Novel Treatment Technology for Scale Prevention in Steam Boilers

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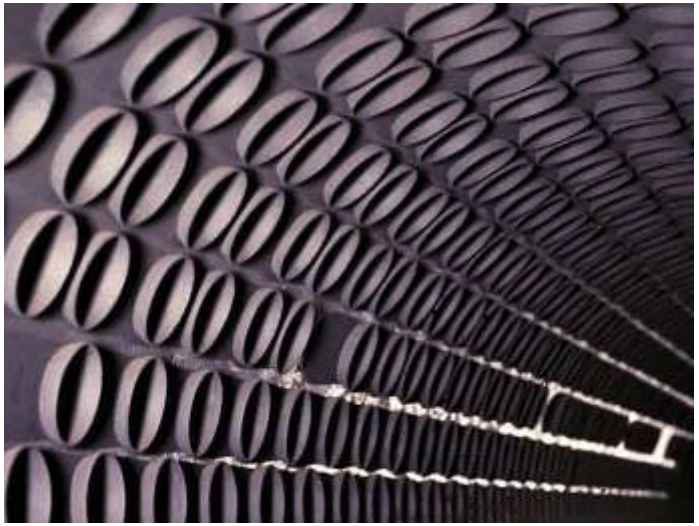
Imagination at work.

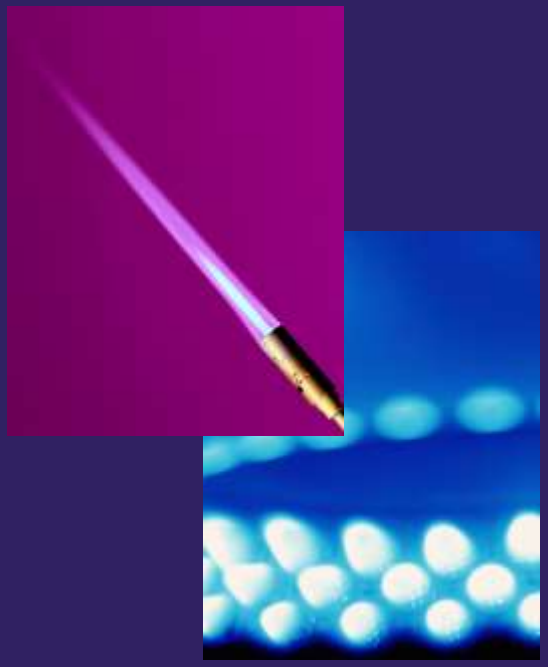
Today's Discussion

- Boiler scale control & why it matters
- The right chemistry for the job
- Performance delivered



Why is effective control of boiler scale important?

