Why Use Warm Mix?

Erv Dukatz
Mathy Construction Co.

2008 NCAUPG Meeting
Springfield, IL
January 10, 2008

Why use warm mix asphalt?

- **Social**
- **Economic**
- **Technical**

What is warm compared to hot mix asphalt?

hot mix asphalt?

Warm or hot mix asphalt?

Mat temperature: 275F

Warm or hot mix asphalt?

Mat Temperature: 228F

Air ~40F

What is warm compared to hot mix asphalt?

Webster's New World Dictionary – 2nd College ed. has 10 definitions of Hot and 14 for Warm.

Hot – having a hot temperature; very warm; having a high temperature or abnormally hot.

Warm – a moderate or pleasurable degree of heat; heated or over heated.

What are the Goals?

- Reduced emissions
  - Visible particulates and vapors
  - Odor
- Reduced energy and fuel costs
- Reduced compaction effort
- Increased time for compaction
- Increased Social Acceptance
- Equal or improved pavement performance.

Review of the Basics

- The role of the asphalt plant:
  - Produce heated mix at the highest possible production rate so it can be compacted at the lowest possible cost.
- Impediments
  - Moisture
  - Binder stiffness

So let's start with compaction and work backwards.

How are asphalt mixes compacted?

- **Viscosity or Internal Friction Reduction (IFR) of the binder.**

Once the internal friction is sufficiently reduced, the binder

- **Coats the aggregate and**
- **Lubricates the mix so the aggregate can be moved into it's densest packing configuration.**

IFR Control

- **Temperature**
- **Additives**

Temperature

- Reduces the viscosity of the binder and
- Removes moisture from the aggregate,
- Which is an endothermic process.

Translation: the quicker steam is produced, the more the mix is cooled.

Problem: 1 cf of water ~ 15,000 cf of steam

Temperature

- Tradition thought – to remove more moisture increase the temperature of the mix.
- Traditional rule of thumb to determine if the mix is abnormally hot – check the temperature drop between the plant and silo, silo and paver.
- If the temperature ≥ 25F (14C), the mix is too hot.
- If there is water dripping out of the truck at the paver, the mix is too hot.

Corrective action: lower the mix temperature

Temperature

- Why?
- To slow the production of steam.
- Save fuel
- Improve mix compaction.
- What is the optimum temperature for compaction per MS-4, 2007 edition?
- The temperature at which the mix doesn't move laterally, like a pie crust, under the roller.

