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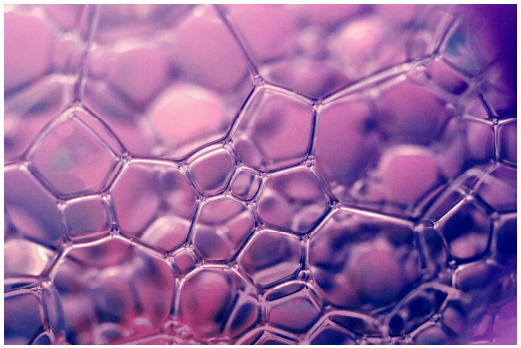

The Complex World of Foam

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NNSA National Nuclear Security Administration

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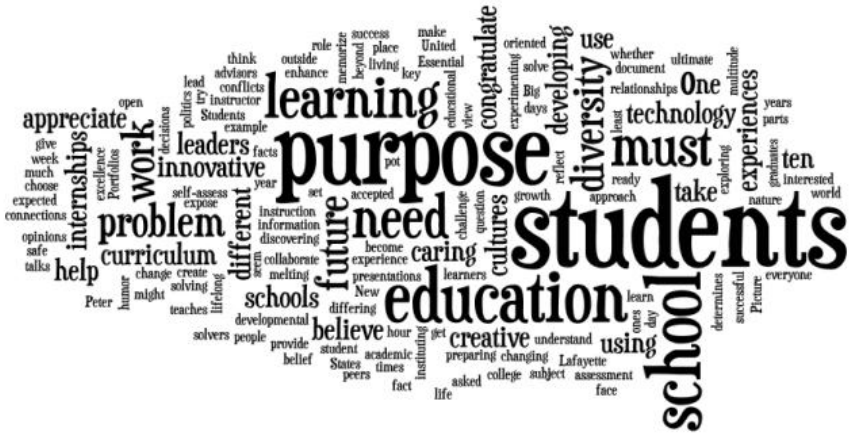
Purpose

- Work under the mentorship of some of the best and brightest scientist and engineers in the world at Sandia National Labs.
- Learn about science and engineering work at Sandia.
- Broaden my understanding of different technical career fields.
- Seek potential career opportunities.



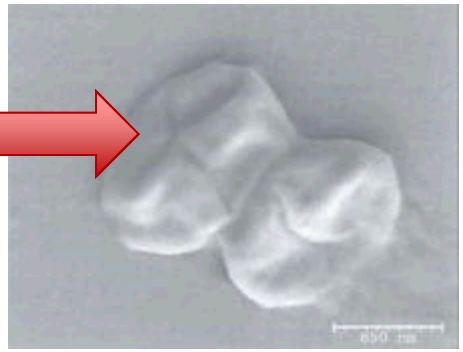
Foam- A mass of small bubbles formed by suspension of gas in a liquid or solid medium.

- Edible Foam
  - Froth from coffee
  - Soda
  - Marshmallows
- Practical Foam
  - Shaving cream
  - Fire extinguisher
  - Memory foam mattress
- Natural foam
  - Pumice
  - Ocean Foam

Foams of Interest to Org. 6632

Anthrax spores.

Anthrax Spores after Foam.



Decontamination Foam

- Also known as Decon Foam, is used for the neutralization of both chemical and biological agents.
- Cleaning up after:
  - Ebola,
  - anthrax,
  - meth labs,
  - chicken coups, etc.

Decontamination Foam backpack with sprayer. To clean up Boston after bombing.

Foams of Interest to Org. 6632

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Blast without foam.

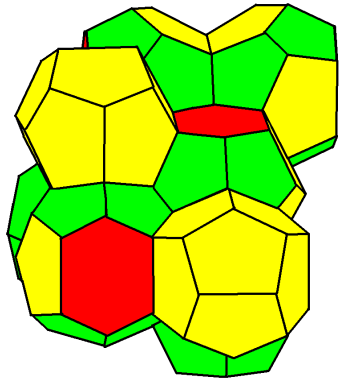
Blast with foam.