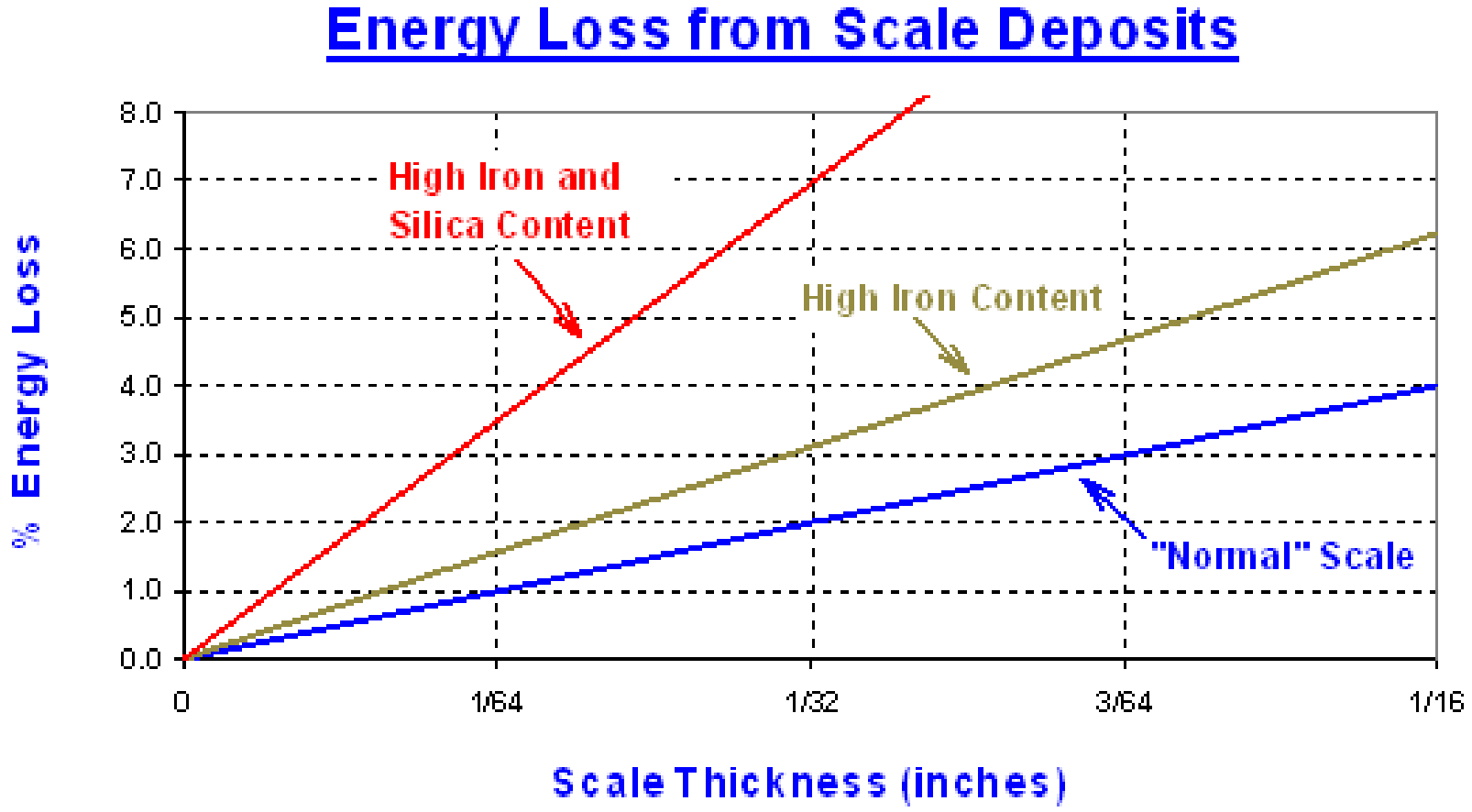
Lower fuel costs



Greater reliability

Less downtown costs

Compromised boiler efficiency



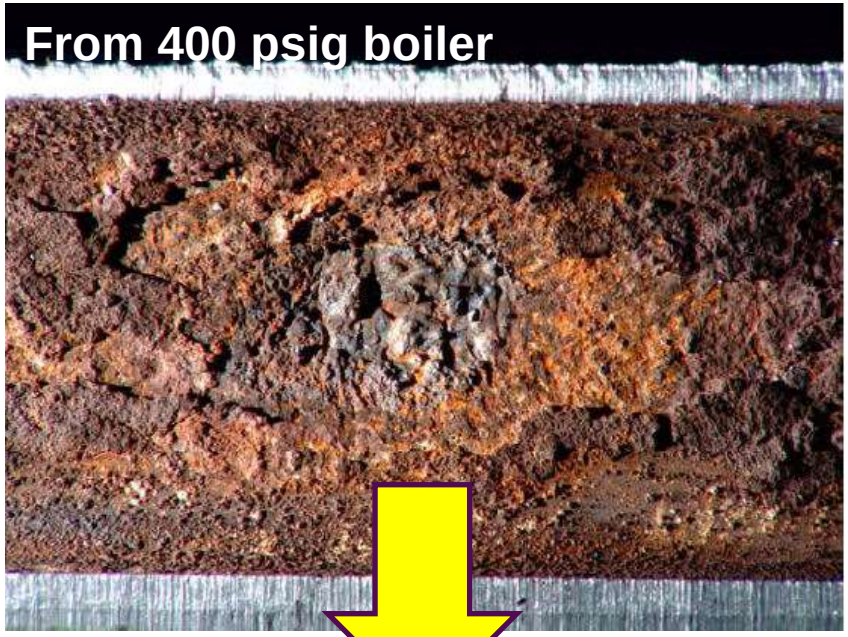
Source: Georgia Office of Energy Resources and Ga. Tech's Engineering Experiment Station

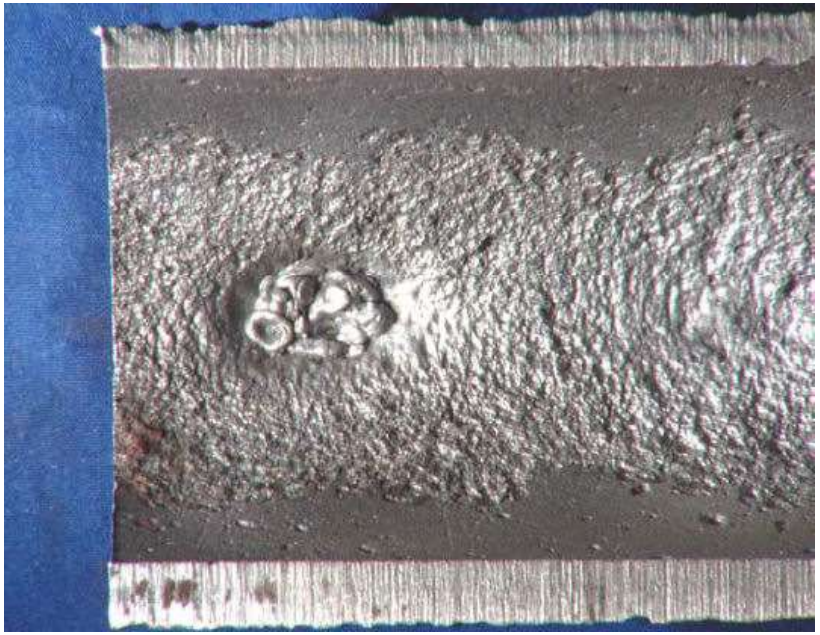
Overheating tube failure due to scale

Element	Deposit 1 (wt %)
Calcium	51.2
Phosphorus	21.6
Iron	13.6
Silicon	3.0
Magnesium	2.9
Copper	2.3
Manganese	2.2
Aluminum	1.2
Sulfur	1.1
Sodium	0.9

DWD Section	DWD (g/ft^2)	Internal Surface Deposit Thickness		Wall Thickness		Internal Pit Depth
		min. (in.)	max. (in.)	min. (in.)	max. (in.)	max. (in.)
Side I	194	0.016	0.028	0.135	0.137	0.002
Side II	197	0.023	0.033	0.132	0.139	0.002

