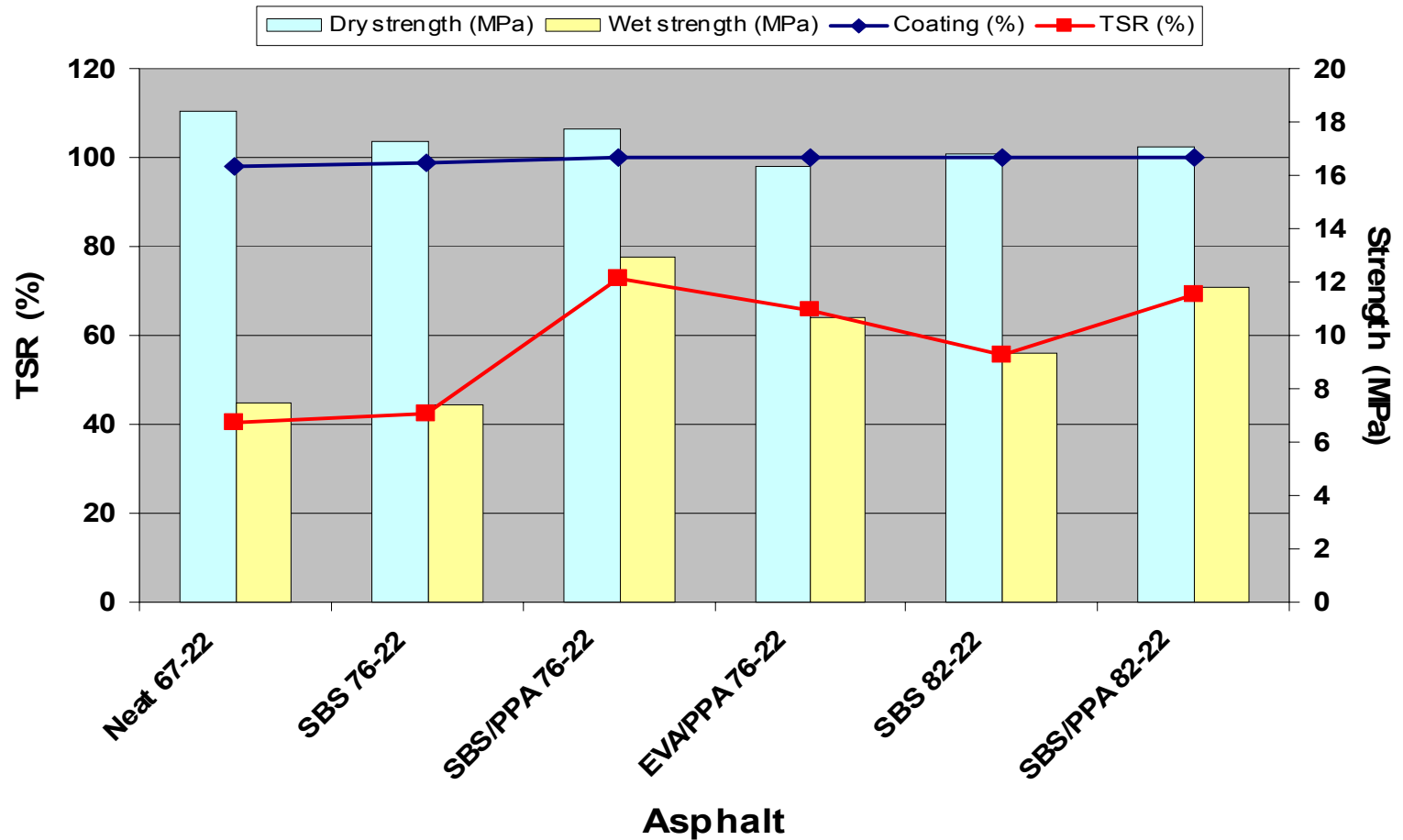




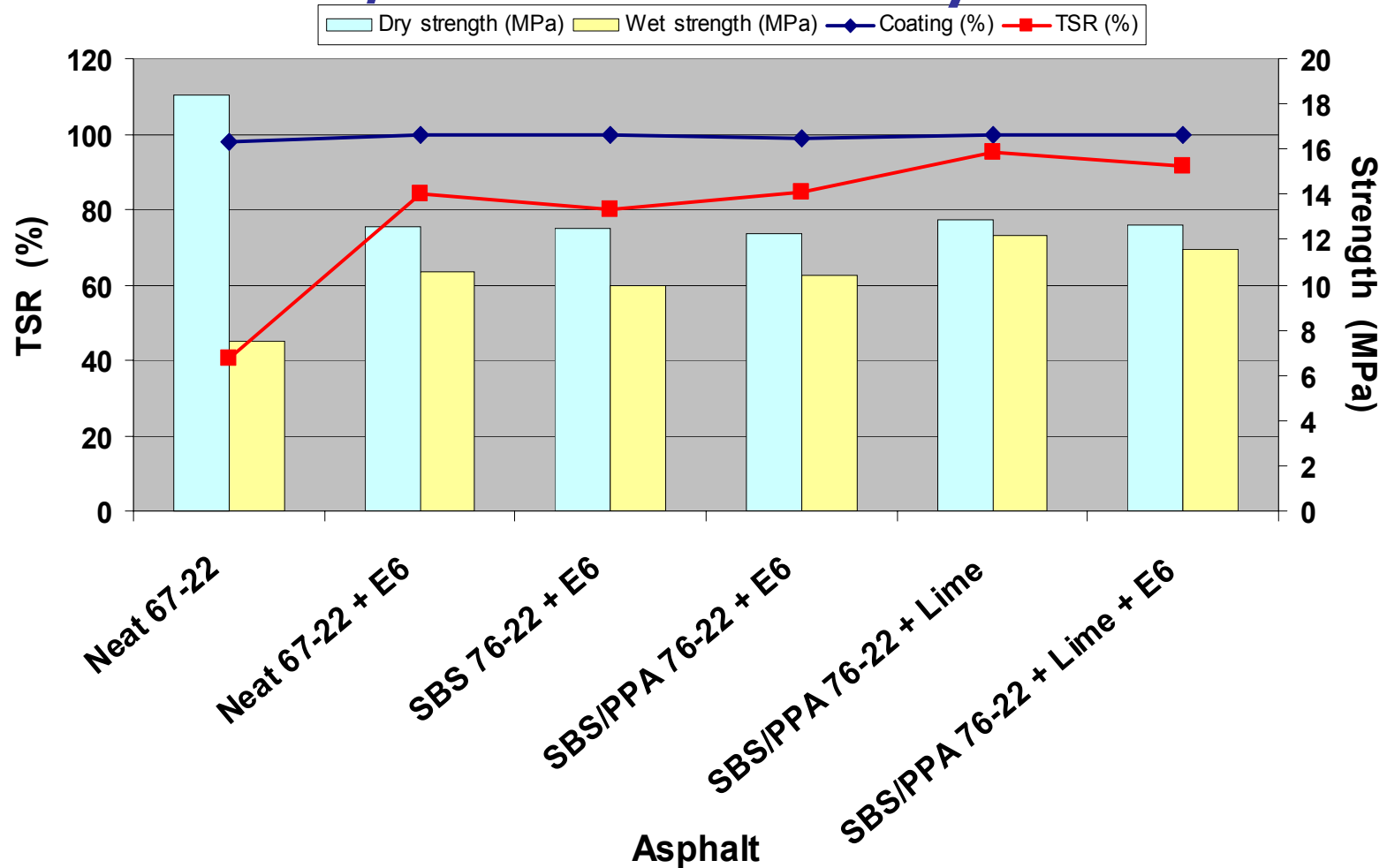
TSR

Liquid	Dry Strength	Wet Strength	TSR	% Dry Strip	% Wet Strip
EPG67	8675	7000	80.7	4	6