Blast Mitigation Foam

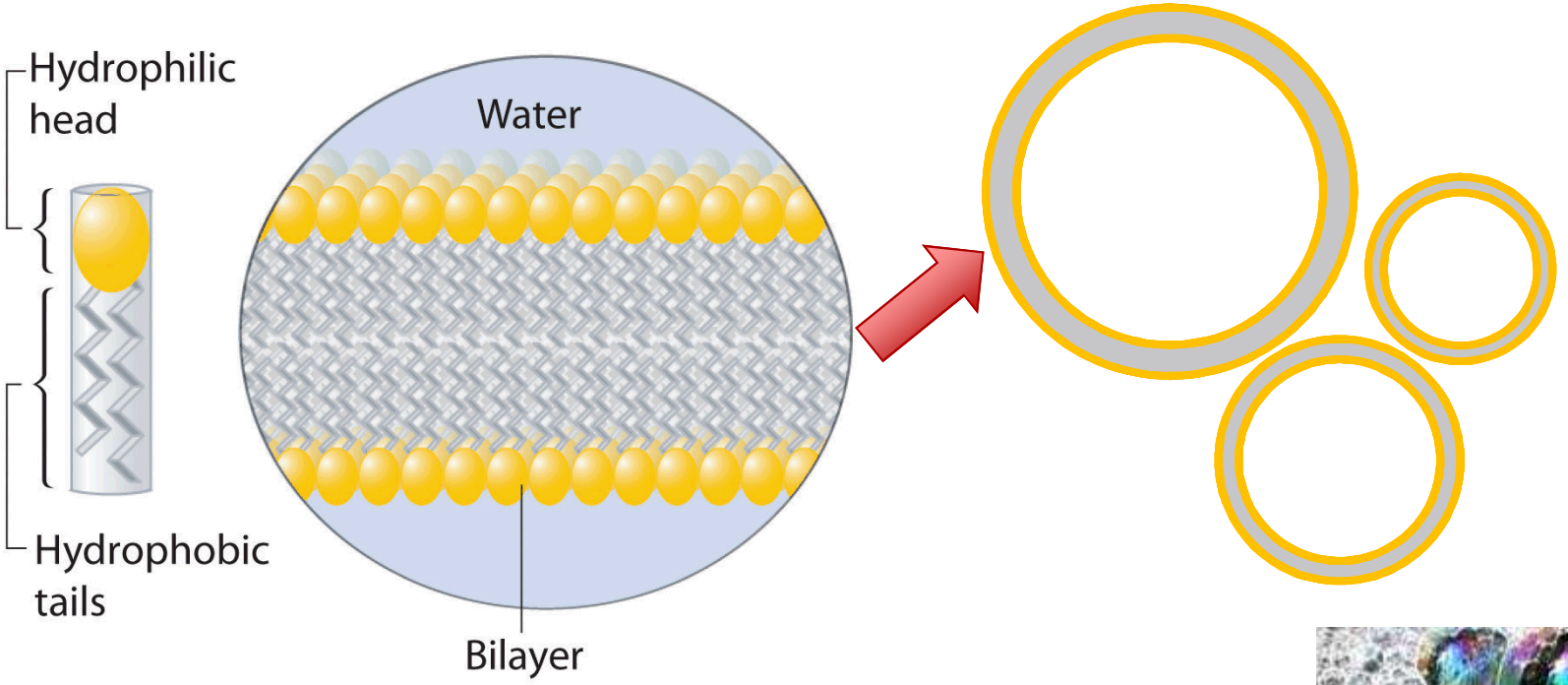
- Used to lessen the impact of a future chem, bio, or dirty bomb attack.
- Examples of foam use: Fill a room with foam where there is a suspected dirty bomb to limit potential damage.

Foam Structure

- The Weaire-Phelan structure is considered to be the most stable structure of foam.
- The foam has two main parts
  - Hydrophobic- Water fearing molecule
  - Hydrophilic- Water loving molecule