Metal oxide-induced overheating & under deposit corrosion



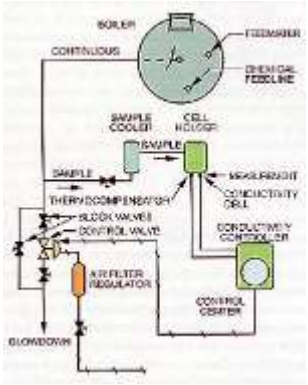


Test Section	DWD g/ft²	Deposit Thickness (in.)
Hot	71.8	0.001 - 0.111
Cold	17.7	0.002 - 0.003

Element	Weight Percent
Iron, as Fe_3O_4	39
Copper, as CuO	26
Silicon, as SiO_2	17
Magnesium, as MgO	12
Sodium, as Na_2O	2
Calcium, as CaO	2
Phosphate, as P_2O_5	1
Loss On Ignition	1

4 pillars of clean waterside surfaces

2. Control of solids



1. Effective Pre-Treatment

3. Effective Chemistry

4. Steam Purity

imagination at work

3 mechanisms of polymer deposit control

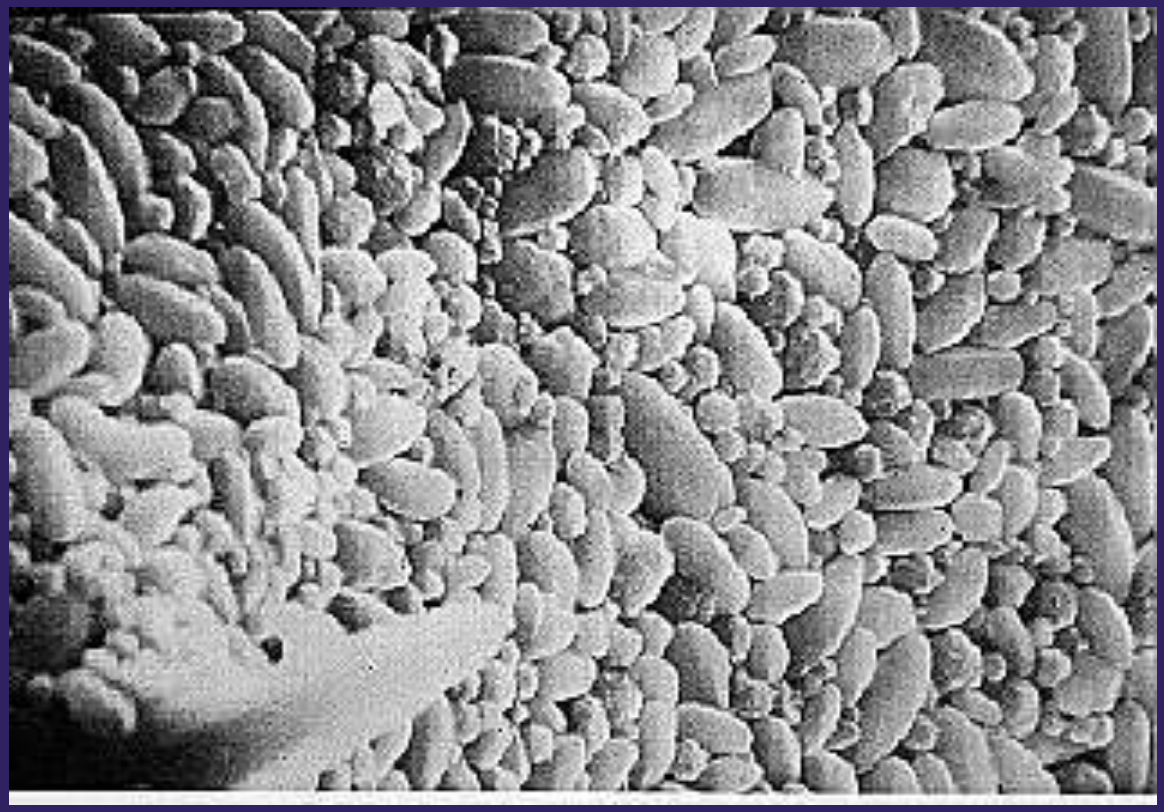
1. Dispersion → Particles repel

2. Crystal Modification → Slower crystal growth

3. Complexation → Keeps any formed particles in solution

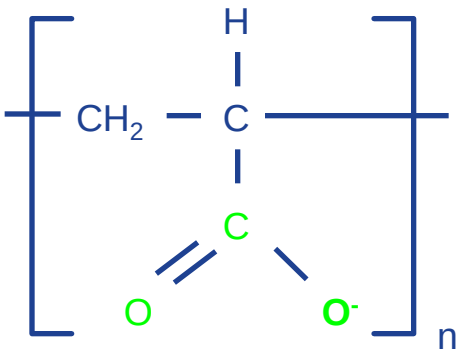
Calcium phosphate - Magnesium silicate untreated condition – 4000X

Same contaminants and boiler conditions with addition of effective polymeric dispersant



