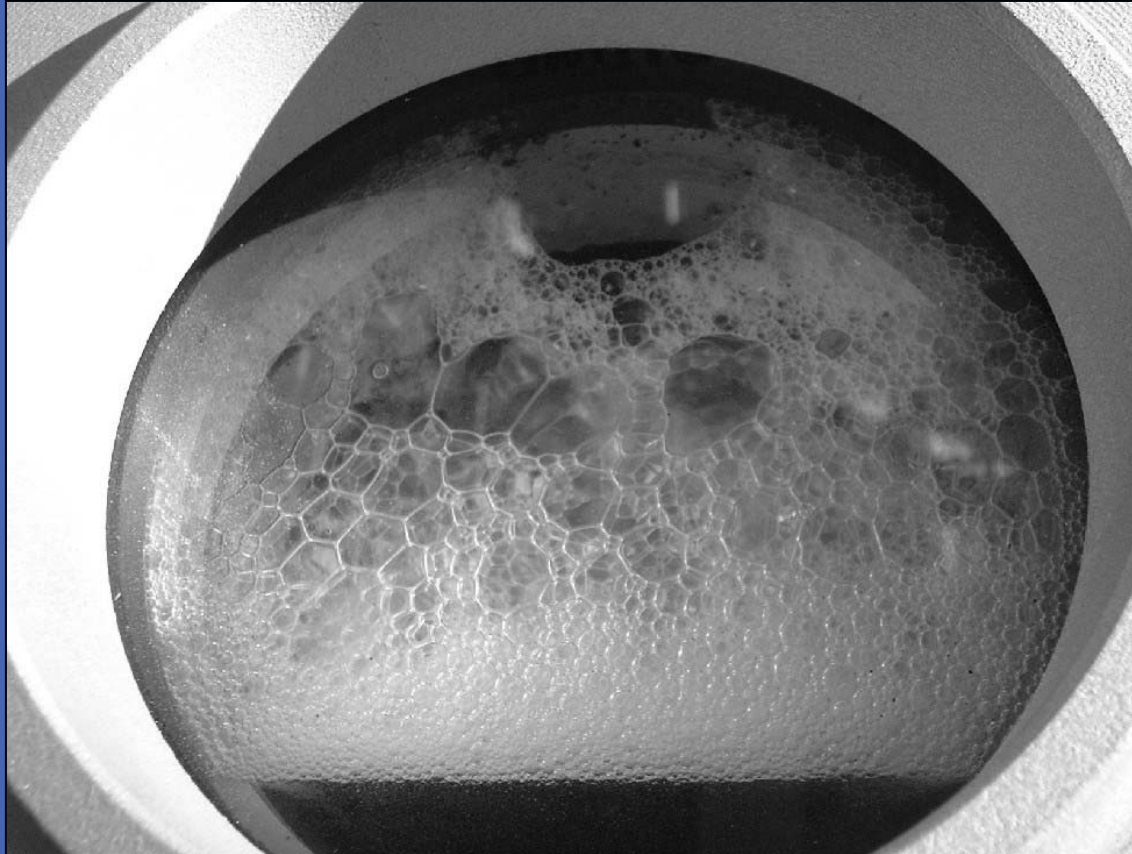


Amine Process Foaming



Solution foaming in the SigmaPure™ System.
(The solution foamed like this for us before the plant even had operating symptoms!)

Amine Foaming Upsets Cost Operating Companies Millions Every Year.

- Treating Inefficiencies
 - Throughput cutbacks
 - Solvent activity reduction (mass transfer inhibition)
- Solution losses
 - Overhead with the foam
 - Bleed and feed to dilute foaming contaminants
- Up and downstream affects to other units
- Engineering, operations, maintenance time
- Environmental discharge exceedences
- Associated response costs
 - Mechanical filter changeouts
 - Activated Carbon replacement
 - Antifoam injection

Why does Amine foaming continue to be such a huge problem?

