

Binder Engineering

A Presentation

By

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SASOL
reaching new frontiers



MOORE & MUNGER, Inc.

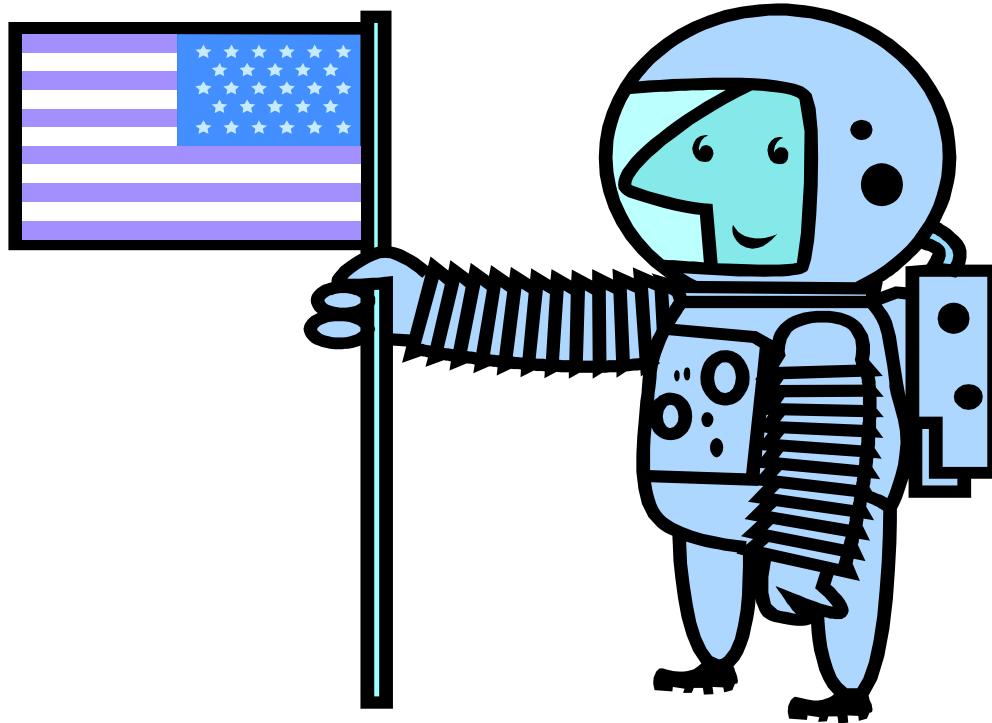


Binder Engineering

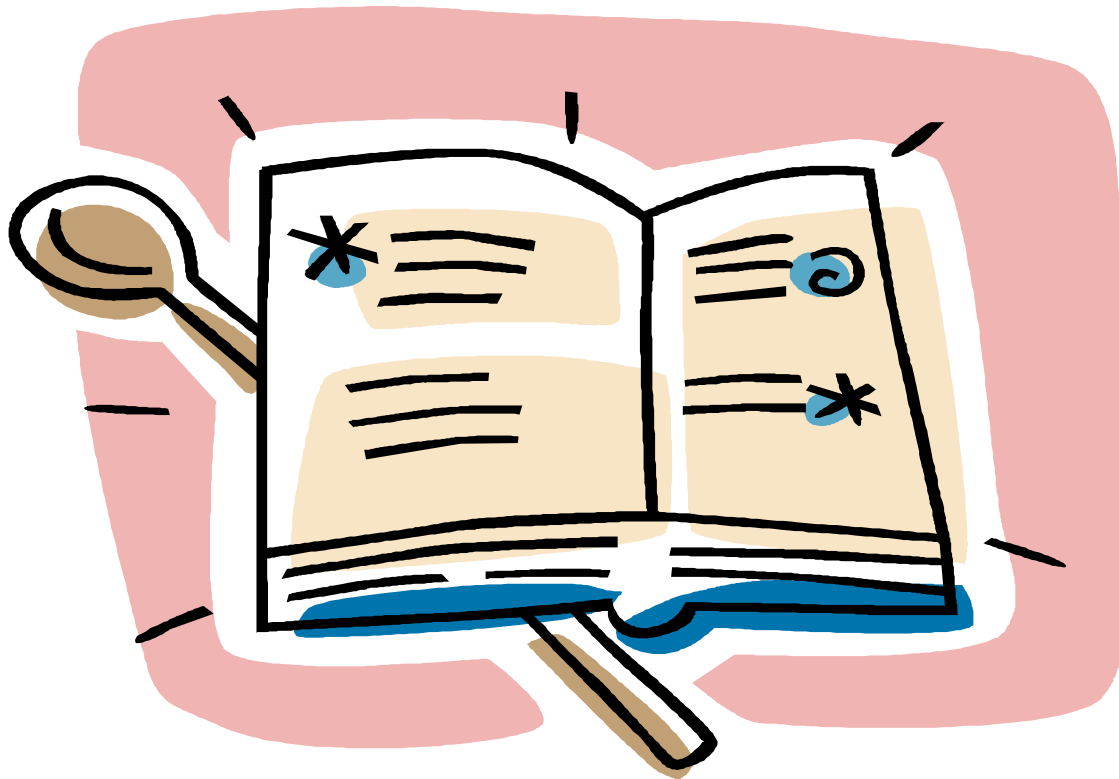
1. Exploratory – Ideas & Concepts
2. Work with/around Current Hardware
3. Binder vs. PG
4. Binder vs. Application
5. Need for Convergence
6. Asphalt Quality Variability
7. Formulation Tool Kit
8. Examples of PG Movements
9. Binder Requirements
10. Conclusion