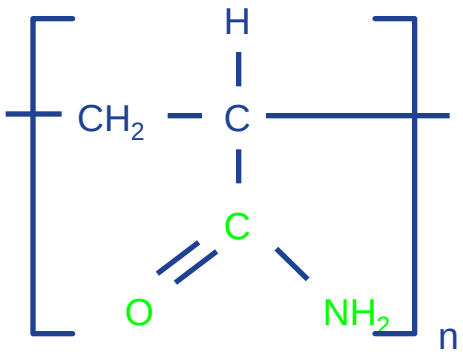
First Generation Polymer Chemistries

PAA



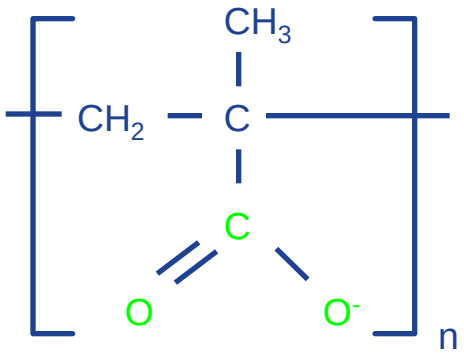
Polyacrylate

PAAM



Polyacrylamide

PMA

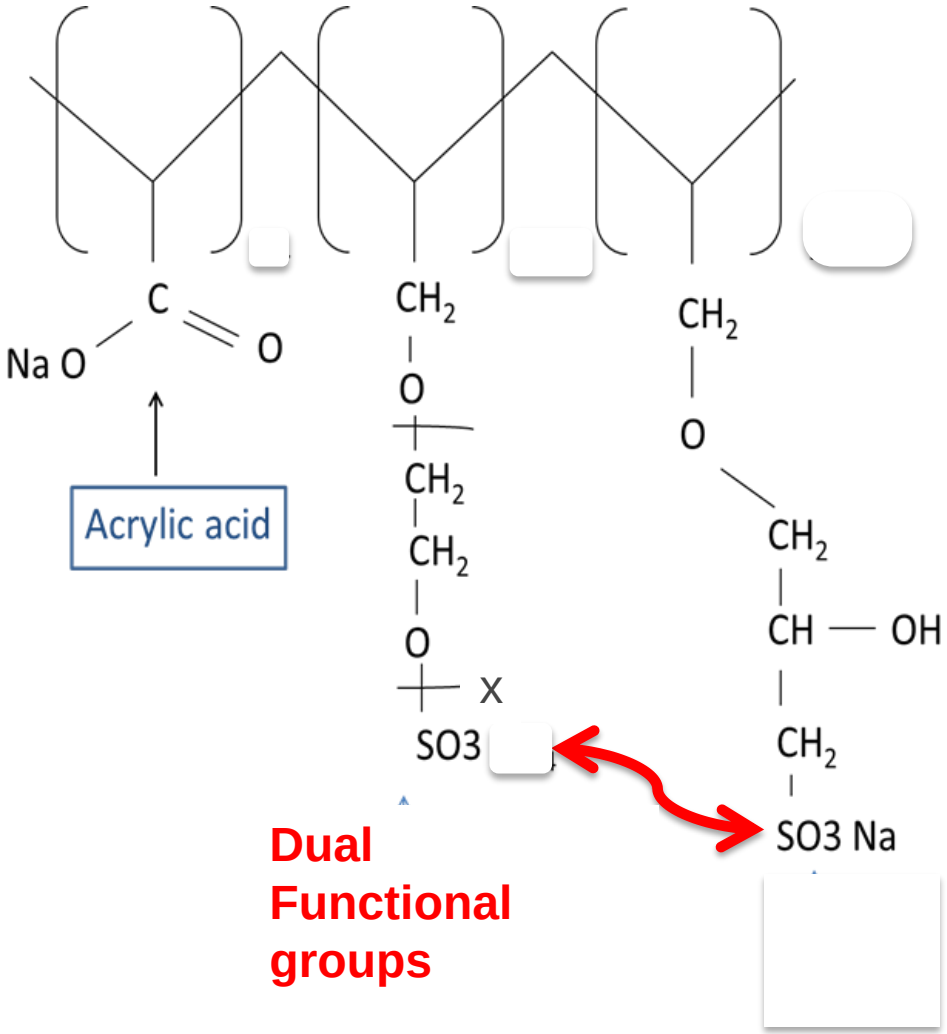


Polymethacrylate

Novel Terpolymer Boiler Treatment Technology

Boiler Terpolymer (BTP)

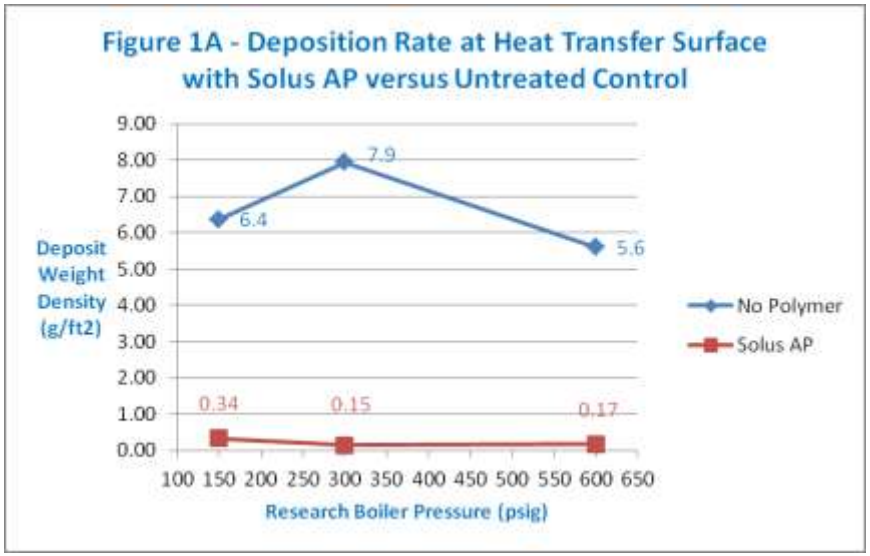
- Patented technology
  - Acrylic acid plus two unique monomers
- Two unique, sulfonated monomers enhance performance on **iron, magnesium & silica**
- Effective on Common District Energy/CHP contaminants