- Operating companies don't have time or the resources to become foaming experts.
 - Plants are limited to information within their gates.
 - What little industry literature that exists only addresses location specific remedies.
- Plants are addicted to antifoam.
 - It is a short term fix that covers up the actual problem.
 - It is the easiest thing to do.
 - No viable alternative. (**until now!**)

We Solve Foaming Problems

- D-Foam, Inc. was founded to concentrate specifically on solution foaming problems.
- We have developed laboratory tests that help differentiate mechanical from chemical foaming causes while prequalifying the need for SigmaPure™.
- We developed a plant level system that separates foam causing contaminants from other solution constituents.

D-Foam Laboratory Testing

- Solution Foaming Properties
 - Foaming tendency (foam volume)
 - Foam break time (gas – liquid disengagement)
- Surface Tension
- Microscopic verification of enhancing or inhibitive contaminants.



Pre-qualifying SigmaPure™'s Use

Sample ID	Surface Tension [dyne/cm]						Foaming Tendency [ml]			Break Time [s]			Foam Removal Benefit Potential*
	1.0	2.0	3.0	4.0	5.0	Avg	1	2	Avg	1	2	Avg	
Refinery 1													
Plant 1	43.0	43.0	42.0	42.5	43.0	42.7	500	500	500	90	90	90	10
Refinery 2													
Plant 1	50.5	51.0	51.0	50.5	50.5	50.7	250	180	215	15	14	14.5	5
Plant 2	49.0	49.0	50.0	50.0	49.5	49.5	0	0	0	0	0	0	0
Plant 3	44.0	45.0	45.0	44.0	44.0	44.4	50	50	50	5	5	5	2
Refinery 3													
Plant 1	50.0	51.0	50.0	51.0	51.0	50.6	15	15	15	3	3	3	1
Plant 2	48.0	48.0	48.0	49.0	48.5	48.3	320	170	245	34	19	26.5	8
Plant 3	50.0	51.0	51.0	51.0	51.0	50.8	5	5	5	4	4	4	1
Plant 4	45.0	45.0	46.0	46.0	46.5	45.7	850	900	875	120	120	120	10
Refinery 4													
Plant 1	52.5	53.0	52.5	53.0	53.5	52.9	290	220	255	40	28	34	9
Plant 2	49.0	49.0	49.0	50.0	49.0	49.2	330	290	310	19	22	20.5	7
Plant 3	50.0	49.5	50.5	51.0	51.0	50.4	200	140	170	15	17	16	5
Plant 4	46.0	45.0	45.0	45.5	45.0	45.3	720	570	645	47	61	54	10
Refinery 5													
Plant 1	53.0	53.0	54.0	53.5	53.5	53.4	90	120	105	6	7	6.5	2
Plant 2	38.0	39.0	39.0	39.0	40.0	39.0	50	120	85	13	35	24	6
Plant 3	51.0	51.5	51.5	52.0	51.5	51.5	440	450	445	22	24	23	8
Plant 4	48.0	48.0	48.0	48.5	48.5	48.2	310	340	325	14	15	14.5	6

*Benefit Potential based on ST, FT, and BT, also indicates chemical versus mechanical causes of solution foaming symptoms.

SigmaPure Benefit Potential Ranges

(based on samples being representative of circulating solutions)

- **0-2** are probably not producing measurable symptoms unless there are equipment problems such as fouling, mechanical damage, etc.
- **3-4** are producing measurable symptoms in the testing equipment, and NEED TO BE WATCHED.
- **5-6** are, based on past experience, marginal at best, and MAY NEED OPERATIONAL INTERVENTION such as antifoam addition or surfactant removal to stabilize the solution.
- **6-10** are "problem" solutions, and MOST LIKELY NEED IMMEDIATE OPERATIONAL INTERVENTION and/or surfactant removal to stabilize performance.

We don't want to mask or cover up the problems so you can continue to operate. We want to **SOLVE** your foaming problems.

