

RAPRA 2011 - Dusseldorf

Foam Supplies, Inc

THE BENEFITS OF OPTIMIZATION IN ECOMATE[®] BLOWN FOAMS

SUITABILITY OF ECOMATE

- × Well suited BA for PUR & PIR foams
 - + Similar to HCFC-141b
 - × BP identical : [32°C]
 - × LFL slightly lower: [5 vol% v 7.6 vol%]
 - × When blended into polyols – Flammability a non-issue!
 - × Solubility stronger with ecomate
 - + But not a Drop-In
 - × Requires Optimization [like any other BA]

ADVANTAGES OF ECOMATE

- ✘ Environmentally Benign
 - + Zero ODP, minimal GWP, VOC-exempt
- ✘ Low Gas Lambda 10.7 mW/m.K
- ✘ Very Cost Efficient
 - + Lowest MW 60
 - + Low Cost
 - + Pricing independent of Petrochemicals
- ✘ Your LAST Transition ??

ECOMATE FLAWS

- ✘ Can **Hydrolyze** !
 - + An ESTER
- ✘ Slightly More **FLAMMABLE** than 141b
 - + Only in Neat form *LFL = 50,000 ppm*
 - + In Polyols – handle conventionally
- ✘ Slightly Stronger **SOLVENCY**
 - + Can lead to Shrinkage !

NON – FLAMMABLE LIQUIDS

- ✘ The European Chemical Agency [ECHA] guidelines state:
 - + "Liquids with a flash point $>35^{\circ}\text{C}$ may be regarded as **non-flammable liquids** if negative results have been obtained in the **sustained combustibility test L.2...."**
 - + **Polyol /ecomate blends, if properly chosen, will not sustain combustion.**
 - ✘ *The ECHA Guidance on the Application of the CLP Criteria, Guidance to Regulation EC no 1272/2008 on classification, labeling and packaging [CLP] of substances and mixtures, Annex I: 2.6.4.5, <http://echa.europa.eu>*

REFORMULATION STEPS

- × Two Minor Steps
 - + Increasing the XLD of the polymer
 - + Change Surfactant
 - × Type & Amount (lessened)

Increase the Avg Fn

Or

Decrease the Avg XLD

ADJUSTING THE XLD

Table 1a

POLYOLS	OH#	fn	EqWt	Mn	AMT	avg fn	avg XLD
PS2352	240	2	233.8	467.5	50%	1.0	116.9
R315x	315	3.2	178.1	569.9	50%	1.6	89.1
Voranol	360	4.5	155.8	728		0.0	0.0
						2.6	206.0

Table 1b

POLYOLS	OH#	fn	EqWt	Mn	AMT	avg fn	avg XLD
PS2352	240	2	233.8	467.5	50%	1.00	116.9
R315x	315	3.2	178.1	569.9	25%	0.80	44.5
Voranol	360	4.5	155.8	728	25%	1.13	39.0
						3.23	200.4