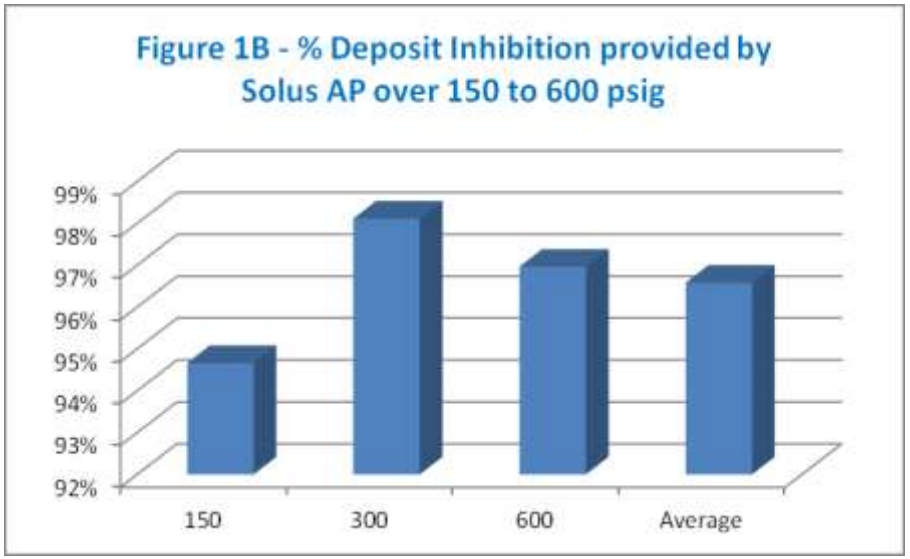


Performance of Boiler Terpolymer

Wide spectrum deposit control performance

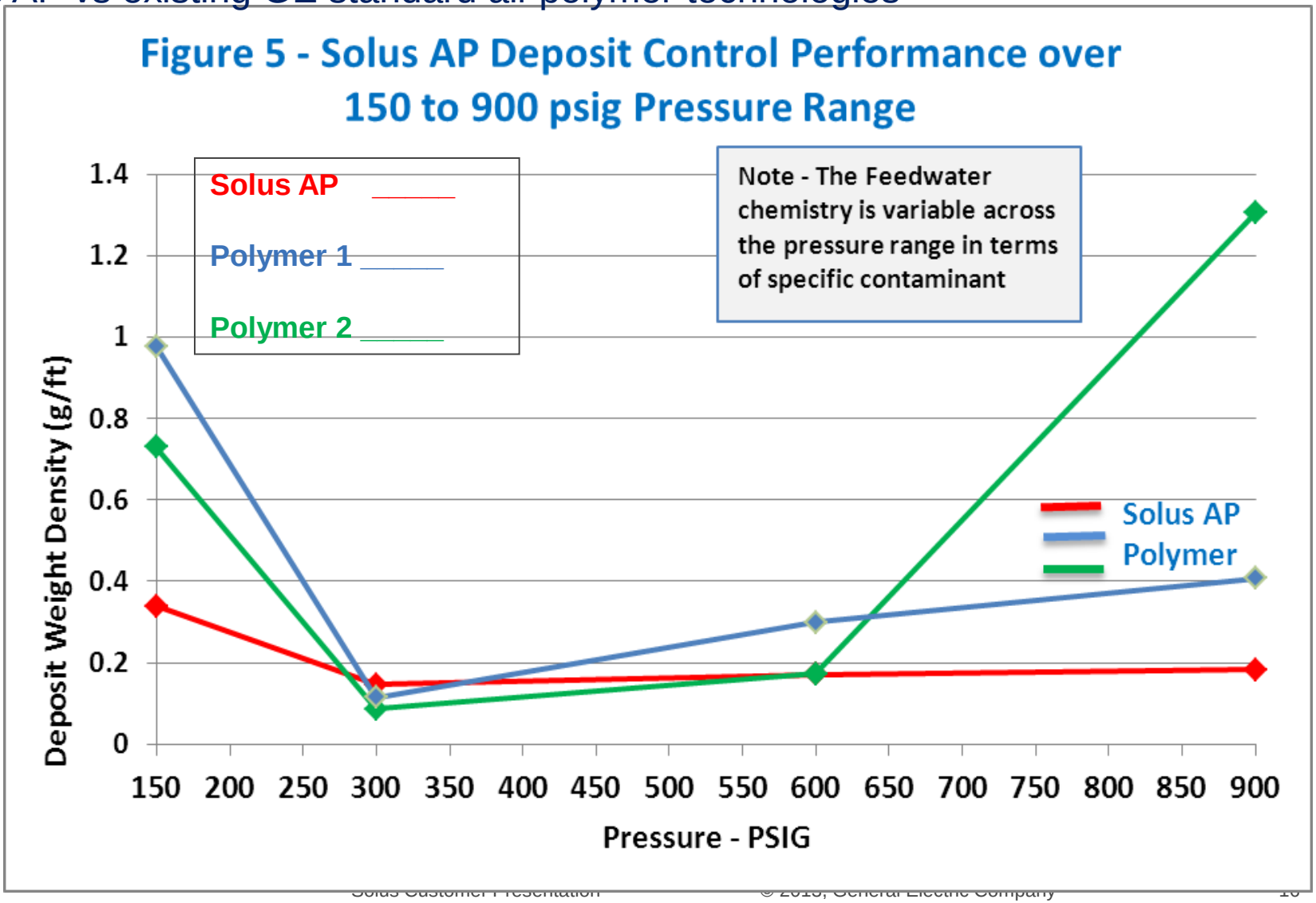
BTP highly effective in preventing hardness, silica and iron-based scale deposits on steam generating boiler heat transfer surfaces up to 900 psig.