D-Foam's Patented SigmaPure™ System **removes** the contaminants that cause foaming, and here is how it works.....

How SigmaPure™ Works

Principle: The contaminants that cause foaming become the foam! Removing the foam removes the contaminant.

4. Clean solution drains from foam and recovered.

3. Solution is made to foam under controlled conditions.

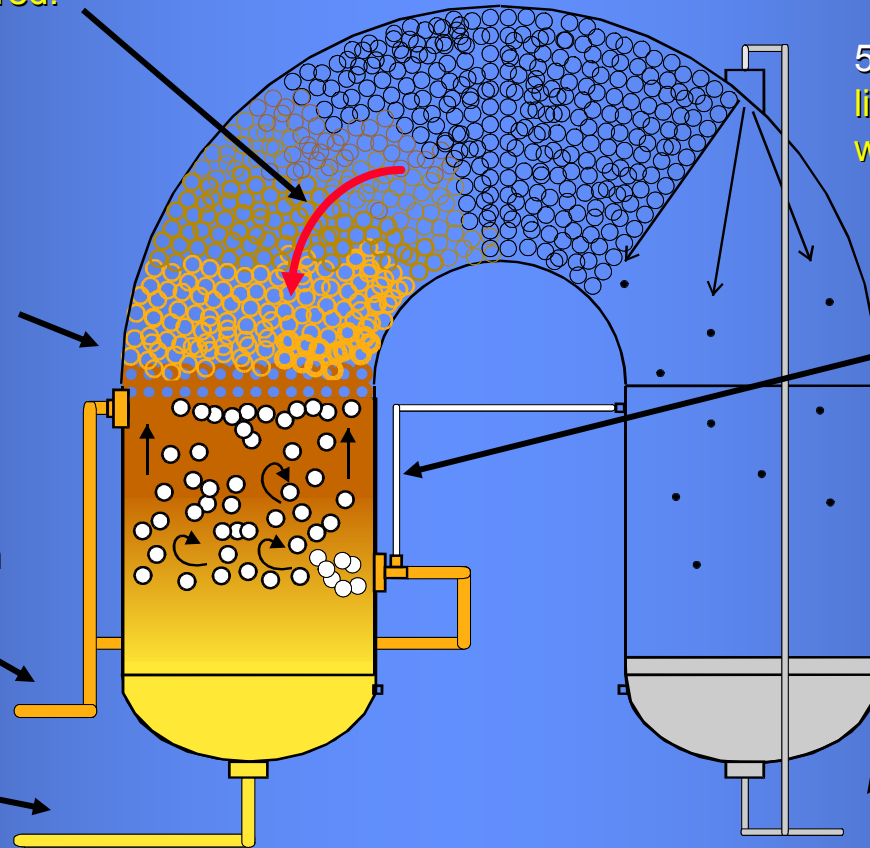
1. Contaminated solution enters the system