STEP 2: SURFACTANT CHANGE

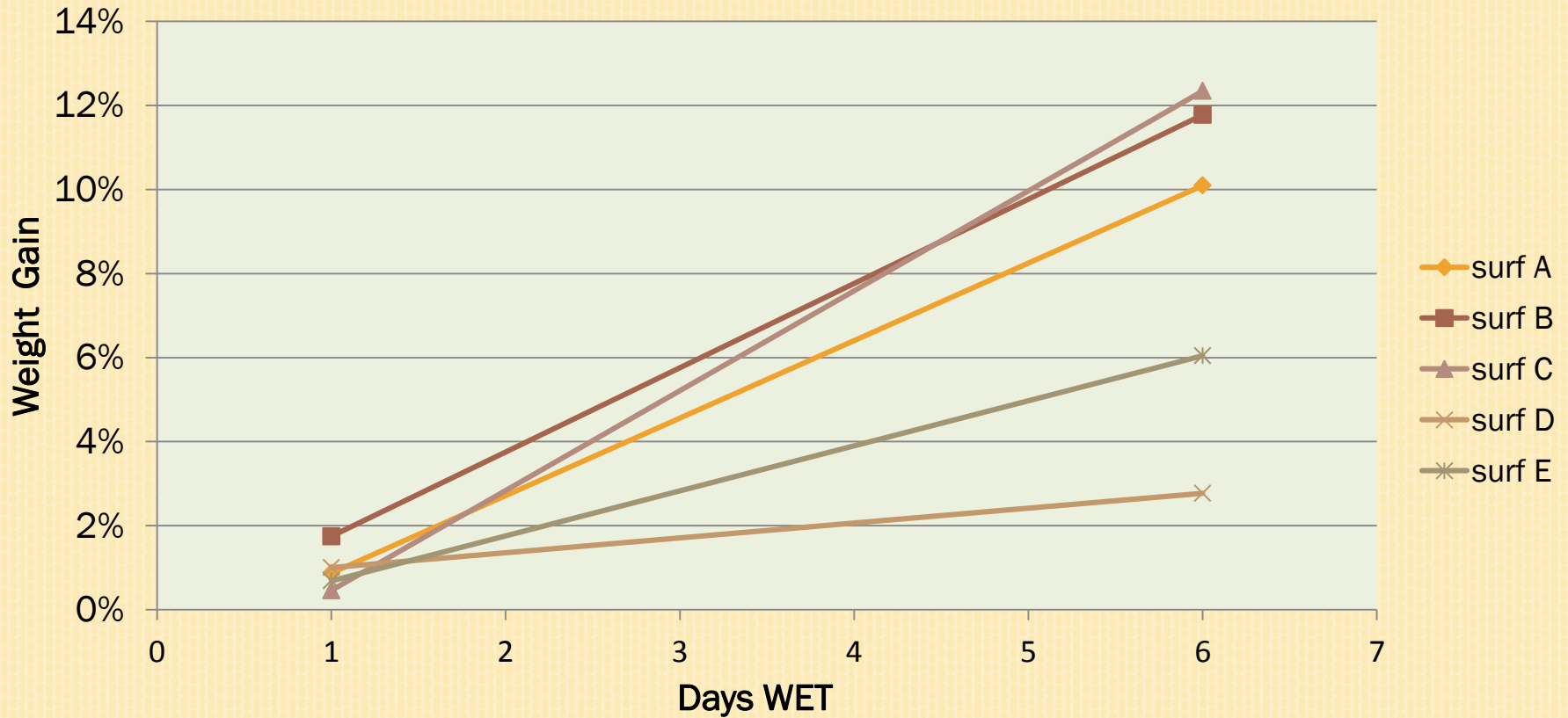
- × Why change the surfactant?
 - + It Affects:
 - × Foam DENSITY
 - × CELL STRUCTURE
 - × THERMAL PROPERTIES
 - + It may Affect:
 - × Shelf stability
 - × Flammability
 - + Let's take a look....

SURFACTANT STUDY

- × Same HANDMIX Formulation
 - + Master batch w/o Surfactant
 - × Split into five Batches
 - + Five different Surfactants
 - × Added at 1 part /100 parts formula
 - + Showed effects on
 - × Density
 - × Compressive Strength
 - × Humid Aging