EPG67+P	8475	6675	78.7	3	6
EPG70	7375	7100	96.3	2	6
EPG70+P	7450	9075	121.8	2	5
EPG70+G	8600	9500	110.5	2	5
LPG64	7575	7650	101	8	8
LPG64+P	7400	6900	93.2	6	6
LPG70	7675	6450	84	4	7
LPG70+P	8025	7550	94.1	4	6
LPG70+G	8300	7250	87.3	4	7

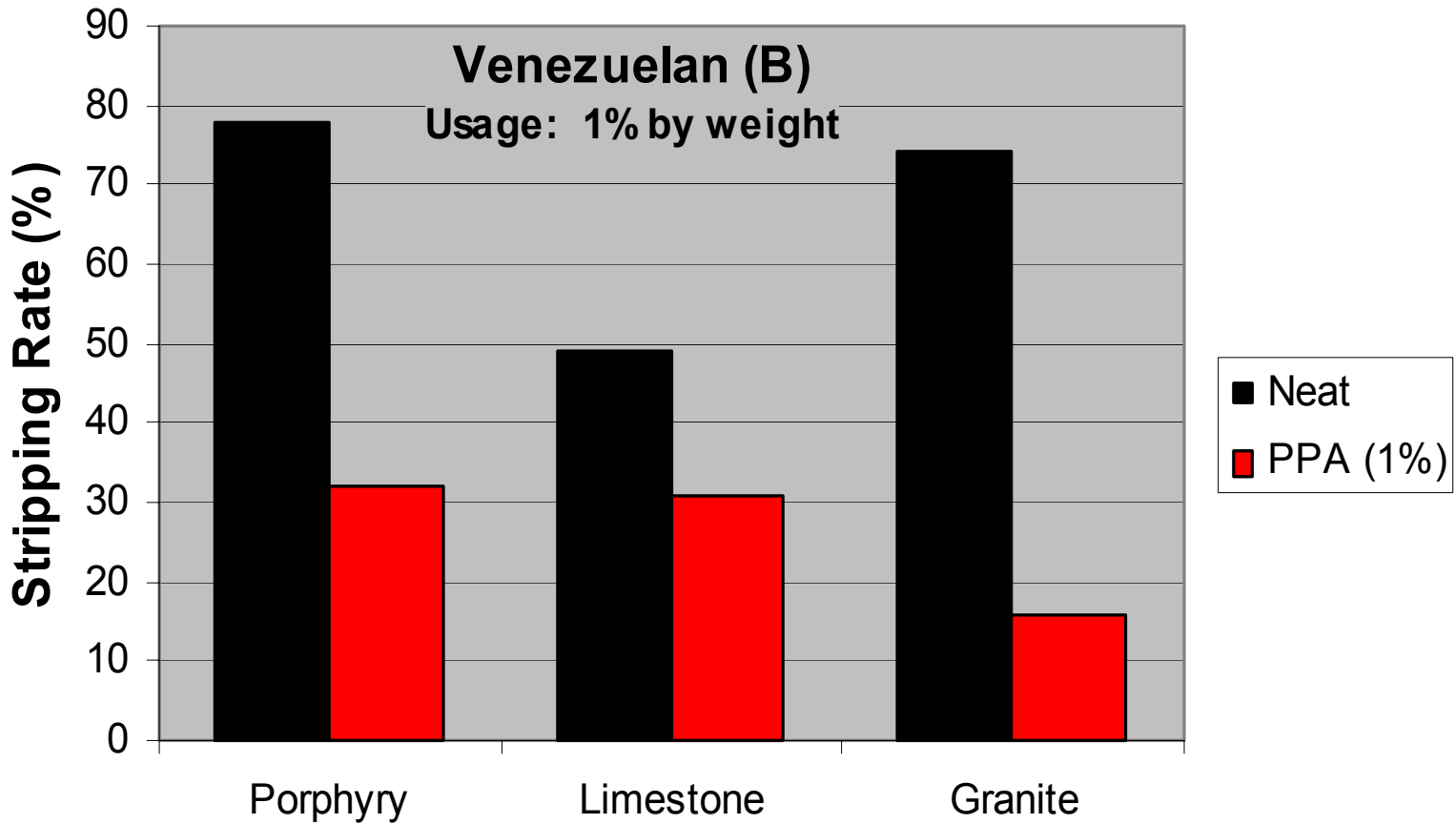
Moisture Resistance (TSR) Venezuelan Asphalt/Granite Agg.