2. Treated solution back to the process

5. Dry foam is broken and liquid fraction collected as waste.

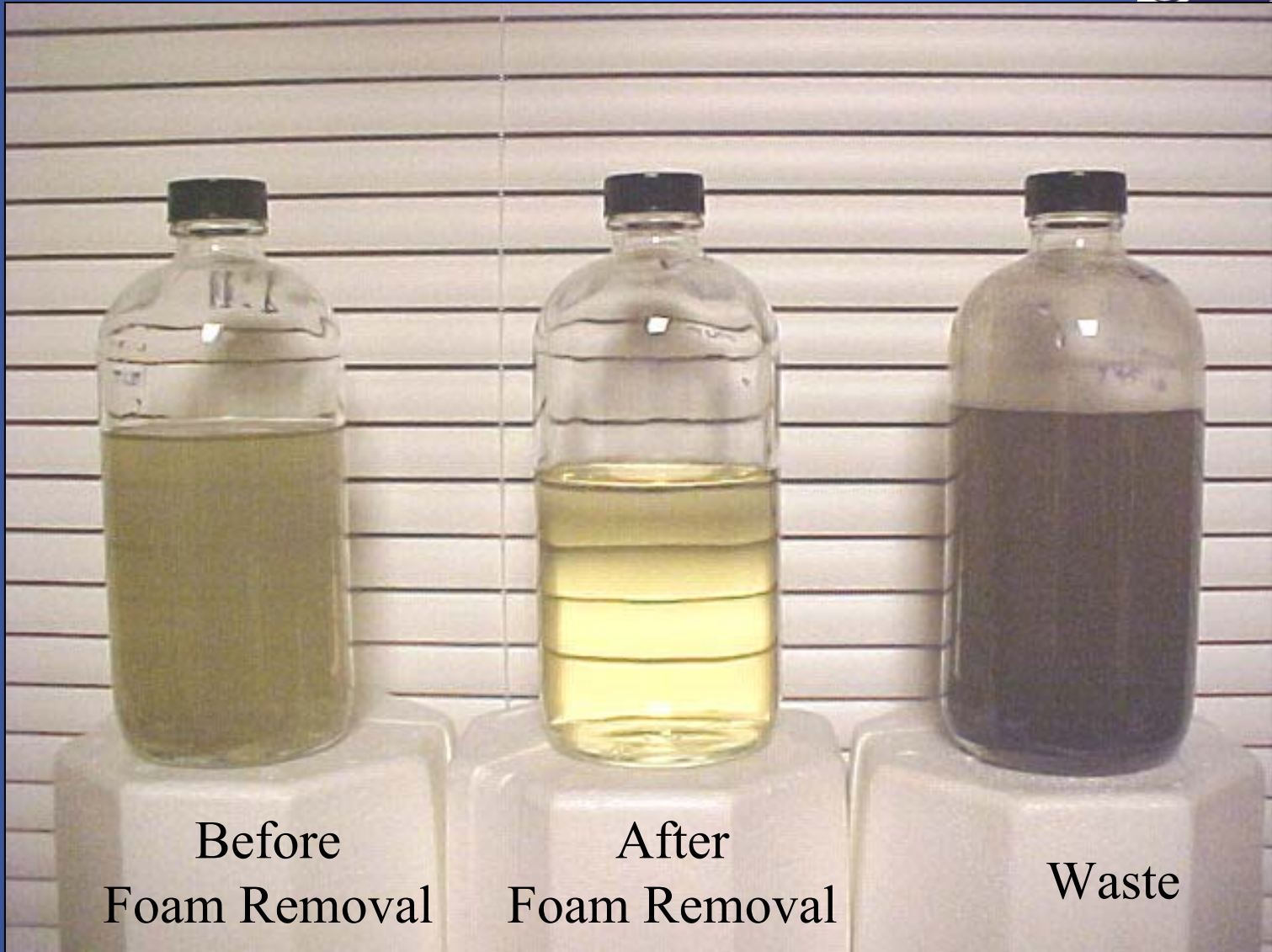
6. Gas fraction of broken foam is recycled back to create more foam.

7. Foamate waste is discharged.



D-Foaming With SigmaPure™

- No disposables like filters or carbon.
- No solution pretreatment required.
- Slip stream installation.
- Low operating cost.
- Low maintenance cost.
- Will work on any solution chemistry.
- Can be operated on rich or lean streams.
- Minimum waste generation.
- Portable