Exploratory – Ideas & Concepts



Work with/around Current Hardware



Binder vs. PG Target

- Need for Menu Driven Options
- Customer Chosen Flexibility



Binder vs. Application

- **Gussasphalt**
- **AC**
- **Coarse Graded**
- **SMA (Fiber, Fibreless)**
- **Land Fill**



Need for Convergence

USA vs. Europe
Binder vs. Mix



Asphalt Quality Variability

- **Composition**
 - **Saturates**
 - **Cyclic**
 - **Aromatics**
 - **Asphaltene**
 - **LMW & HMW**
- **Crude Oil Slate**
- **Pressure on USA Refineries (EPA)**



Formulation Tool Kit

- **Aromatic Oils & Extenders**
- **Polymers**
 - Solid (SBR/SB/SBS/FT/etc)
 - Latex
 - Montan
- **Cross-linking**
 - Sulfur Based
 - Non-Sulfur Based
- **“Modify the Modifier”**
 - Cost
 - Volume
 - Concentrate Route



Examples of PG Movements



Some possibilities – more detailed work required.

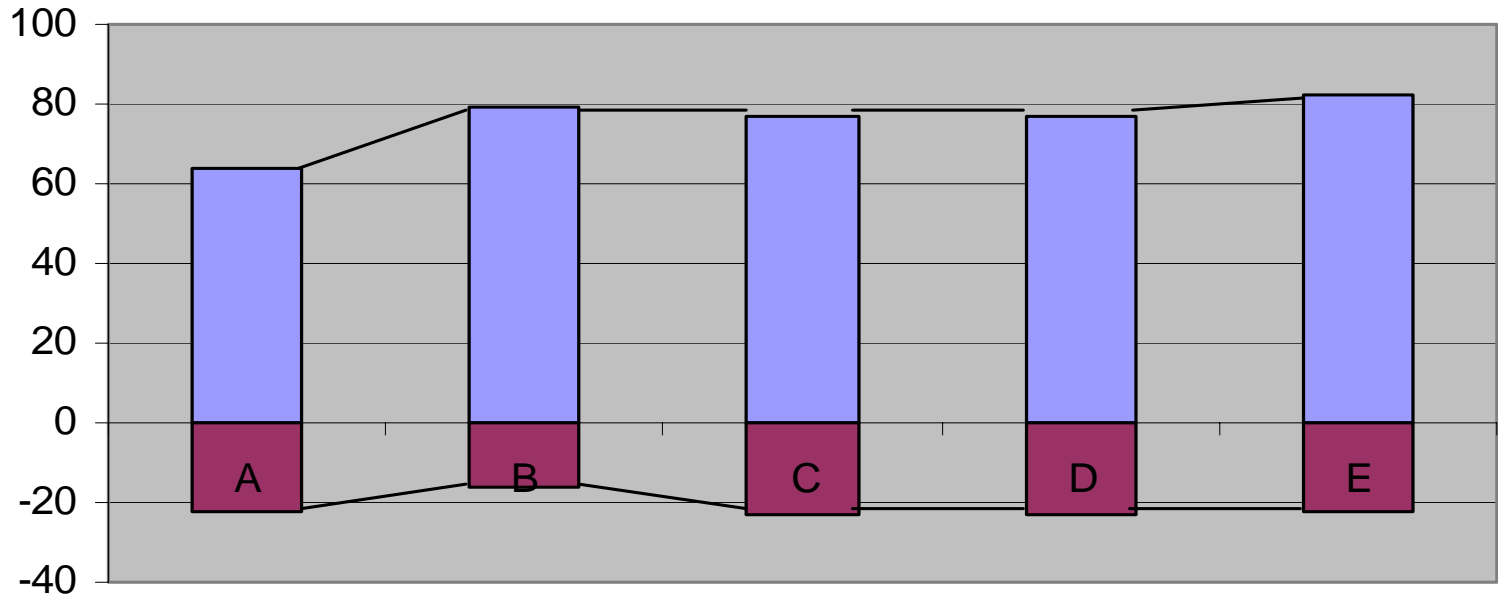
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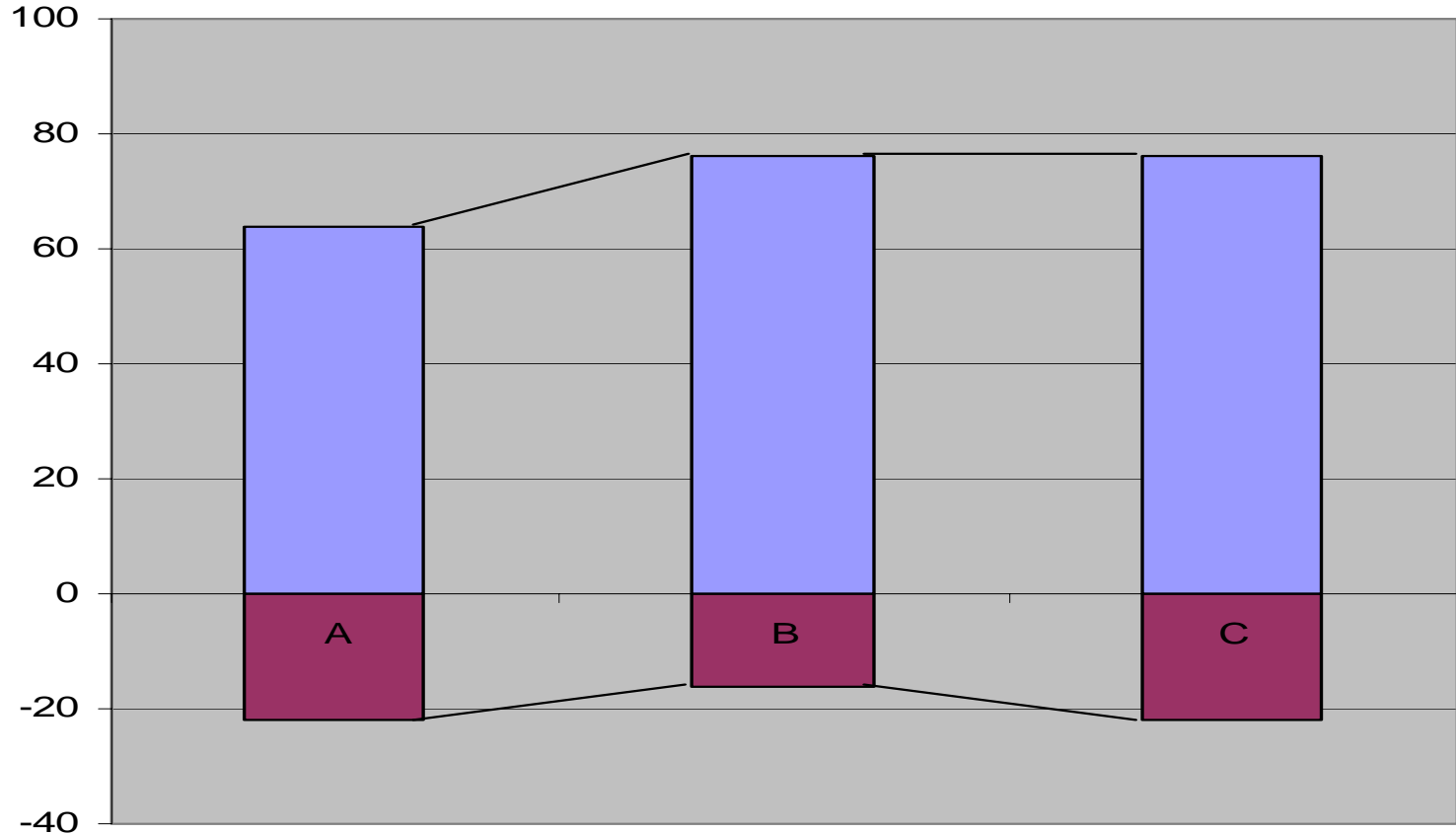