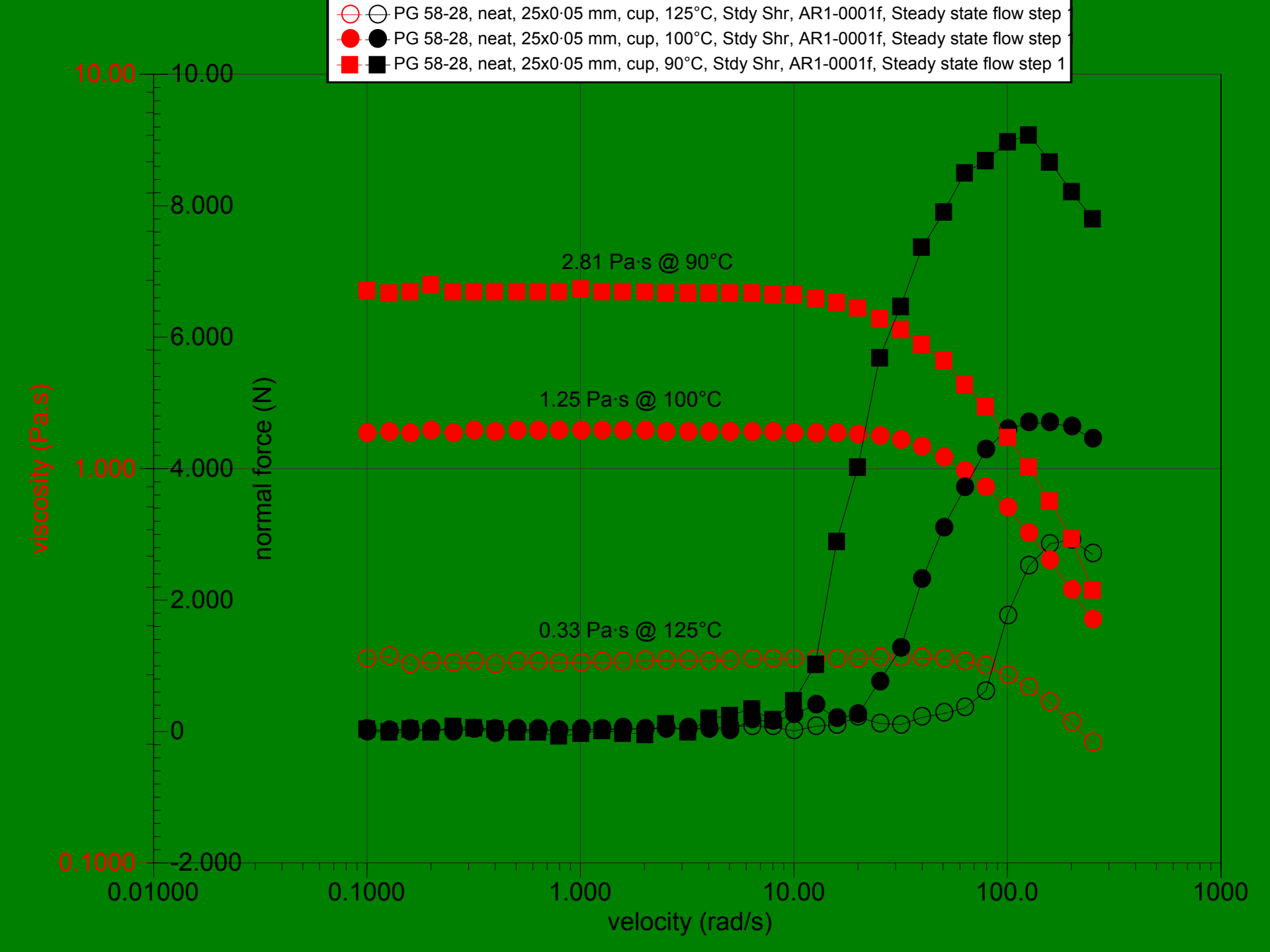
- So, if the mix is being produced between 270 and 280 F, is it HMA, WMA or mix being produced at a lower temperature?