Moisture Resistance (TSR) Venezuelan Asphalt/Granite Agg. W/Lime and Polyamine

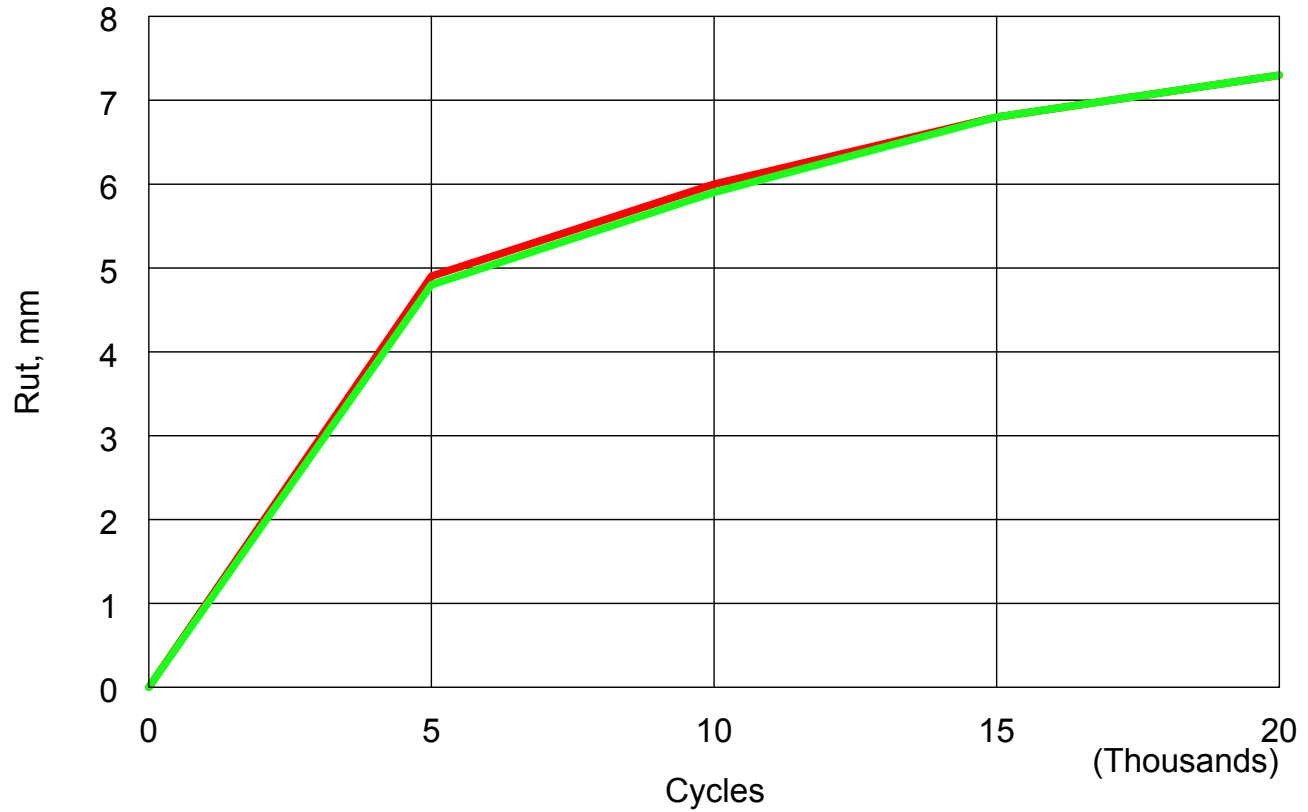


Belgium Road Research Center Stripping Rate