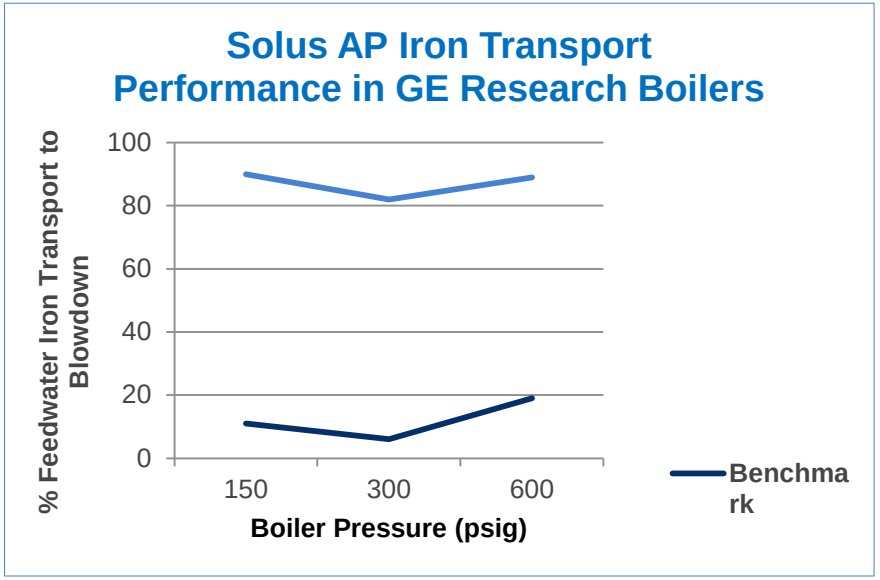
Deposit Control Performance – At Equal Actives Dosage

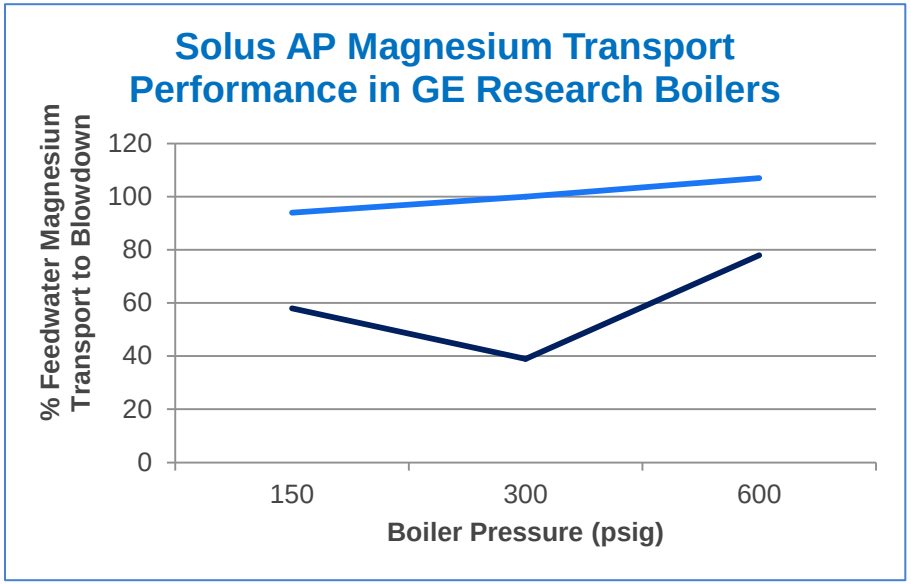
Solus AP vs existing GE standard all-polymer technologies



Reduced sludge accumulation

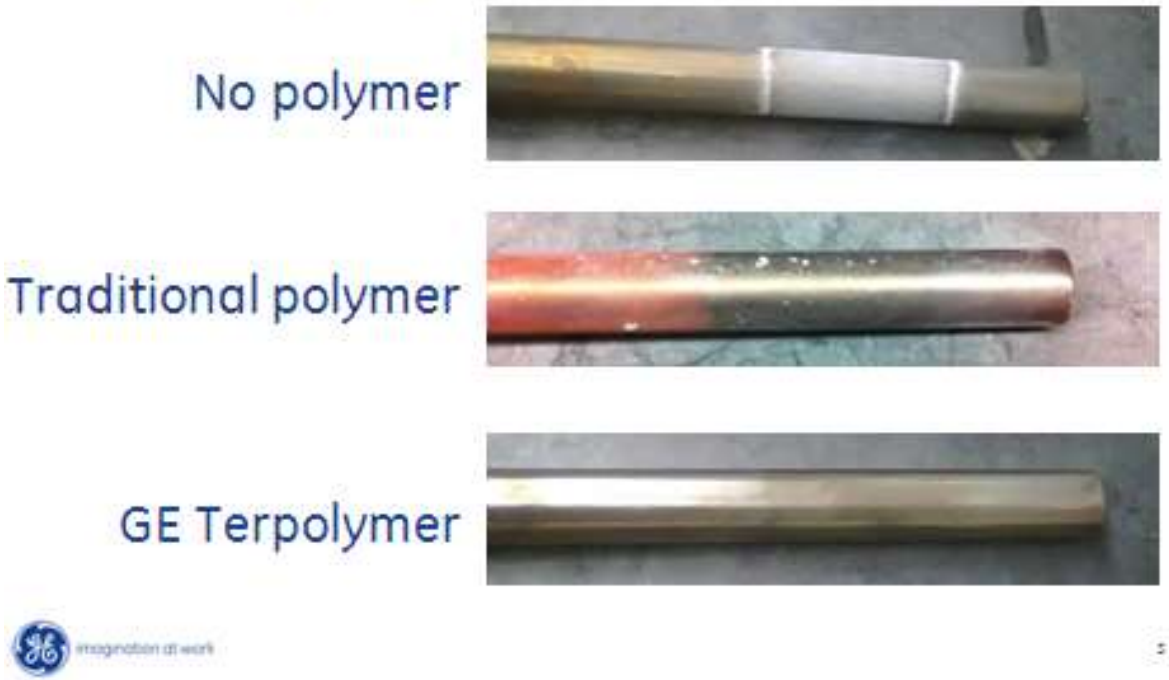
Reduced sludge accumulation on heat transfer & non-heat transfer surfaces and cleaner, more reliable and efficient boilers.