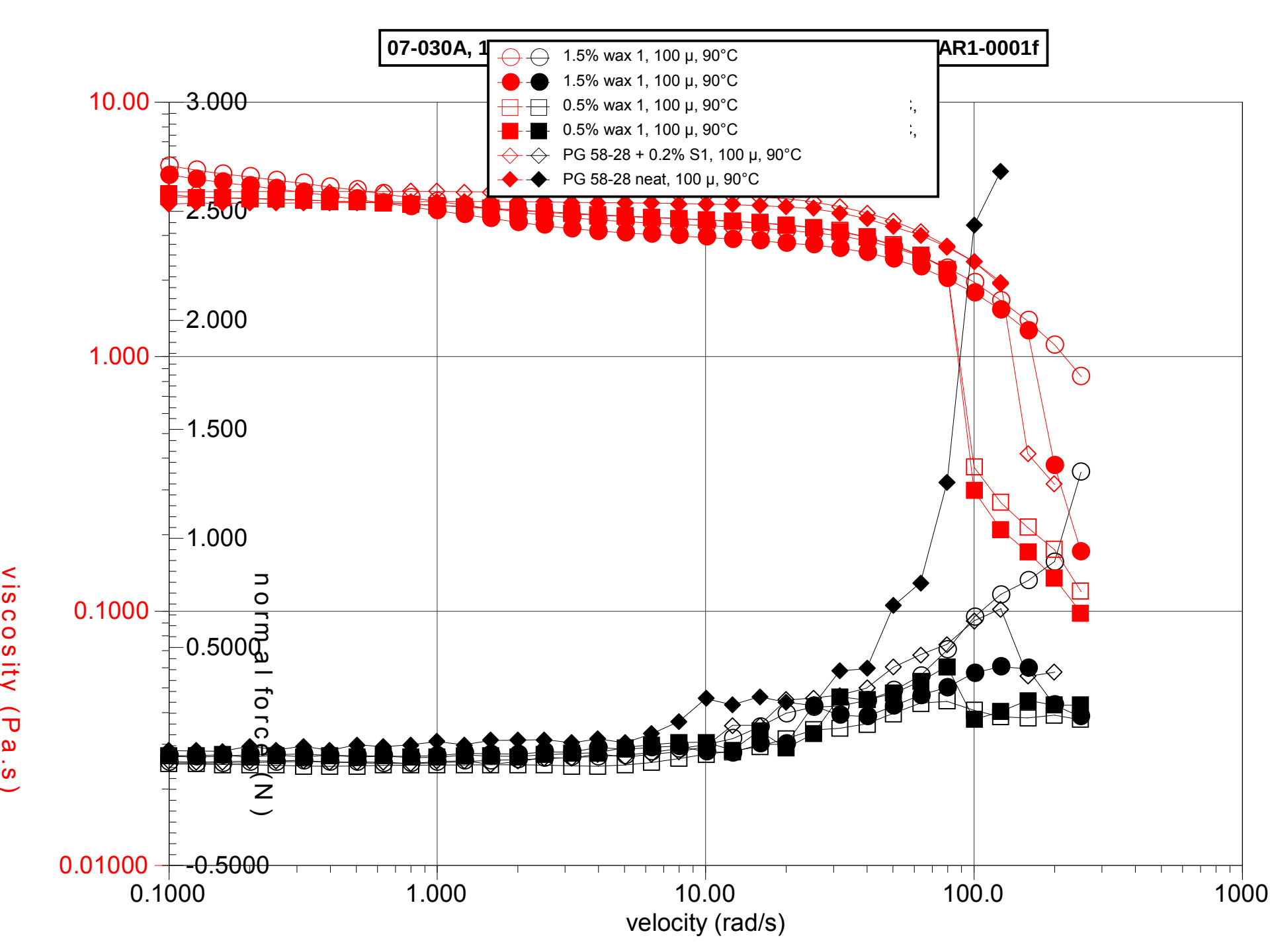
Additives

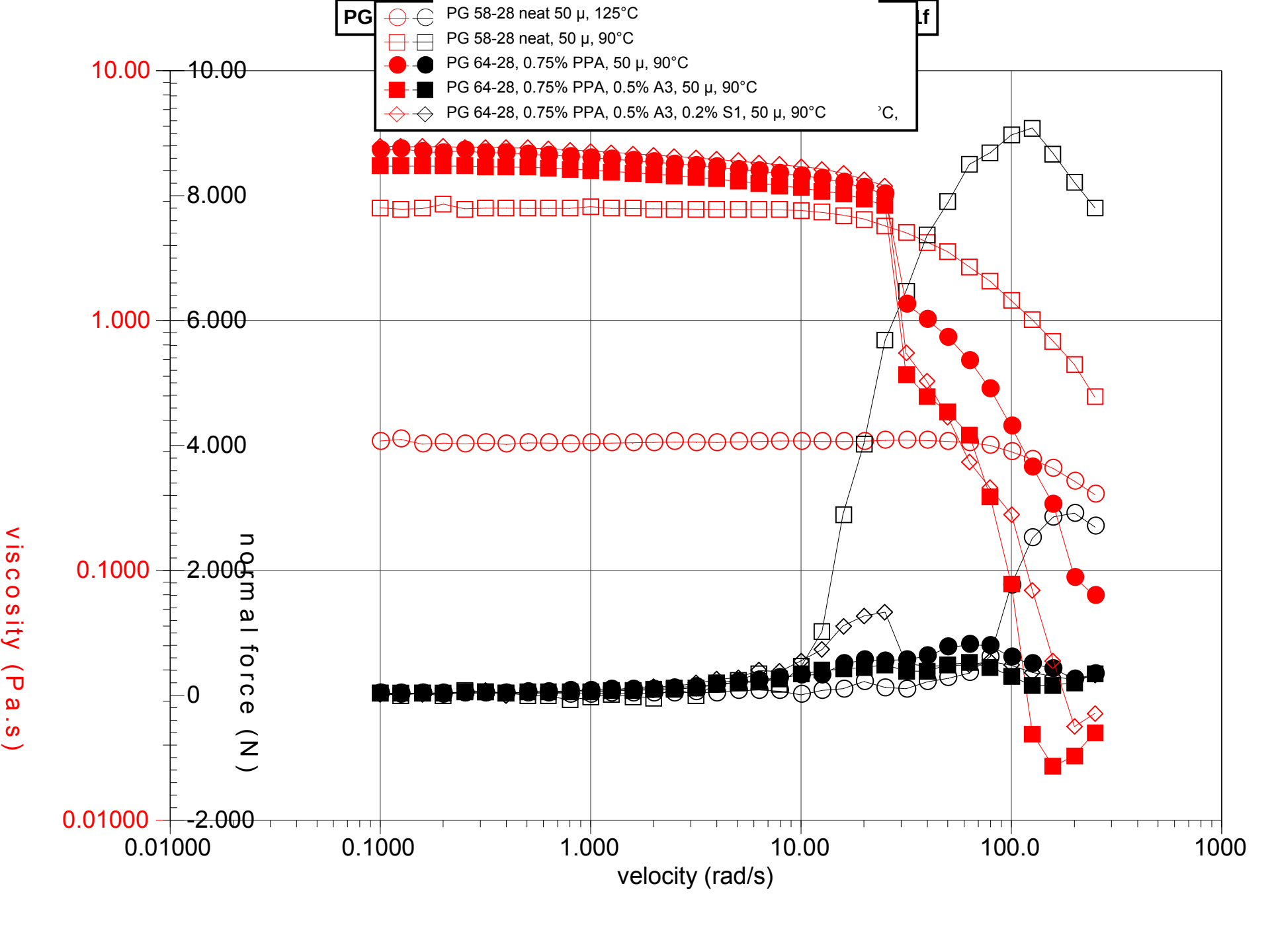
- Some add water to create a foaming action – Aspha-min, WAM-Foam.
- Some add wax – Sasobit
- Some use an emulsion – Evotherm
- And the new product on the market that uses a additive that can blended at the refinery, terminal or HMA plant is REVIX™