Weaire-Phelan Structure

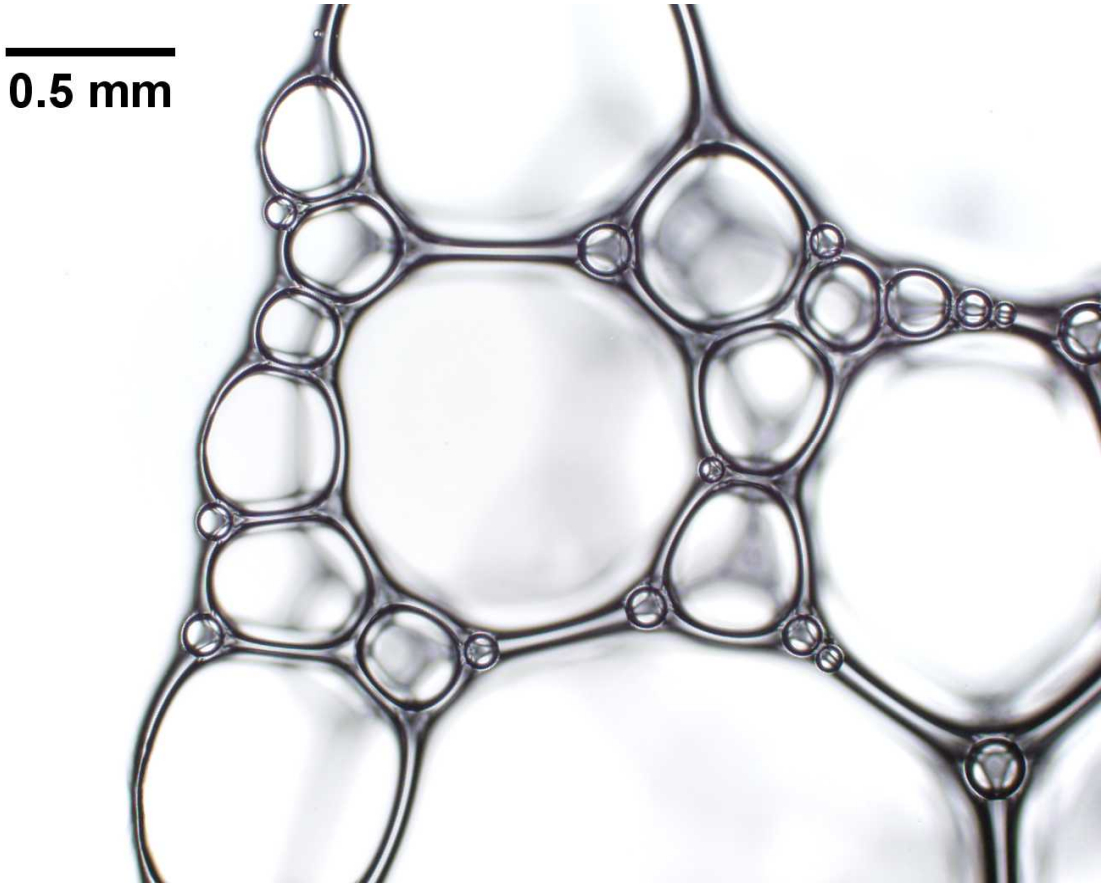


Bubble structure

The hydrophilic and hydrophobic parts of the surfactant form the walls of a bubble.