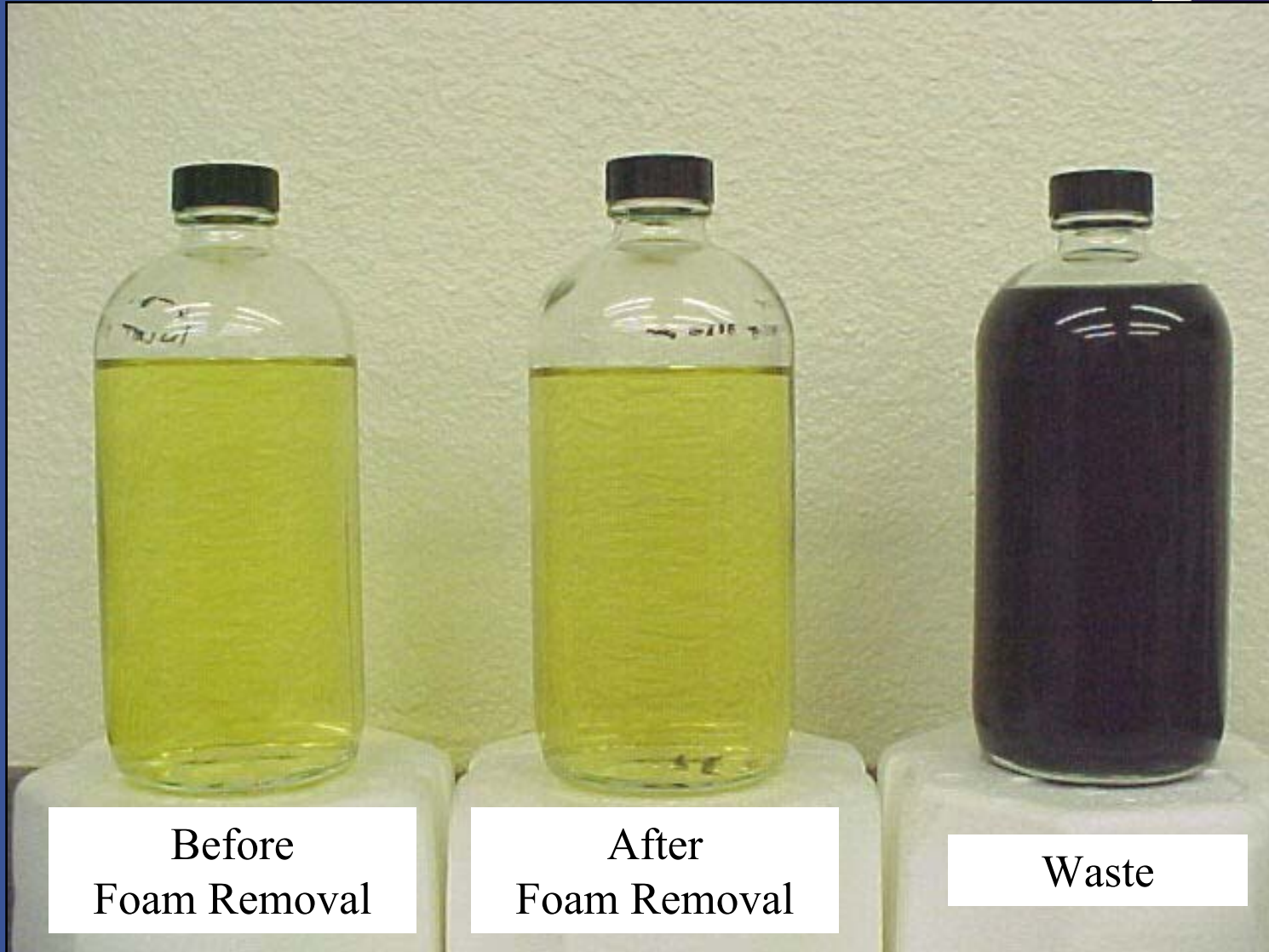


Before
Foam Removal

After
Foam Removal

Waste

....even when the solution looks clean!