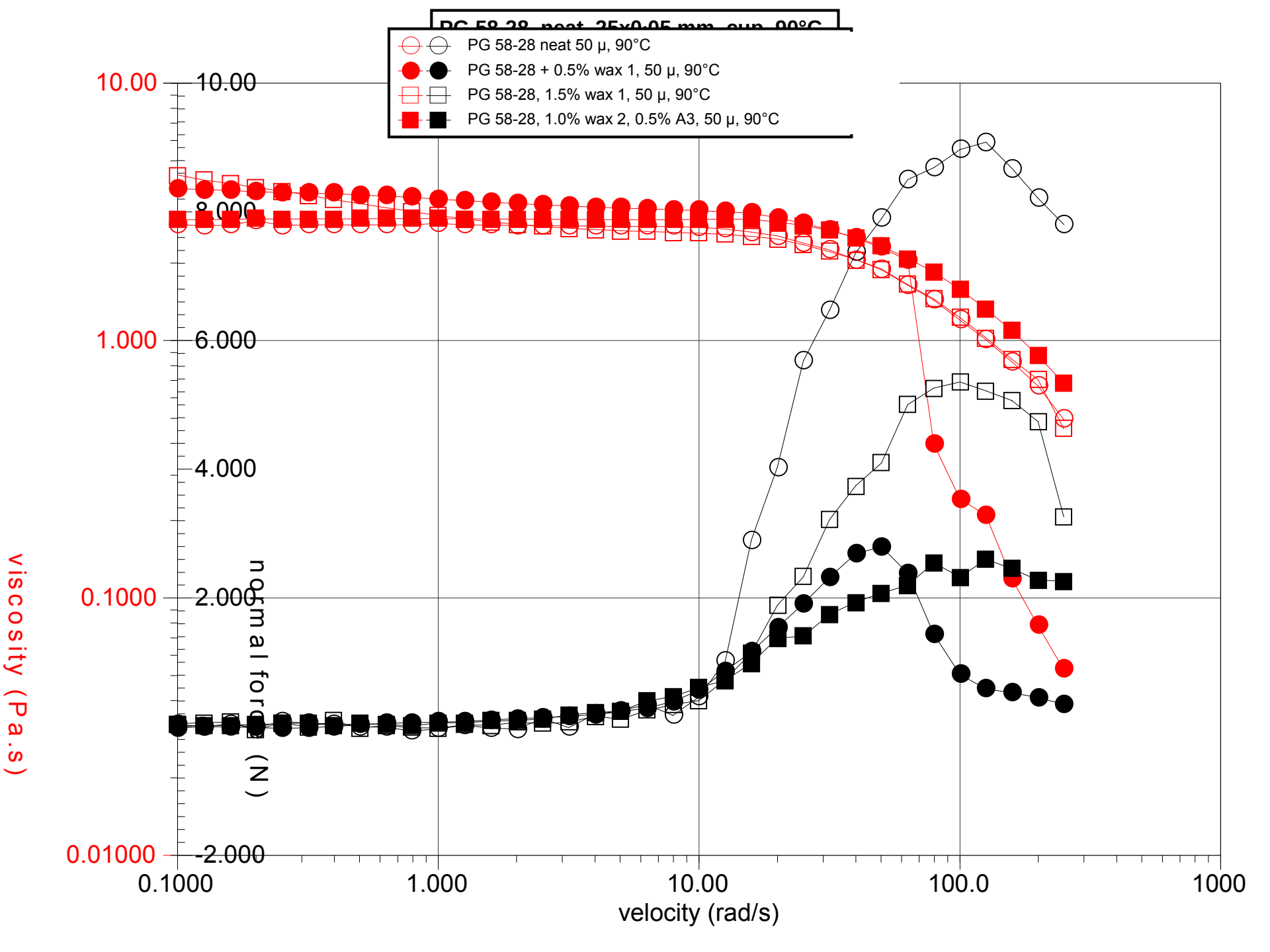
REVIX™

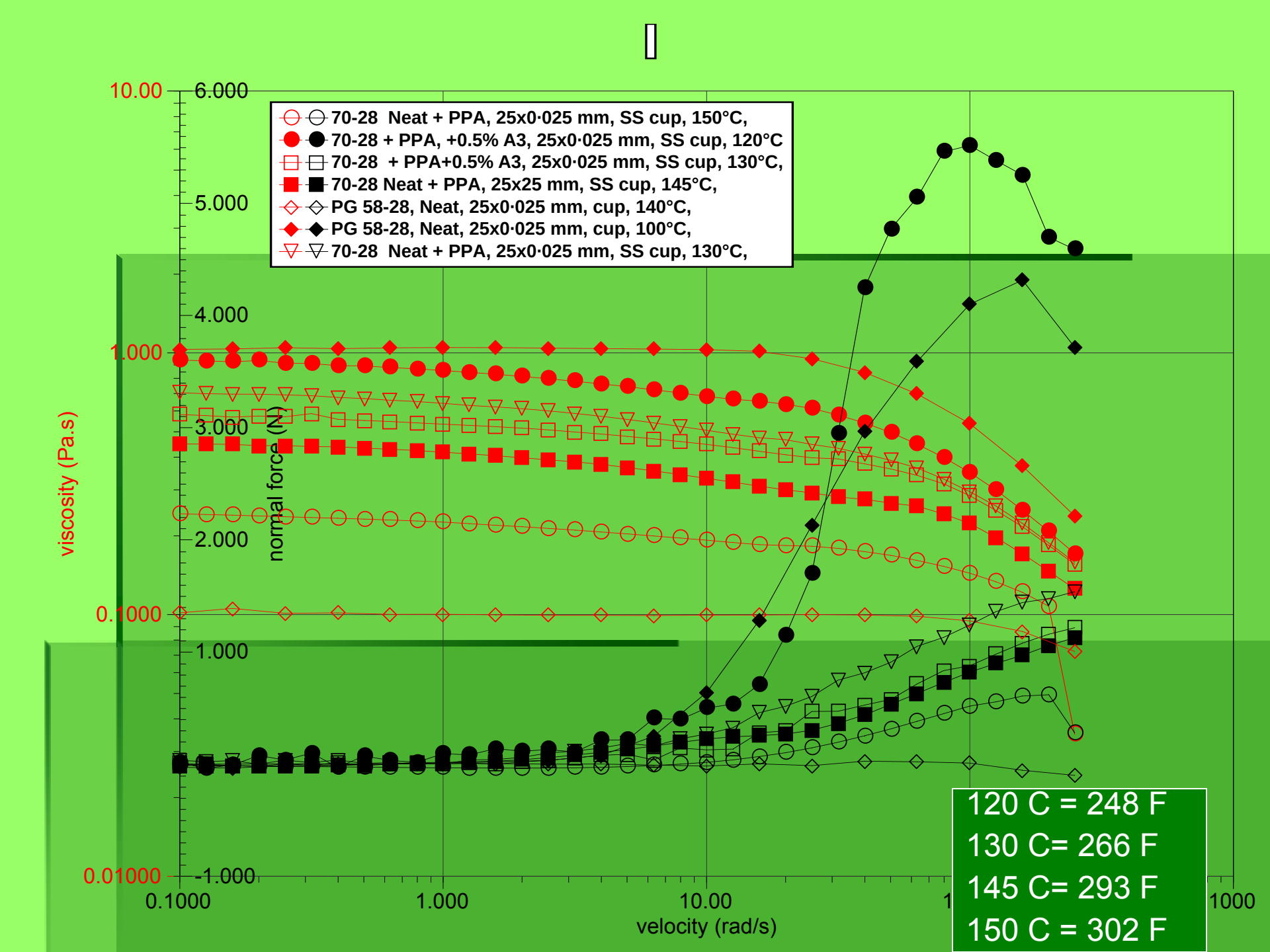
- The reduced temperature HMA (RTHMA) process was co-developed by Mathy Technology & Engineering and Paragon Technical services, Inc.
- The RT-HMA process was developed from observation of a surfactant solution injection WMA process that lab samples could be compacted in the lab at 230F after the moisture contents dropped below 0.2%


PG 58-28, neat, 25x0·05 mm, cup, 125°C, Stdy Shr, AR1-0001f, Steady state flow step 1
PG 58-28, neat, 25x0·05 mm, cup, 100°C, Stdy Shr, AR1-0001f, Steady state flow step 1
PG 58-28, neat, 25x0·05 mm, cup, 90°C, Stdy Shr, AR1-0001f, Steady state flow step 1
2.81 Pa·s @ 90°C
1.25 Pa·s @ 100°C
0.33 Pa·s @ 125°C
viscosity (Pa.s)
normal force (N)
velocity (rad/s)
10.00
1.000
0.1000
10.00
8.000
6.000
4.000
2.000
0
-2.000
0.01000
0.1000
1.000
10.00
100.0
1000