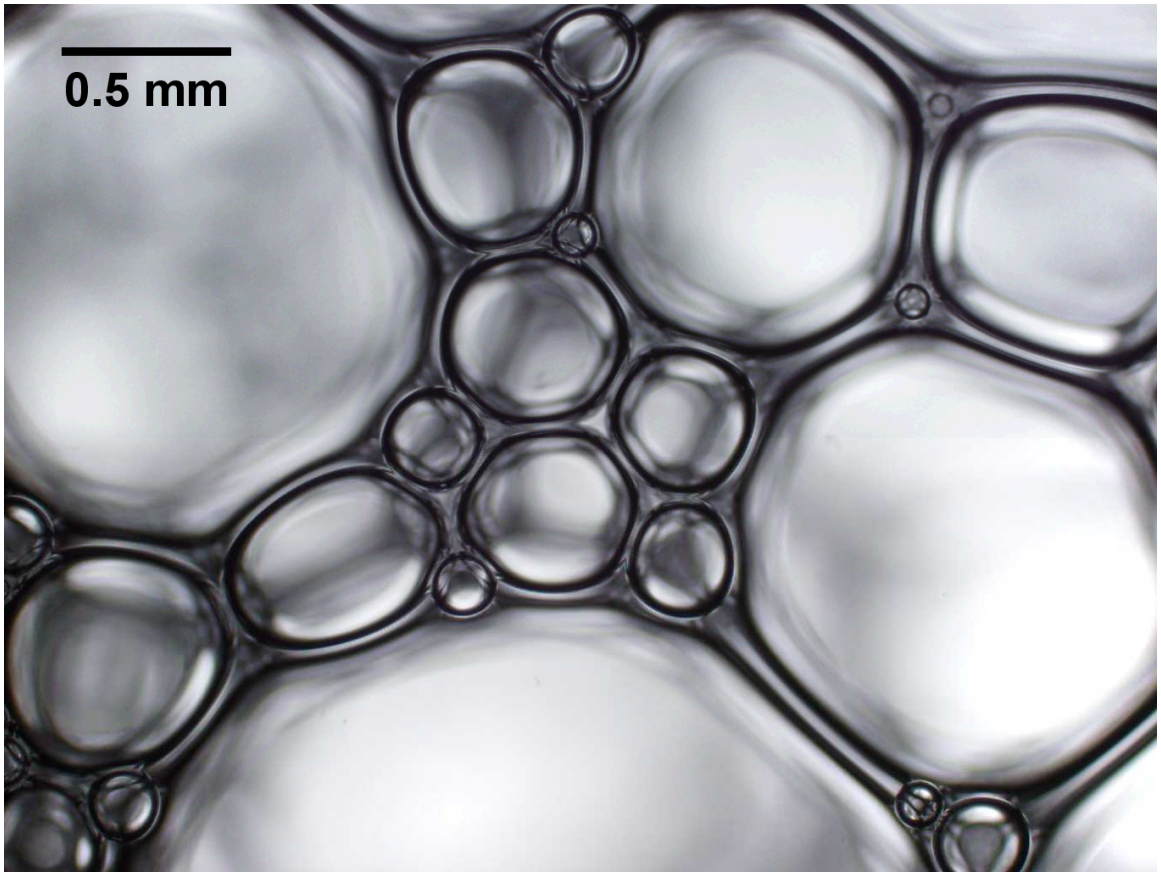
Foam

The foam has very small and seemingly uniform bubbles when viewed with just the naked eye.