Feedwater upset recovery performance

Figure 11
GE Research Boiler
On-line deposit removal evaluation
300 psig / Magnesium silicate-dominated deposit



Removal of magnesium silicate deposit when fed at higher-than-maintenance dosage.

Field Performance

GEWPT Research Boiler

170 psig D-Type Watertube Boiler
August 2012 Inspection
Benchmark Polymer 2 All-Polymer Program

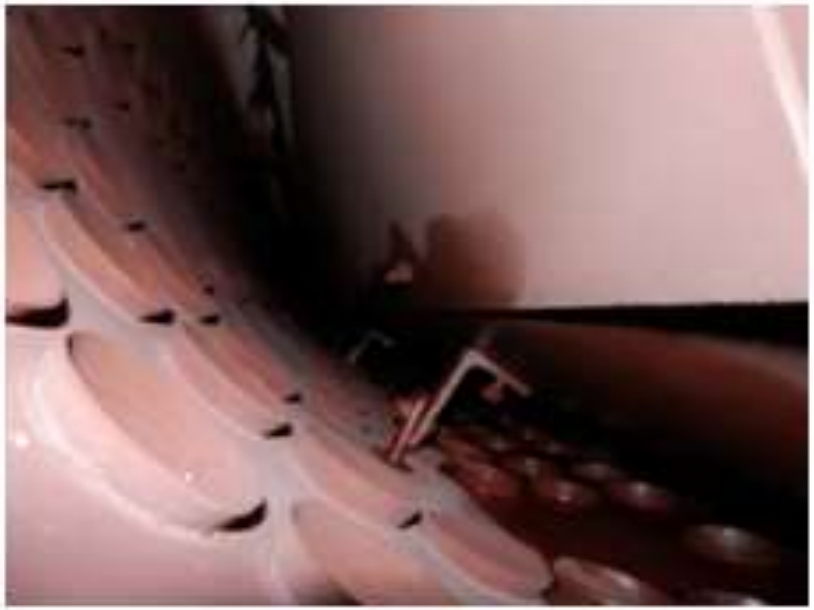
Steam drum surface

Waterside of boiler tube

GEWPT Research Boiler

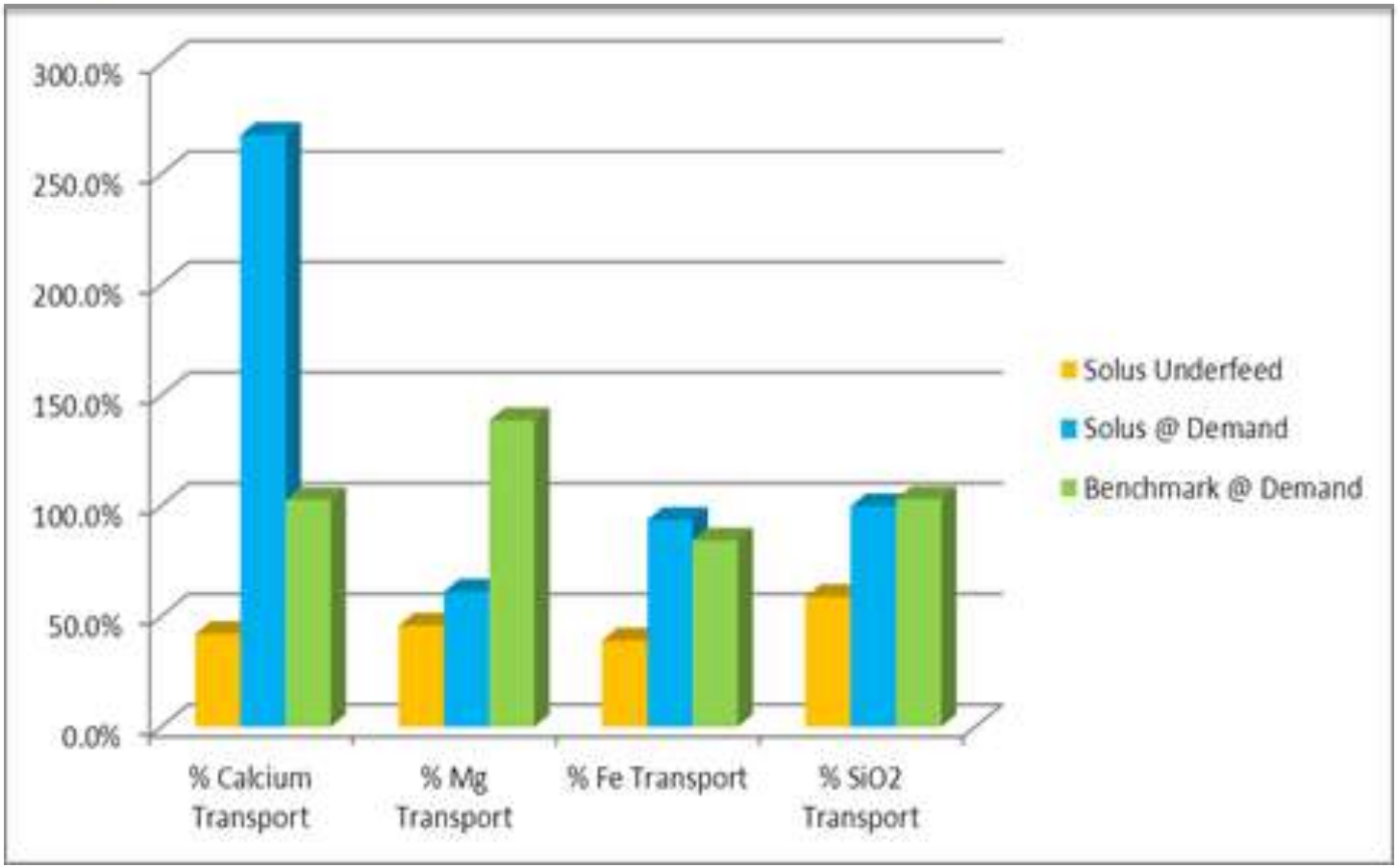
170 psig D-Type Watertube Boiler
August 2013 Inspection
One year on Solus AP All-Polymer Program