Refinery B Asphalt



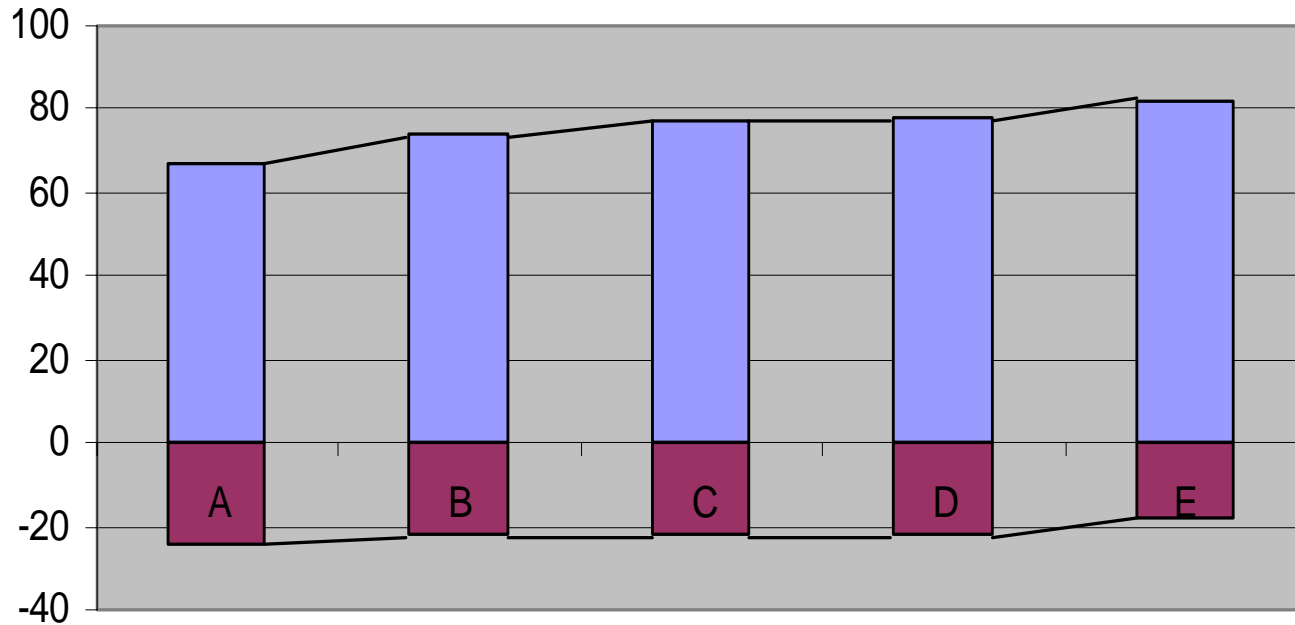
A	B	C	D	E
Base 64-22	Base 64-22	Base 64-22	Base 64-22	Base 64-22
	3% FT	1% FT	1.5% FT	2.2% SBR
		0.3% CL	0.3% CL	0.3% CL
		1.5% FFT	2.0% FFT	1.5% FFT
		2.0% SBS	2.0% SB	
PG Grading (64-22)	PG Grading (76-16)	PG Grading (76-22)	PG Grading (76-22)	PG Grading (82-22)

Refinery C Asphalt



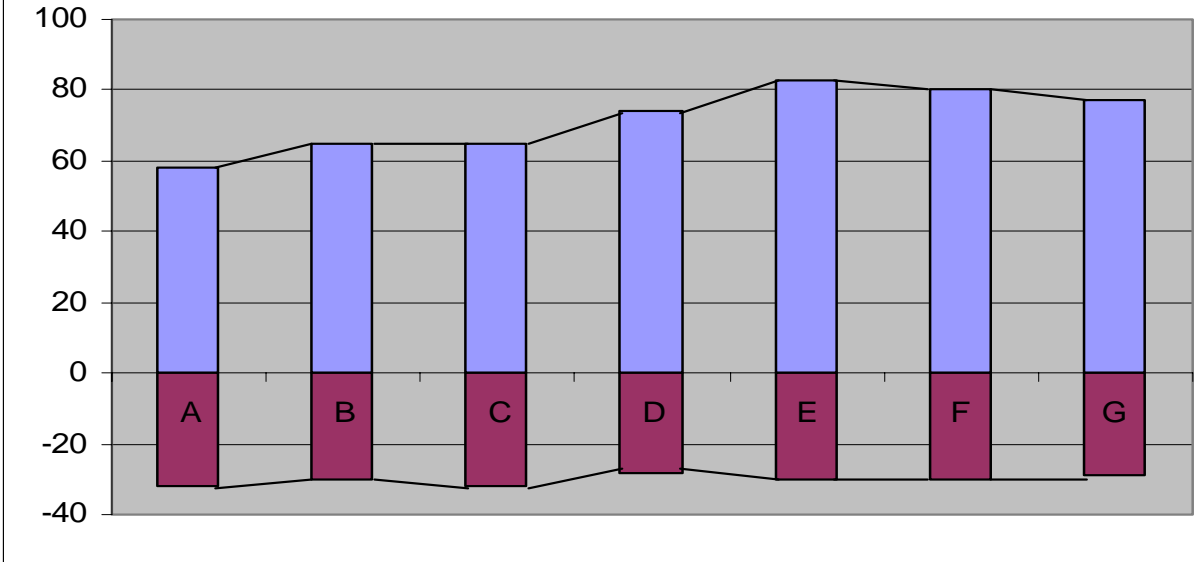
A	B	C
Base Asphalt	Base Asphalt	Base Asphalt
	3% FT	3% One Pack (FT/SBS/CL)
PG Grading (64-22)	PG Grading (76-16)	PG Grading (76-22)