WATER ABSORPTION

Wt gain in WET environment

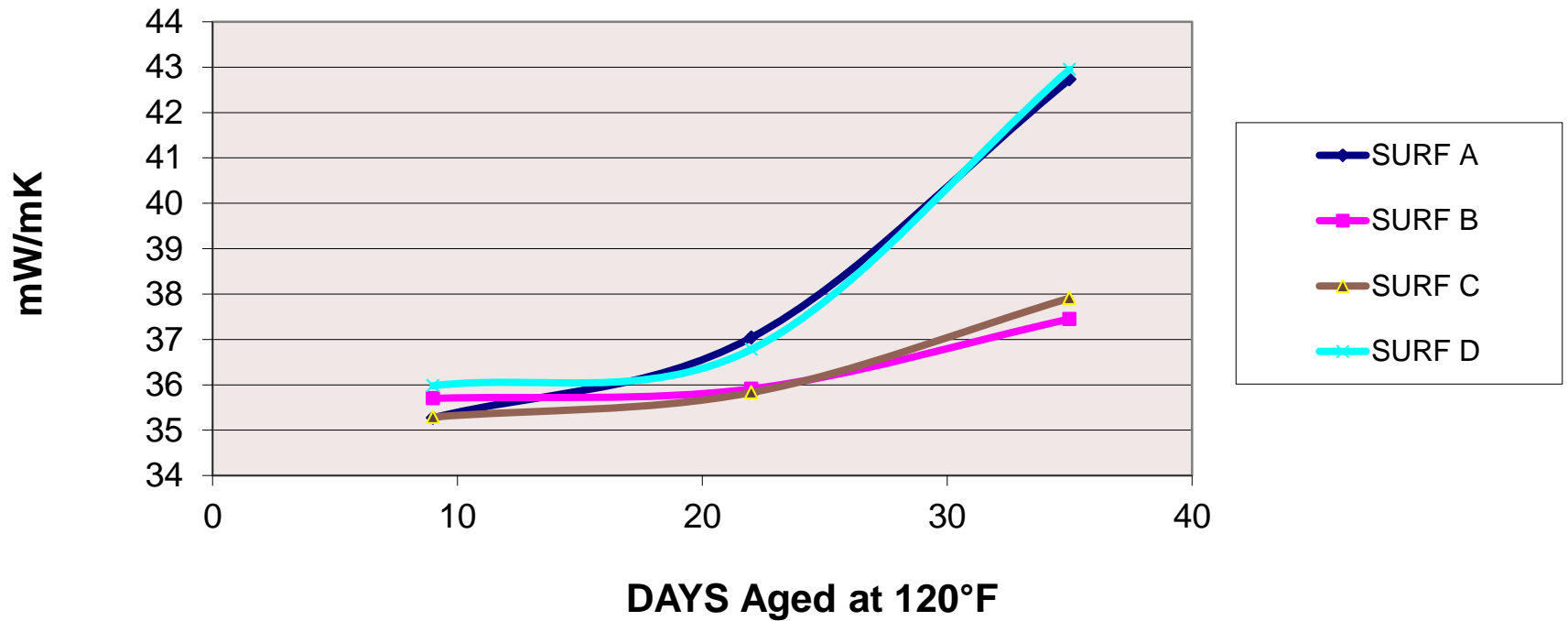


RESULTS

- × Surfactant CHOICE affects:
 - + DENSITY
 - + STRENGTH
 - + SHRINKAGE
 - + THERMAL PROPS
 - + WT GAIN in Humid Environment

SURFACTANT AGING

SURF AGING – HAND MIXED



CAN STABILITY

- ✘ Surfactant Type affects:
 - + Density
 - + Cell Fineness
 - + Thermal Properties
- ✘ Improved Surfactants found
 - + Can stable for over 1 year

THE BENEFITS OF OPTIMIZATION

- × Line Trials

- + ONE – just RXN & DENS

- + ANOTHER - optimized for Thermals

- × But NOT Physical Properties

LAMINATE OPTIMIZATION 1

× System 1

- + Pentane blown
- + Drop-In Substitution
- + Minimal Optimization
 - × Uniform Density
 - × Equal Reactivity
- + **USED 4 % LESS CATALYST w ECOMATE**

NON-OPTIMIZED LAMINATE RUN #1

- ✘ RXN Rate & DENSITY same
- ✘ STRENGTH poorer w Ecomate [$\sim 15\%$]
- ✘ STABILITY \sim Same
- ✘ LAMBDA IMPROVED !
- ✘ BURNS IMPROVED !

PROPERTY	PENTANE	ECOMATE	
CREAM	15	15	s
FIRM	40	39	s
DENS	25.4	25.4	kg/m ³
CS//	189	162	kPa
CS_ _	85	72	kPa
DS+5	-0.22	-0.3	%
DS-15	-0.27	-0.32	%
Lambda	22.04	21.49	mW/m.K.
B2	14.2	13.6	cm
M45	4.9	4.5	%

LAMINATE OPTIMIZATION 2

× System 2

- + Pentane blown

 - × 4" THICK

 - × Foil faced

- + Optimized for Thermal Properties

OPTIMIZED LAMINATE RUN #2

- ✘ DENs higher
 - + RXN Rate SAME
- ✘ STABILITY SIMULAR
- ✘ CS // Poorer
- ✘ FLAMMABILITY IMPROVED
- ✘ THERMALS **VASTLY** IMPROVED [10-15%]

Trial 2	C ₅ CONTROL	ECOMATE
Dens, pcf	1.75	1.97
CCC, %	98.5	94.6
Δ%Vol, 7d		
COLD	0.98	-0.7
WET	4.11	5.06
DRY	3.03	4.35
CS //, psi	20.3	12.9
FS*	30	25
Smoke	400	180
Lambda, 20°F	19.3	16.9

CONCLUSIONS

- ✘ **All foam systems can benefit from optimization.**
 - + Get the most out of YOUR Formulation
 - + Without increasing costs, and
 - + Potential of vastly superior properties
- ✘ **Ecomate has all the properties you might want**
 - + Excellent thermal properties
 - + Excellent environmental properties
 - + Low molar cost
 - + Excellent miscibility with all raw materials
 - + The ability to produce systems w/o flammability issues
- ✘ **It can work for you if you are willing to optimize!**
- ✘ **This can be the LAST BA reformulation you will have to make!**
- ✘ **We are eager to work with you**