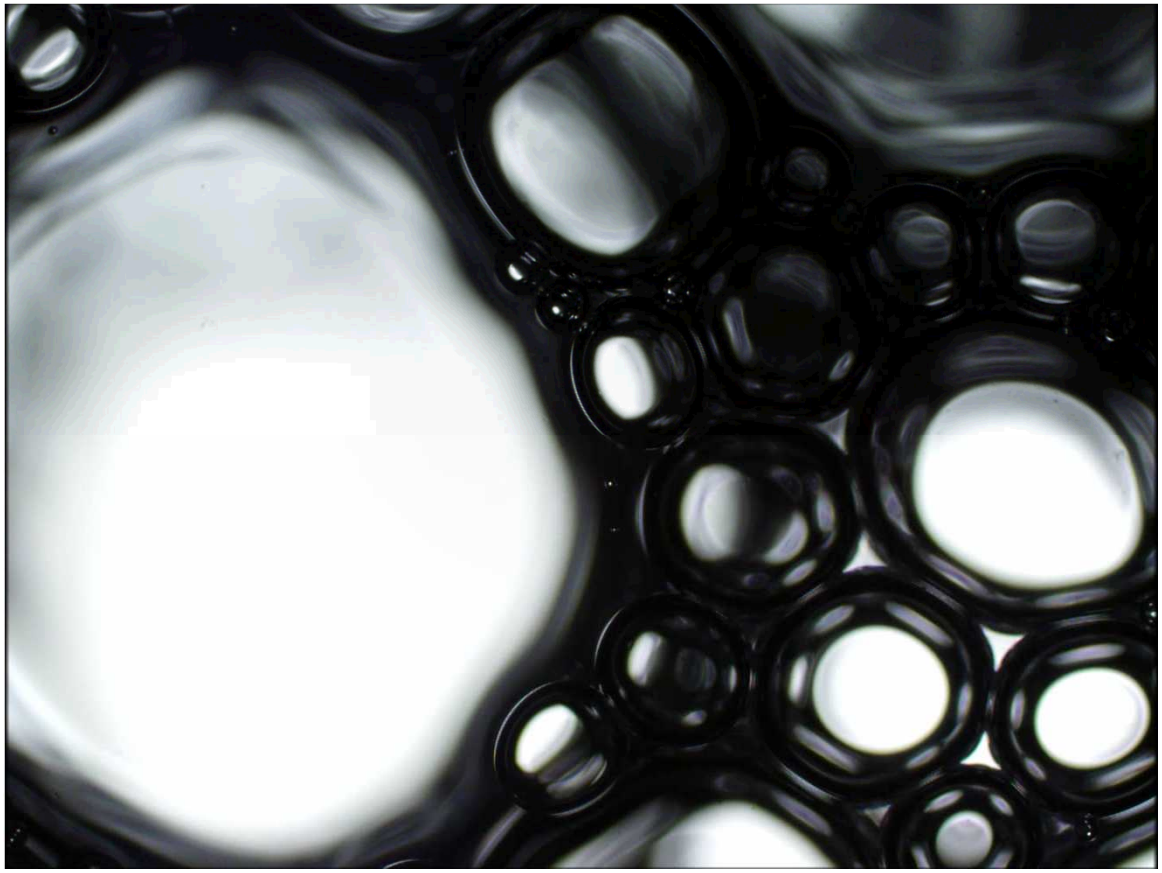
Foam

This foam structure is very stable because there are large bubble and small bubbles. Making it so that there is not much room in-between the bubbles for the water to drain out.



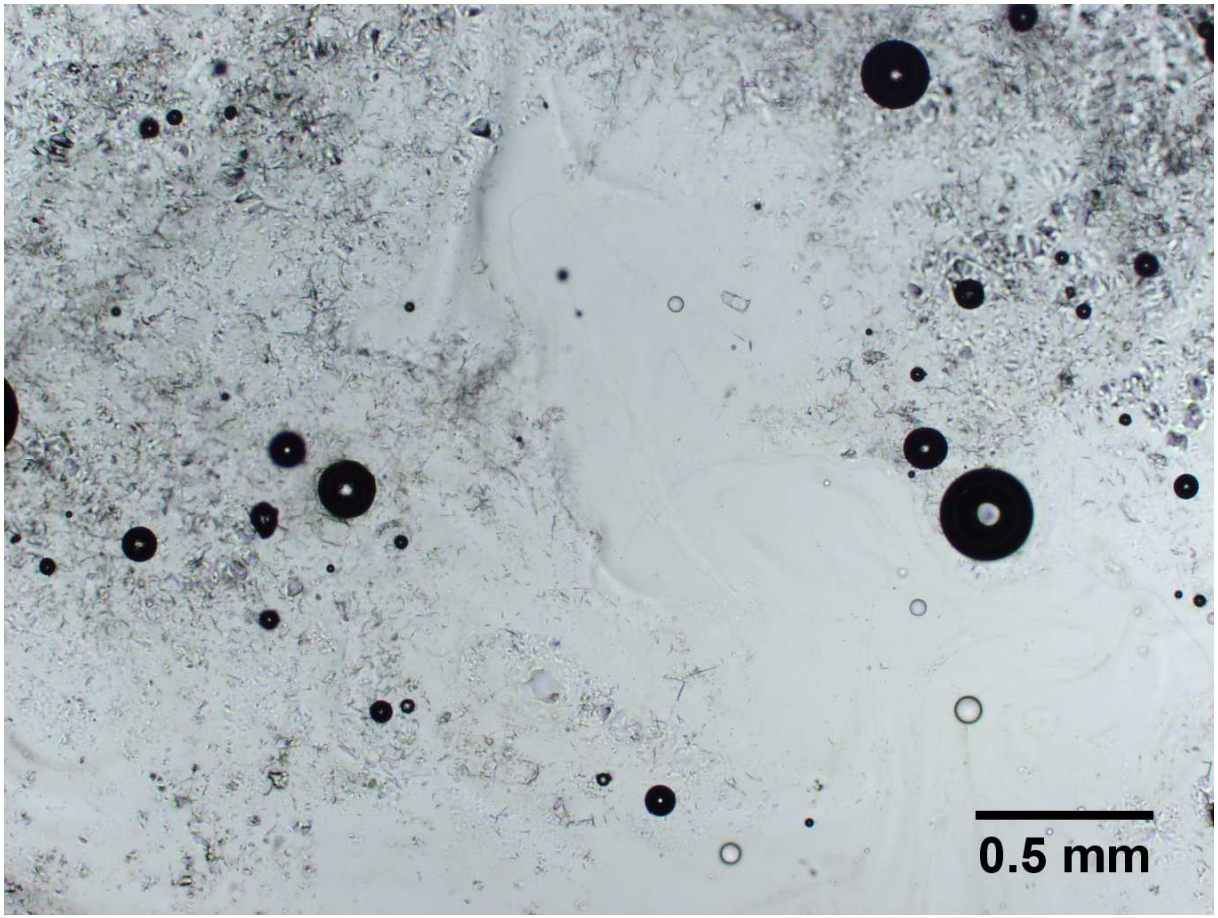
Foam under a Inverted Microscope

The walls of this foam are thick, making the bubble stronger and harder to collapse. This image also shows the different sizes and shapes of the bubbles.