Refinery V Asphalt



A	B	C	D	E
Base 64-22	Base 64-22	Base 64-22	Base 64-22	Base 64-22
	2% SBS	2% SBS	4% SBS	2% SBS
		0.3% CL		0.3% CL
				2% FT
PG Grading (64-22)	PG Grading (70-22)	PG Grading (76-22)	PG Grading (76-22)	PG Grading (82-16)

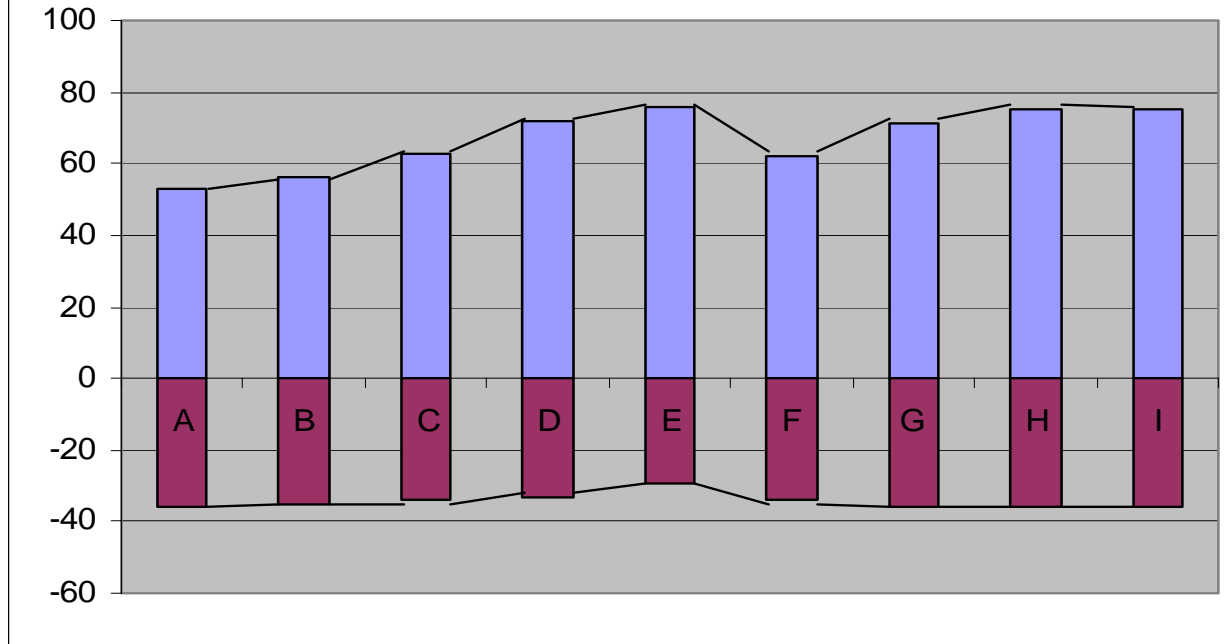
Pen 150/200 Asphalt Refinery H



A	B	C	D
Base 150/200	Base 150/200	Base 150/200	Base 150/200
	3% FFT-2	2% FFT	1% FT
			0.3% CL
			3% FFT
			1% SBS
PG Grading (58-28)	PG Grading (64-28)	PG Grading (64-28)	PG Grading (70-28)

E	F	G
Base 150/200	Base 150/200	Base 150/200
1.5% FT	1.5% FT	1% FT
4.0% FFT	0.25% CL	0.25% CL
1.5% SBS	2.0% FFT	1.5% FFT
	1.5% SBS	2.5% SBS
PG Grading (82-28)	PG Grading (76-28)	PG Grading (76-28)