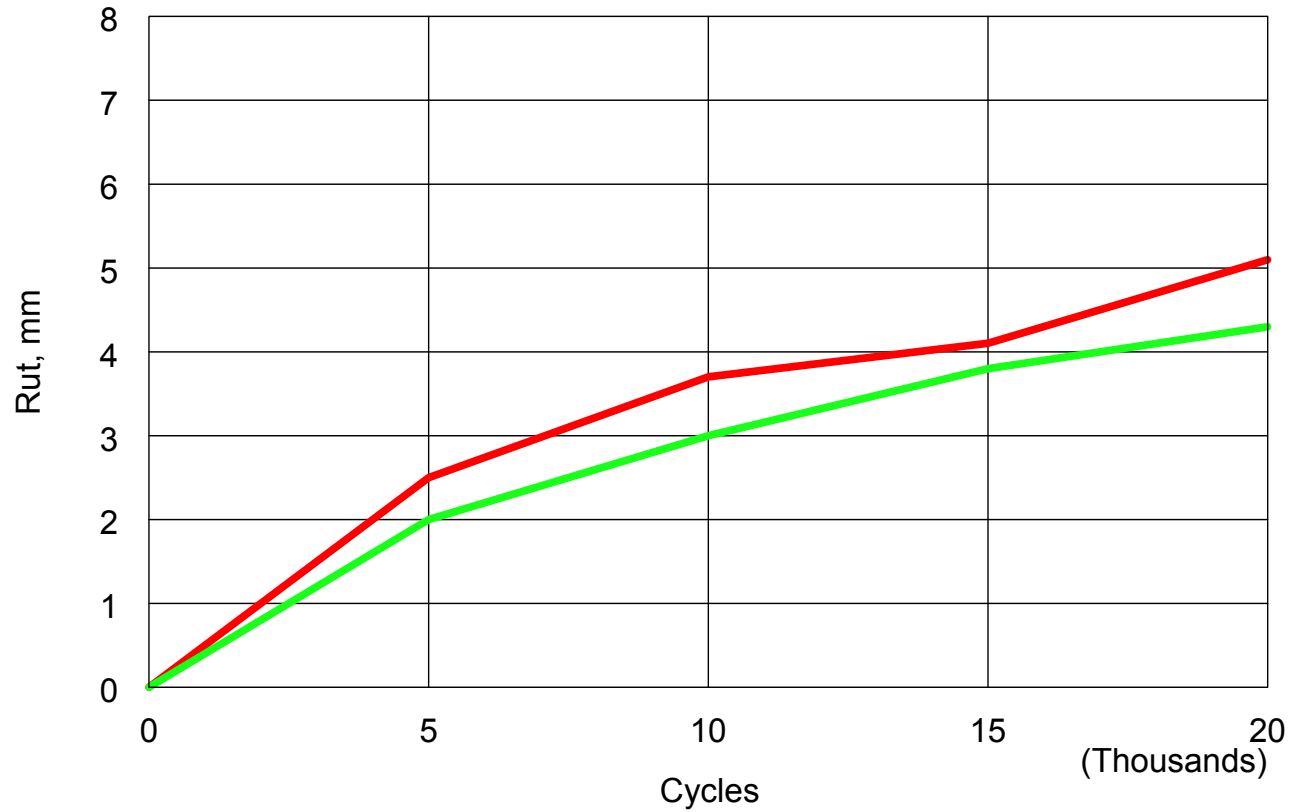
Hamburg @ 50C Wet

— L 70 Rut Depth = 7.3 mm — E 70 Rut Depth = 7.3 mm



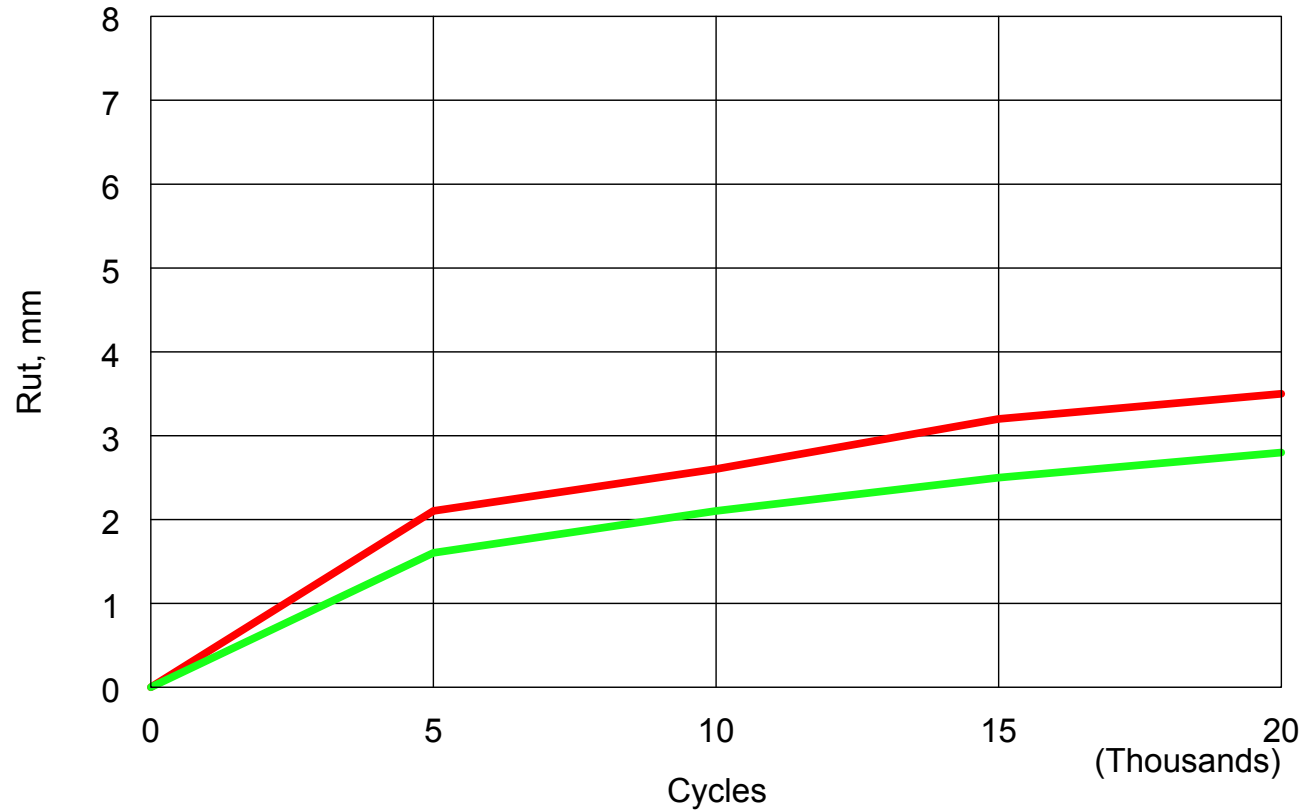
Hamburg @ 50C Wet