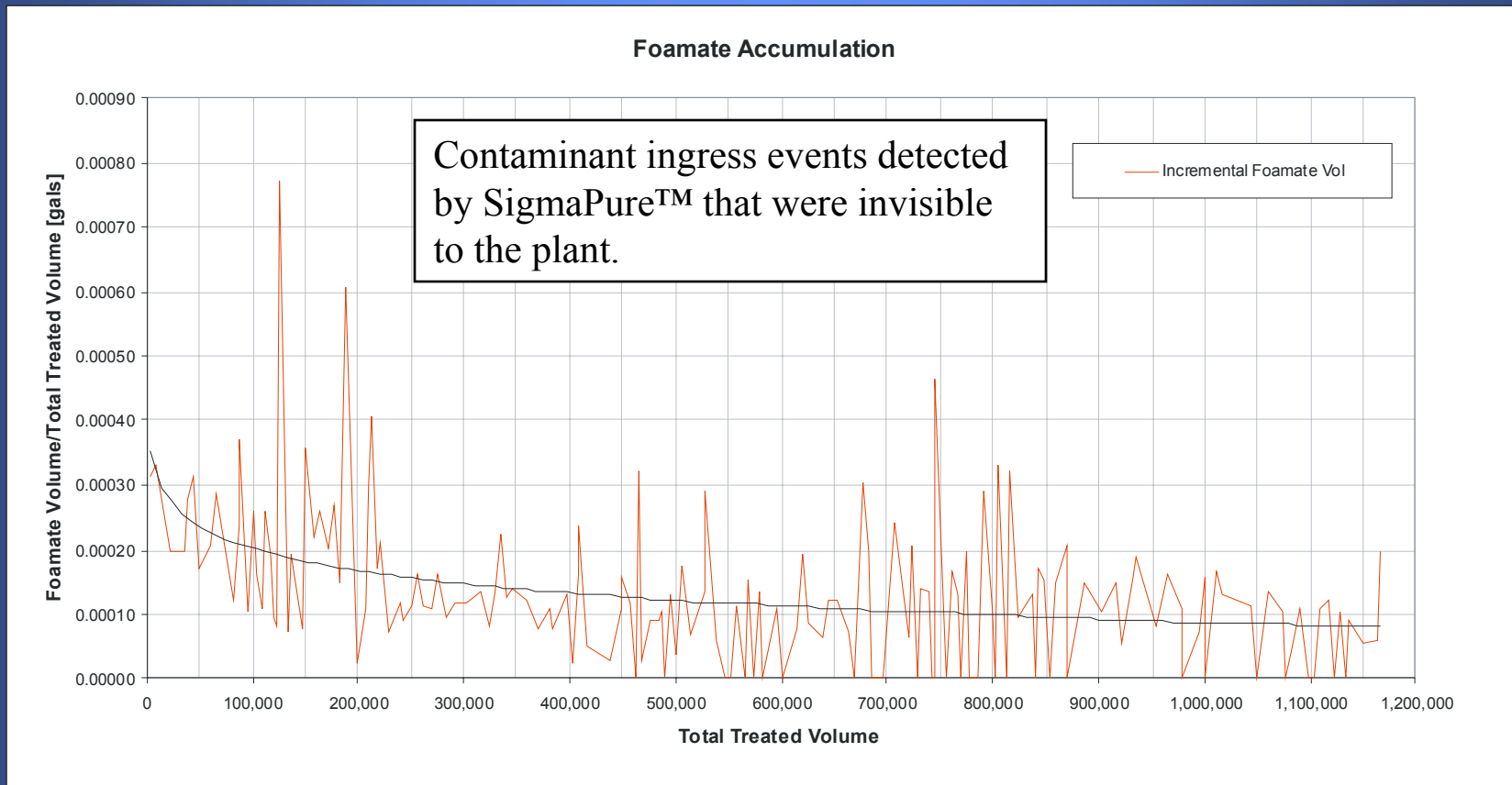
What Was in the SigmaPure™ Waste?