Steam drum surface

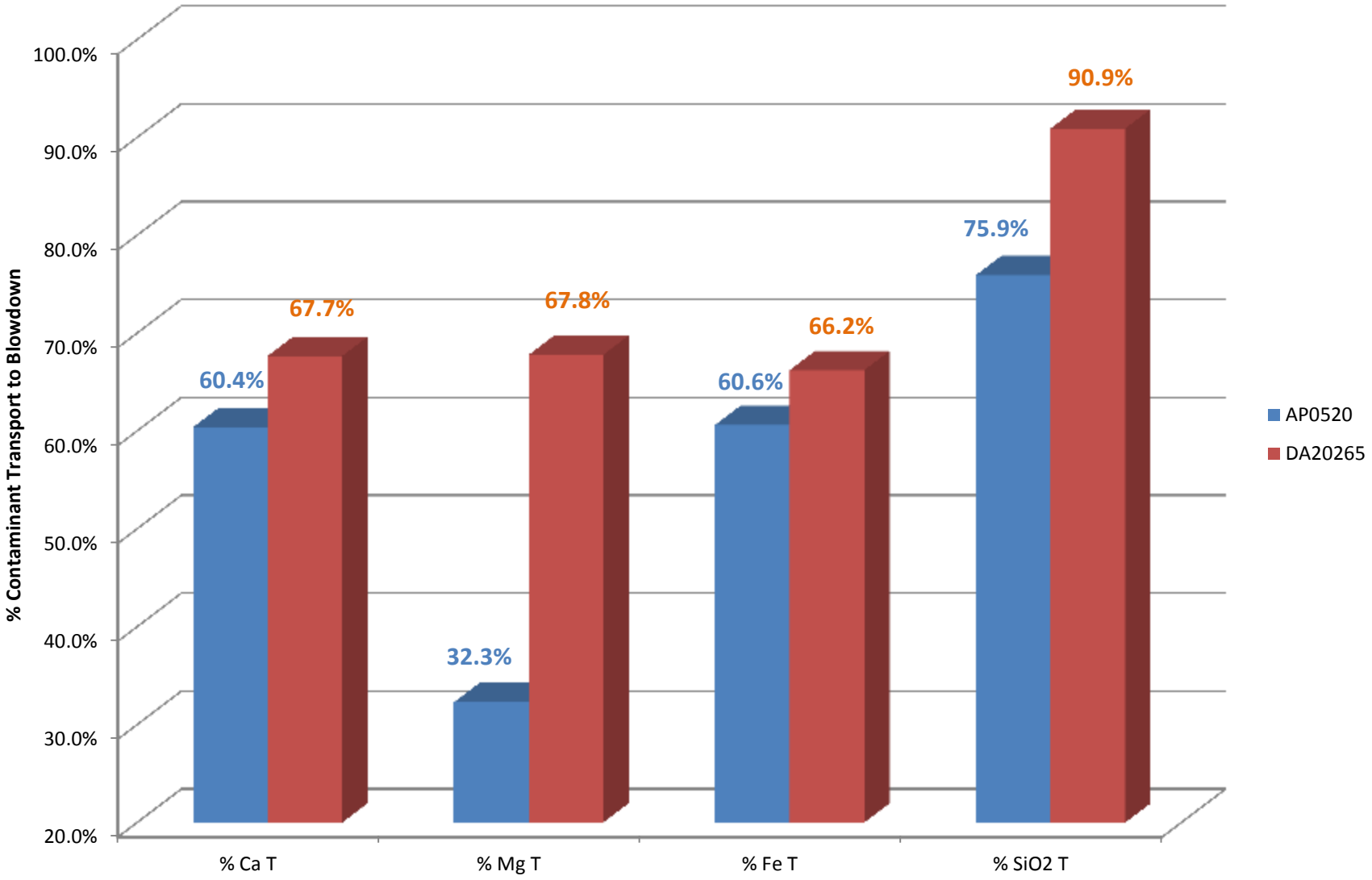


Tubes under belly plate

Northeast University
Simple Cycle HRSG
Fall 2012 – Spring 2013



Pennsylvania Refining Operation
Oct. 2012 – Sept. 2013



Thank you