— L 70P Rut Depth = 5.1 mm — E 70P Rut Depth = 4.3 mm



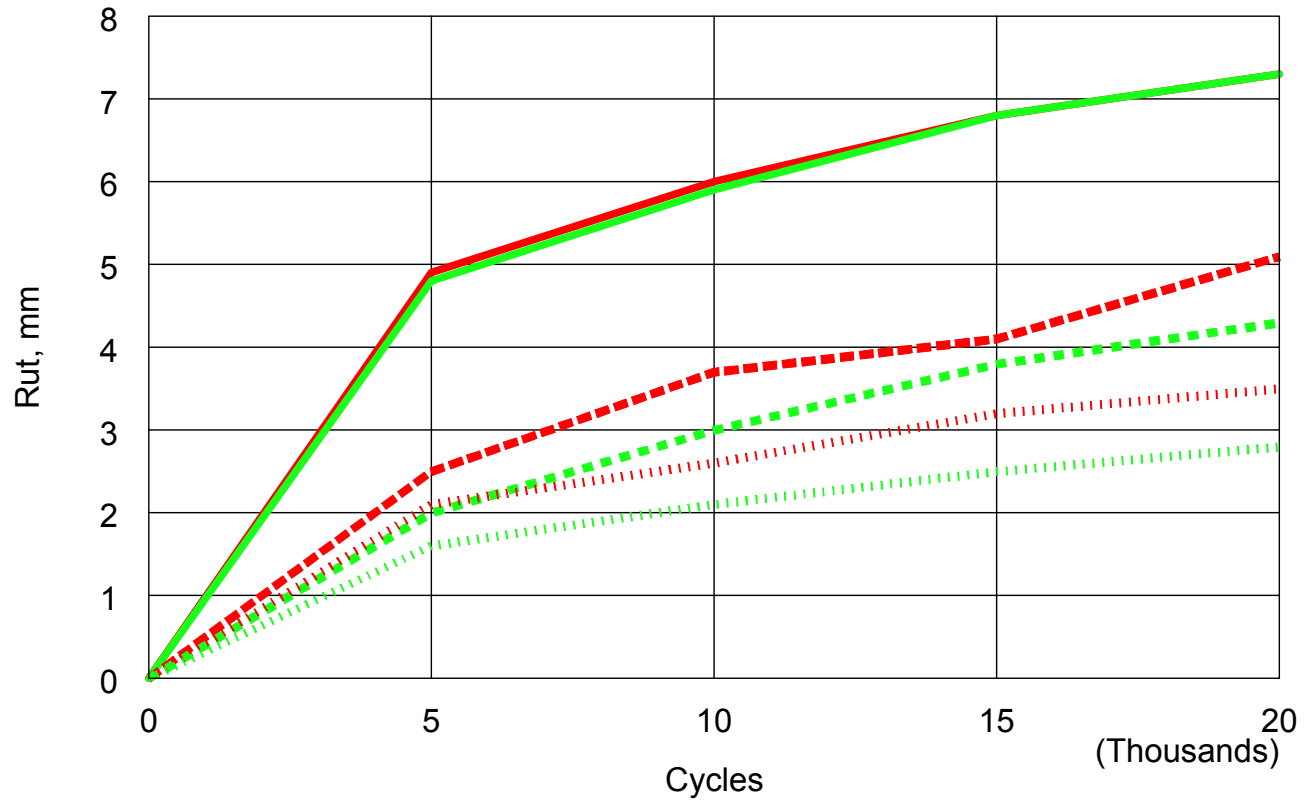
Hamburg @ 50C Wet

— L 70G Rut Depth = 3.5 mm — E 70G Rut Depth = 2.8 mm