Foam with a drop of Defoamer

This shows that just with a single drop of the defoamer the bubble walls start to weaken then collapse. When one bubble collapses it creates a ripple effect making the ones surrounding it collapse.

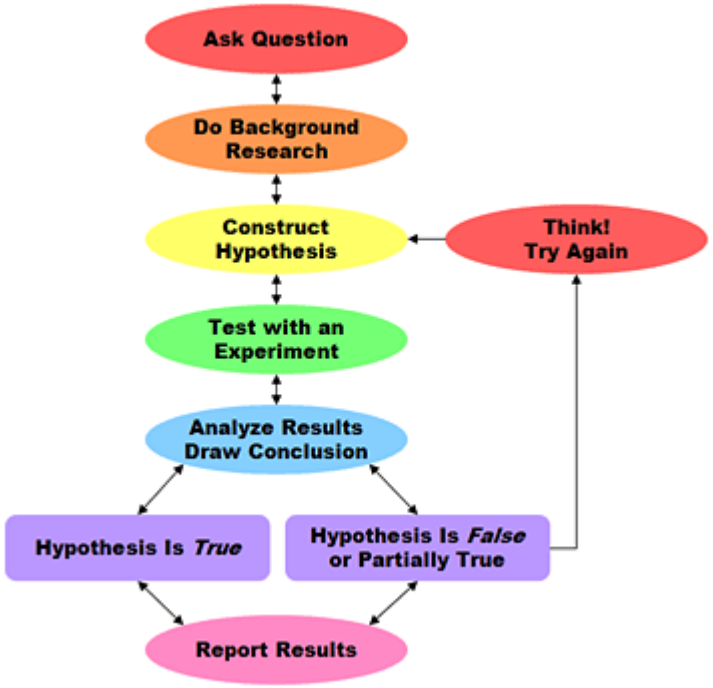


After Foam and Defoamer

What is left after the defoamer is part water, part of the oily defoamer, and a small portion of the foam concentrate.

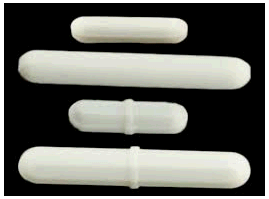
Experiment

- Use the scientific method to produce the best combination of chemicals to clean up the foam faster after the explosion.
- Compare commercial defoamers to in-house defoamers.



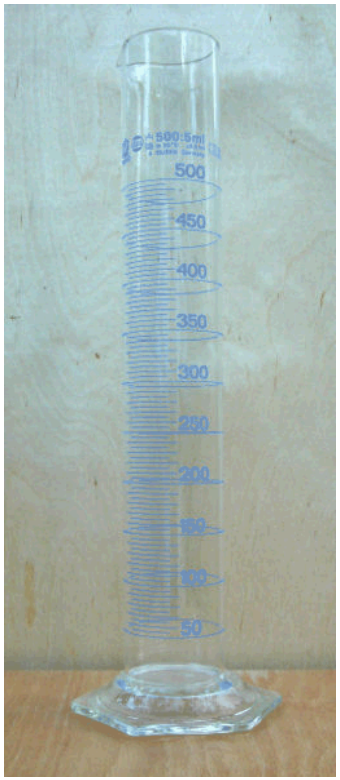
Equipment Used

- Fume Hood
- Inverted Microscope
- Hot plate/stirrer
- Stir bar
- Various beakers
- Microliter pipets
- Scales
- Bubbler to make Foam