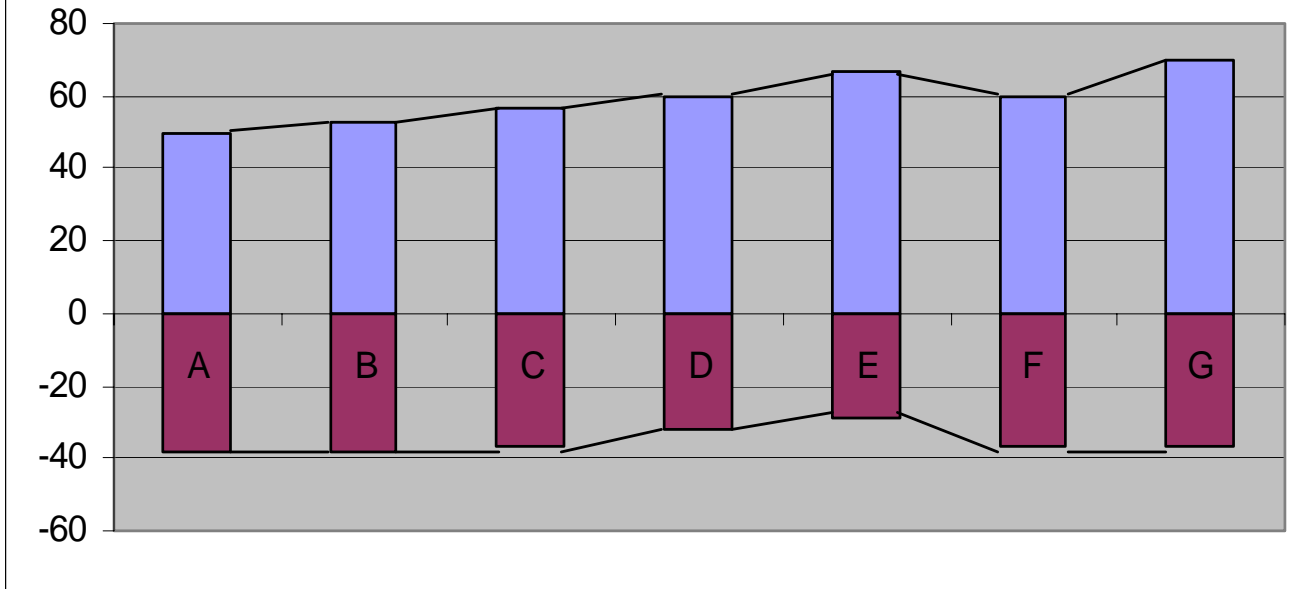
Pen 200/300 Asphalt Refinery H



A	B	C	D	E
Base 200/300	Base 200/300	Base 200/300	Base 200/300	Base 200/300
	1% FT	2% FT	3% FT	4% FT
PG Grading (52-34)	PG Grading (52-34)	PG Grading (58-34)	PG Grading (70-28)	PG Grading (76-28)

F	G	H	I
Base 200/300	Base 200/300	Base 200/300	Base 200/300
3% One Pack (FT/SBS/CL)	1% FT	1% FT	1% FT
	0.3% CL	0.3% CL	0.25% CL
	2.0% FFT	3.0% FFT	1.5% FFT
	1.0% SBS	1.0 SBS	2.5% SBS
PG Grading (58-34)	PG Grading (70-34)	PG Grading (70-34)	PG Grading (70-34)

Pen 300/400 Asphalt Refinery H



A	B	C	D
Base 300/400	Base 300/400	Base 300/400	Base 300/400
	1% FT	2% FT	3% FT
PG Grading (46-34)	PG Grading (52-34)	PG Grading (52-34)	PG Grading (58-28)

E	F	G
Base 300/400	Base 300/400	Base 300/400
4% FT	2.5% FFT	1% FT
		1.5% FFT
		0.3% CL
PG Grading (64-28)	PG Grading (58-34)	PG Grading (70-34)