- Short chain carboxylic acids
 - Amine degradation byproducts
 - Pipeline or upstream process contamination ingress
- Long chain carboxylic acids
 - Amine degradation polymerization
- Sulfonates
 - Sulfur containing surfactants
- Glycols, ethoxylated alcohols
 - Antifoam and antifoam degradation compounds

Compounds	Concentration Percent of Total
Short Chain Carboxylic Acids	5
Long Chain Carboxylic Acids	20
Total Amines	35
Aldehydes	<1
Ketones	<1
Sulfonates	10
Ethoxylated Alcohols	15
Glycols	15

Compounds	Concentration [percent of total]
Short Chain Carboxylic Acids	20
Long Chain Carboxylic Acids	5
Total Amines	10
Aldehydes	5
Ketones	5
Sulfonates	20
Ethoxylated Alcohols	30
Glycols	5

SigmaPure™ Is A In-Situ Foaming Tendency Device



Trending incremental foamate waste accumulation reveals local increases in solution foaming tendency (ingress episodes).

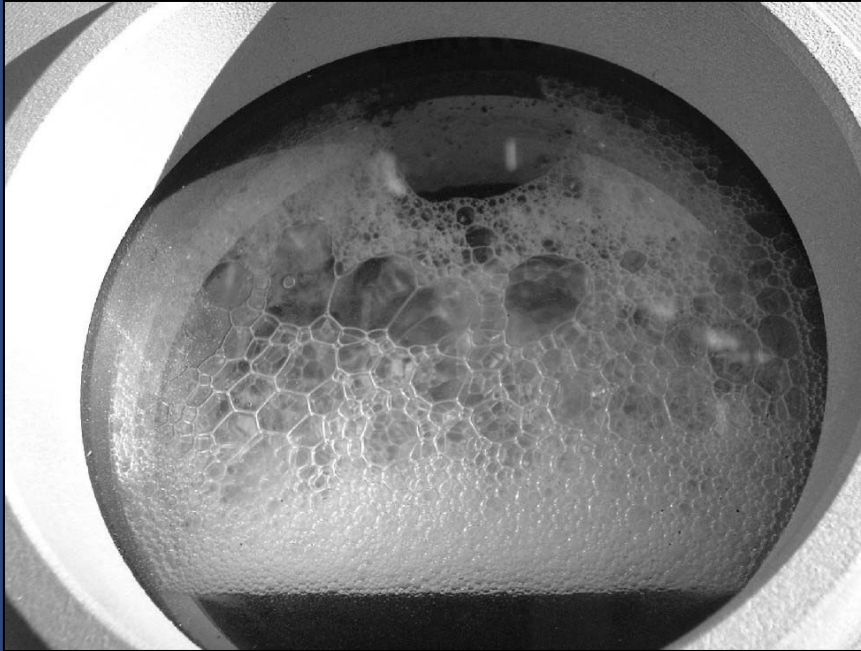
Long Term Operational Benefits of SigmaPure™ D-Foaming

- Address foaming upsets before they occur.
- Constantly monitor the foaming properties of the solution.
 - Trend even minor contaminant ingress.
 - Differentiate chemical from mechanical causes of tower differential pressure.
- Reduce system corrosion
 - Continuously remove surface active heat stable salt precursors (corrosive acid anions).
- Allow continuous availability of foaming contaminant samples.

Some of the companies we've already helped

- Shell Oil Company Groups
 - Shell USA Chemical and Refining
 - Shell Canada Ltd.
- ExxonMobil
- Husky Energy
- Kerr McGee
- Kinder Morgan/Natural Gas Pipeline
- EnCana
- Valero Refining

Please let us help before this happens!



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A little antifoam buys you time to address foaming problems. You may even get away with injecting it over a long period of time without too much consequence. But, sooner or later, covering up the foam causing surfactants with antifoam will cause gas phase foam (left) to convert to liquid phase foam (right). Liquid phase foaming is far more costly to handle.



Whether Diagnosing or Treating Foaming Problems

D-Foam, Inc. and our operating licensee
MPR Services Inc. are the companies you
want working for you to define and solve
your foaming issues.

Thank you for your kind attention.

Please feel free to visit us at our websites:

www.D-Foam.com

Contact: help@D-Foam.com

www.mprserve.com

Contact: infomprservices@tkinet.com or
mpreurope@tkinet.com