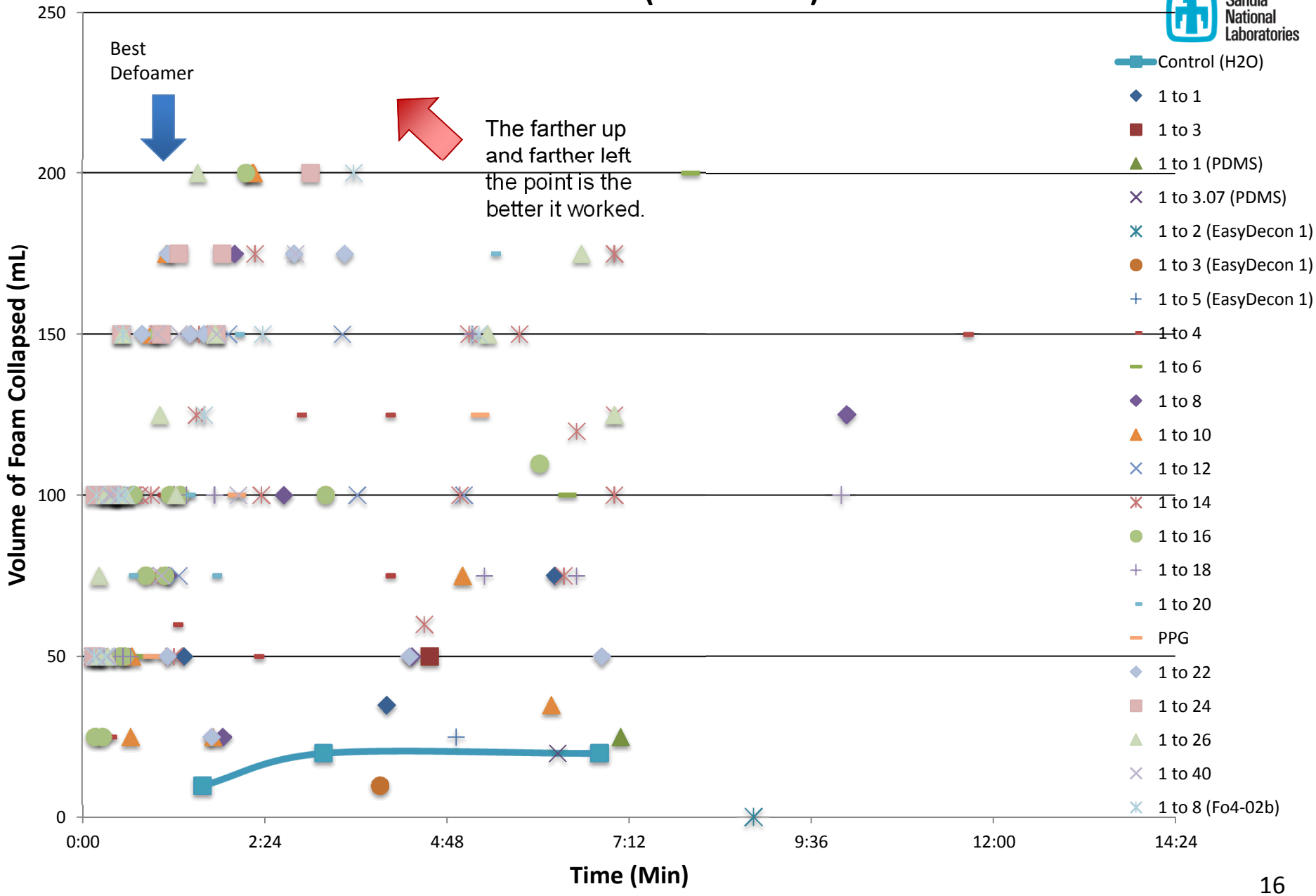


Small Scale Experiment

1. Make Ultra Foam Concentrate UFC.
2. Make a concentrate of 2%UFC and 98% water.
3. Use a bubbler to make 250mL 2% UFC foam in a graduated cylinder.
4. Drop 1000µL of defoamer on foam.
5. Time how long it takes for foam to collapse.
6. Repeat with different dilutions of Defoamer or new Defoamer.



Defoamer (Small Scale)