SBS at 3% - Without Cross Linking Agent

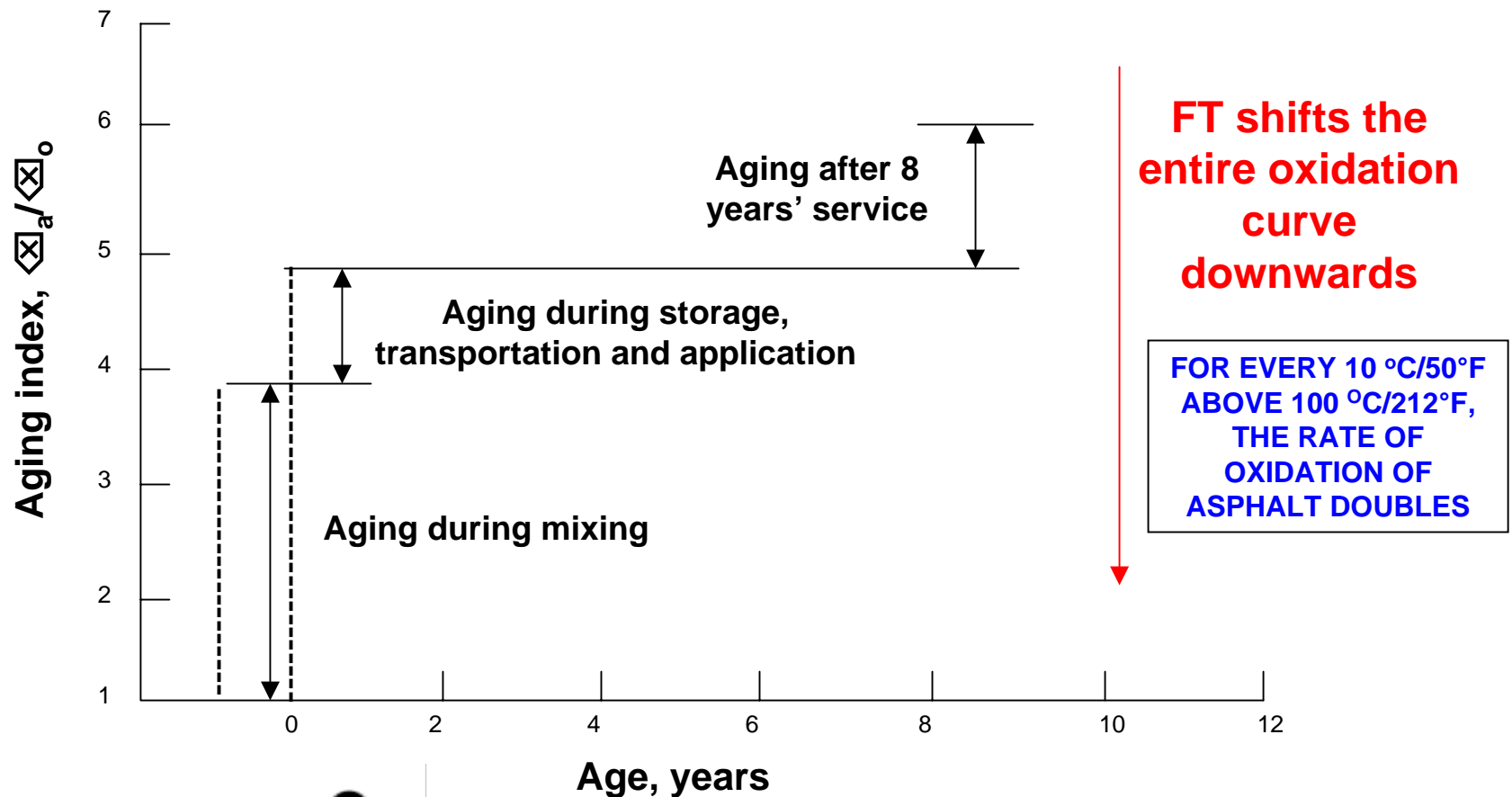




SBS at 3% Plus Cross-Linking Agent (0.3%)



Aging of Asphalt during mixing, storage, transportation, paving and in service





Cold Mix – Alaska Trials

- 68 Tons Mix Produced – Dense Graded
- Binder At 6.2%
- PG 52-28
- 3% One Pack (FT/SBS/CL)
- Diesel At 33%
- Proprietary Additives
- Mixing Temperature 285°F
- Stock Piled For Later Use





Cold Mix – Alaska Trials Cont.

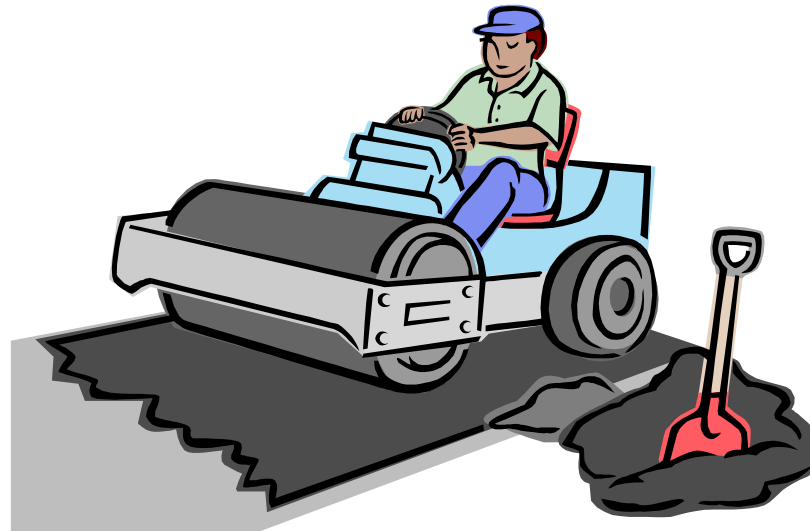
- No Shear Mixer To Disperse One Pack – Only Jet Mixing – 3 Tons Mixed In 2hrs Whereas For SBS Require 5.5hrs Shear Mixing Plus 5.5hrs Stabilization Time.
- Municipality/DOT Confirmed Product Is Superior To Current Commercial Products





Crack Filler In Alaska Trials Cont.