07-030A, 1
AR1-0001f
1.5% wax 1, 100 µ, 90°C
1.5% wax 1, 100 µ, 90°C
0.5% wax 1, 100 µ, 90°C
0.5% wax 1, 100 µ, 90°C
PG 58-28 + 0.2% S1, 100 µ, 90°C
PG 58-28 neat, 100 µ, 90°C
10.00
1.000
0.1000
0.01000
viscosity (Pa.s)
3.000
2.500
2.000
1.500
1.000
0.5000
-0.5000
normal force (N)
0.1000
1.000
10.00
100.0
1000
velocity (rad/s)


PG 58-28 neat 50 µ, 125°C
PG 58-28 neat, 50 µ, 90°C
PG 64-28, 0.75% PPA, 50 µ, 90°C
PG 64-28, 0.75% PPA, 0.5% A3, 50 µ, 90°C
PG 64-28, 0.75% PPA, 0.5% A3, 0.2% S1, 50 µ, 90°C
10.00
1.000
0.1000
0.01000
viscosity (Pa.s)
10.00
8.000
6.000
4.000
2.000
0
-2.000
normal force (N)
0.01000
0.1000
1.000
10.00
100.0
1000
velocity (rad/s)


PG 58-28 neat 50 µ, 90°C
PG 58-28 + 0.5% wax 1, 50 µ, 90°C
PG 58-28, 1.5% wax 1, 50 µ, 90°C
PG 58-28, 1.0% wax 2, 0.5% A3, 50 µ, 90°C
10.00
1.000
0.1000
0.01000
viscosity (Pa.s)
10.00
8.000
6.000
4.000
2.000
-2.000
normal force (N)
0.1000
1.000
10.00
100.0
1000
velocity (rad/s)