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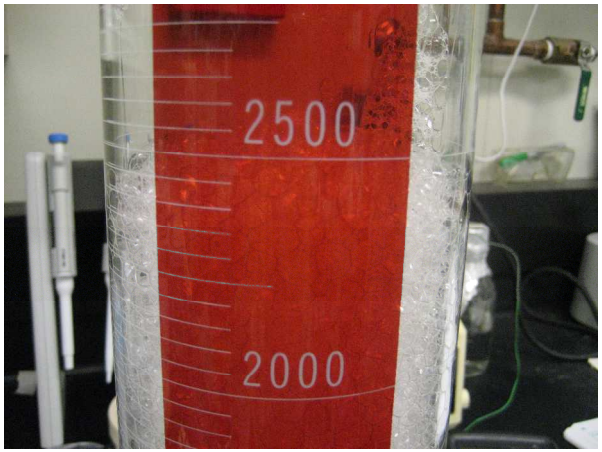
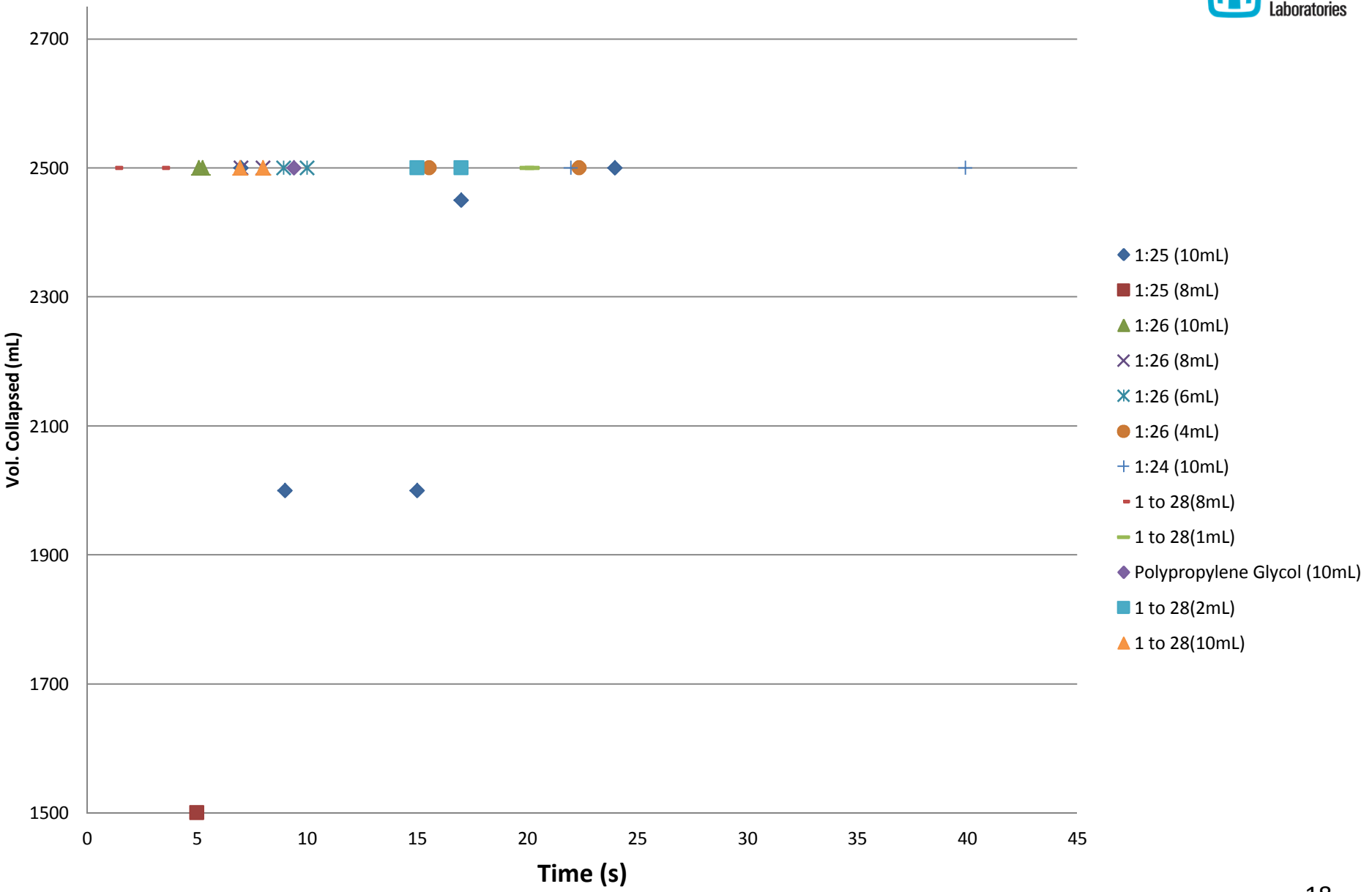
Large Scale Experiment

1. Make a concentrate of 2%UFC and 98% water.
2. Use a bubbler to make 2500mL 2% UFC foam graduated cylinder.
3. Drop 10mL of the best small scale defoamer on foam.
4. Time how long it takes for foam to collapse.
5. Repeat with different amounts of Defoamer or new Defoamer.



Defoamer Results



Conclusion

- Over the course of this internship I have worked with some of Sandia's best and brightest.
- I have learned so much about so many different subjects.
- We have found a defoamer that makes cleaning up the foam much faster.
- The experience that I got while working at Sandia is irreplaceable.