- Opportunity To Increase Filler Level To Change Consistency
- Reduced Fumes – Good For Workers
- 7.5% One Pack (FT/SBS/CL) In Binder Plus Filler Applied At 320°F
- Blended At 350°F To 375°F



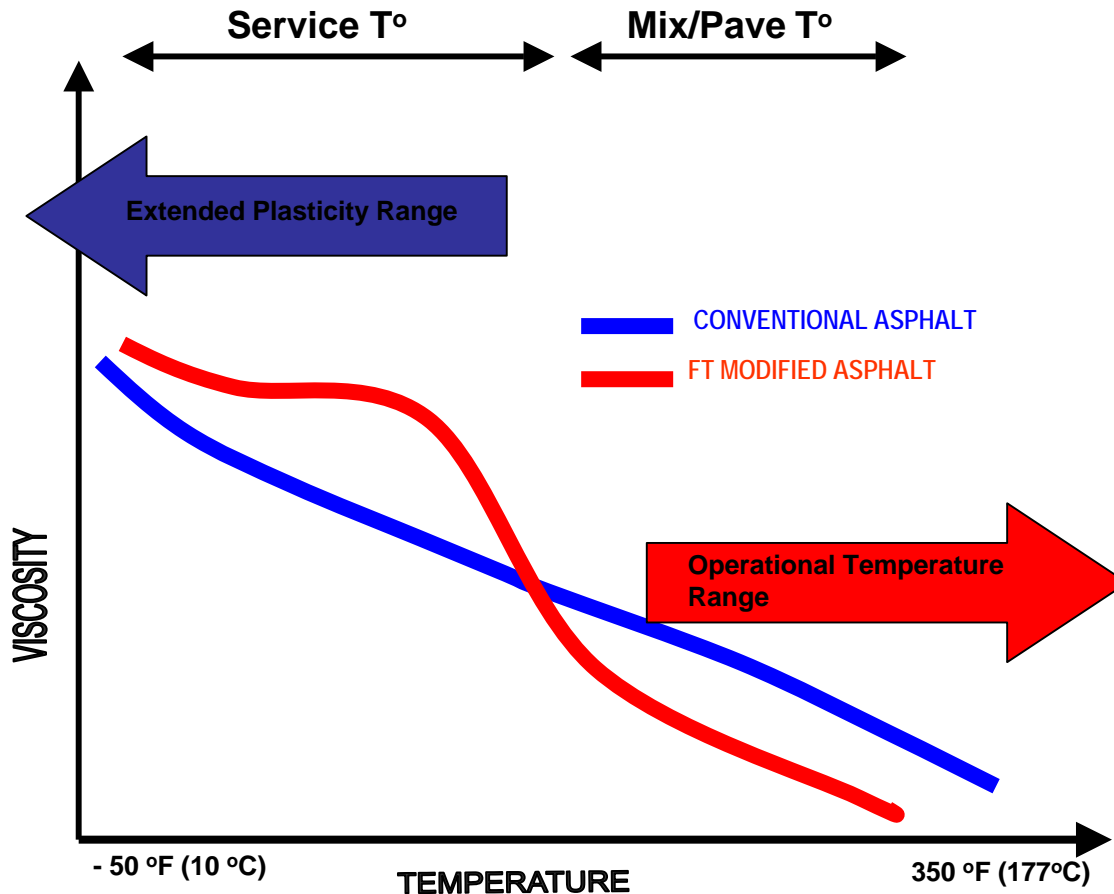


Crack Filler In Alaska Trials

- Trials Done In 3 Subdivisions
- Open To Traffic In 40 Seconds – No Damage Or Lift-Off By Tires
- Yield is Twice Current Commercial Products i.e. Sasoflex Based Crack Filler Covers Twice Crack Area & Quality Is Superior
- Deeper Crack Penetration (Low Viscosity)
- Easier To Apply (Good Flow)



Mix and Compaction Workability



IMPROVED WORKABILITY

Mixing stage

- >20°C/68°F decrease in mixing temperature
- Compatibility & easy blending
- Reduced blending time
- Energy savings

Placing and compaction

- Lower working temperatures - wider working window
- Reduced fumes
- Lower impact of weather
- Reduced roller compaction
- Faster laying or paving



Binder Requirements

- **Comply with PG**
- **Cost Effectiveness**
- **Menu Flexibility**
- **Longer Pavement Life**
- **Reduced Lifecycle Cost**
- **Comfortable Ride**
- **Lower Temperature Mixing**
- **Batch Cycle Time Reduced**
- **Reduction in Emissions**



Conclusion

- Learn by Doing
- Ongoing Process
- Future Concepts
- Progress Report