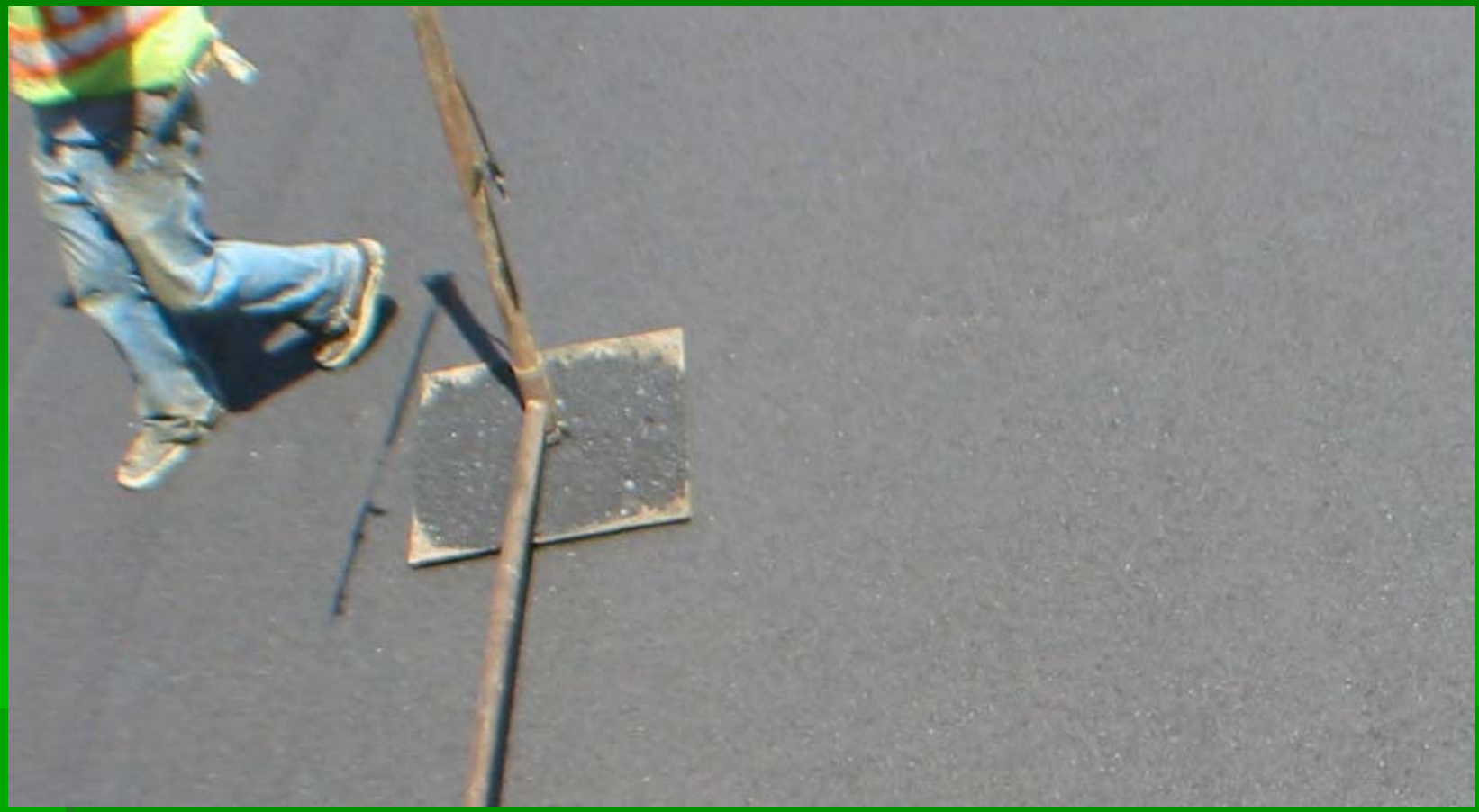

70-28 Neat + PPA, 25x0·025 mm, SS cup, 150°C,
70-28 + PPA, +0.5% A3, 25x0·025 mm, SS cup, 120°C
70-28 + PPA+0.5% A3, 25x0·025 mm, SS cup, 130°C,
70-28 Neat + PPA, 25x25 mm, SS cup, 145°C,
PG 58-28, Neat, 25x0·025 mm, cup, 140°C,
PG 58-28, Neat, 25x0·025 mm, cup, 100°C,
70-28 Neat + PPA, 25x0·025 mm, SS cup, 130°C,
viscosity (Pa.s)
normal force (N)
velocity (rad/s)
10.00
1.000
0.1000
0.01000
6.000
5.000
4.000
3.000
2.000
1.000
-1.000
0.1000
1.000
10.00
1000
120 C = 248 F
130 C= 266 F
145 C= 293 F
150 C = 302 F

Cty N, Rochester, MN

CONSTRUCTION CO.
MATHY
ONALASKA, WIS.

Subdivision entrance, Rochester, MN

CONSTRUCTION CO.
MATHY
ONALASKA, WIS.



REVIX™

No foot prints – good initial compaction with the paver screed

MATHY CONSTRUCTION CO. ONALASKA, WIS.

Turning slow moving traffic

Concern / Advantage

- Since there is less aging during production, stiffer binders maybe required for RTHMA and WMA in parking lots and other locations with slow moving and turning traffic.
- On the other hand, oxidative age cracking maybe reduced.

Mat repair

REVIX™

Revix™ project summary

- 3200+ tons placed, all but 250 tons with between 15 to 30% RAP.
- PG 58-28 to PG 67-22 used, one project with Elvaloy PMA.
- Projects in WI, MN, MS and TN
- Field monitoring of Goodhue Co., MN CTR 11, showed a 66% reduction in total organic produced compared to HMA.
- Five different types of HMA plants successfully made mix with aggregate moistures up to 6%.
- PMA mixes made with PPA addition successfully placed with no degradation measured in the DSR compared same the same mix made with an aqueous solution.

Additional Points

- What effect will high absorption aggregates have on the different processes?
- Curing period time and temperatures need further investigation. To date field performance for all processes is better than lab TSR and Hamburg rutting results.
- Extended paving seasons in the Northern states appears to be limited.

Why use RT-HMA and Warm Mixes?

Summary

- **Social – good neighbor, reduced emissions.**
- **Economic – some fuel and construction cost savings, overall costs, equal or higher than HMA.**
- **Technical – need more work on mix design and lab mix performance testing.**