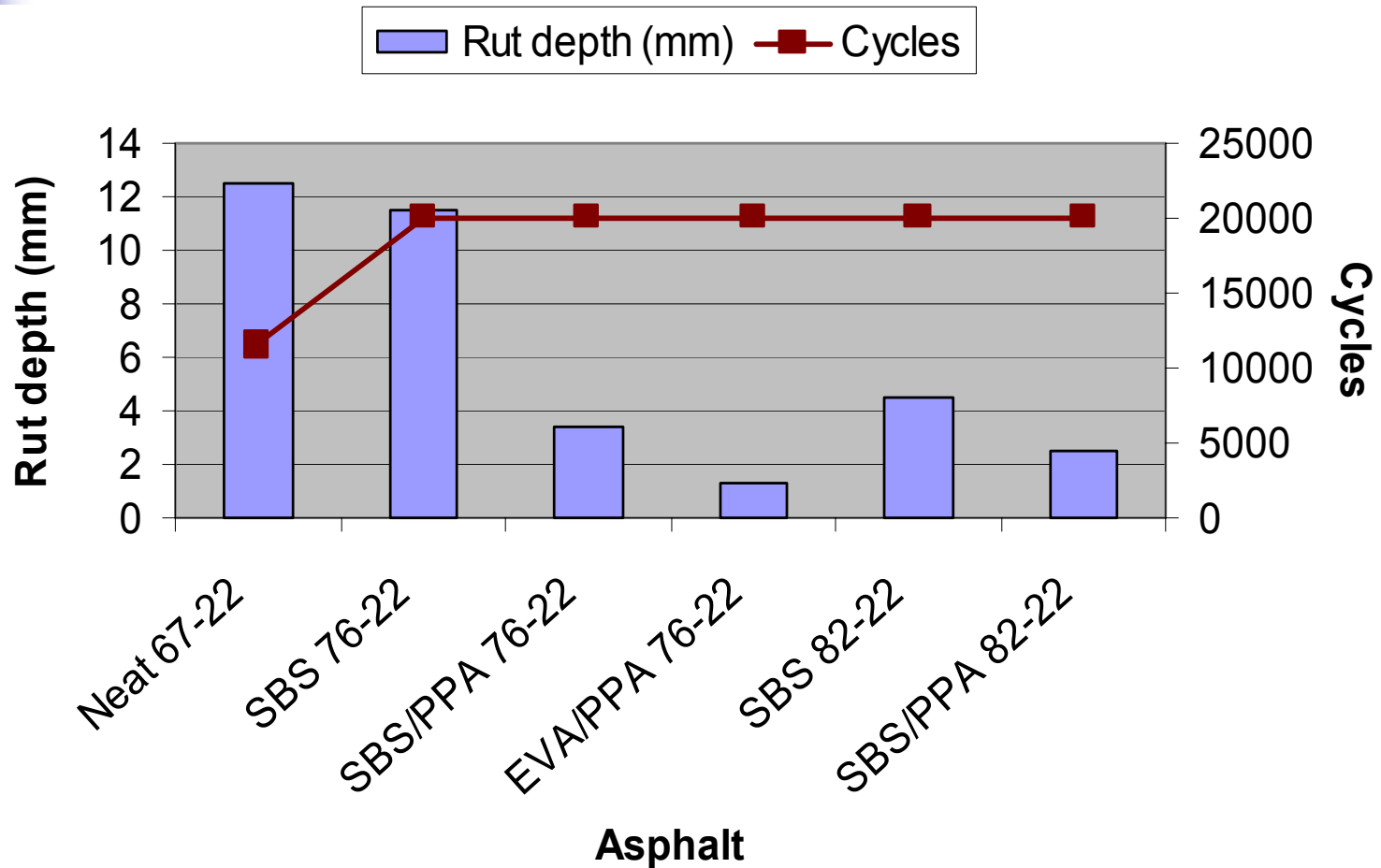


Hamburg @ 50C Wet

— L7 — E7 - - - LP - - - EP ····· LG ····· EG



Hamburg Wheel Tracking Venezuelan Asphalt/Granite Agg.





Conclusions

- Polyphosphoric Acid is a Valuable Tool
- Polyphosphoric Acid can be Use to Produce Quality High Performance Binders
- We are Custodians of the Publics Money