

# **DOE GRANT #DE-FGO-97ER14828**

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**Savannah River Technology Center**

# Problem Statement

- **Foaming in radioactive waste processing can cause carryover of radioactive elements into the vapor treatment equipment. This can lead to lower production and other processing difficulties.**
- **Commercial antifoam agents are not effective in the aggressive physical chemical environment present in radioactive waste processing.**

# When is Foam a Problem?

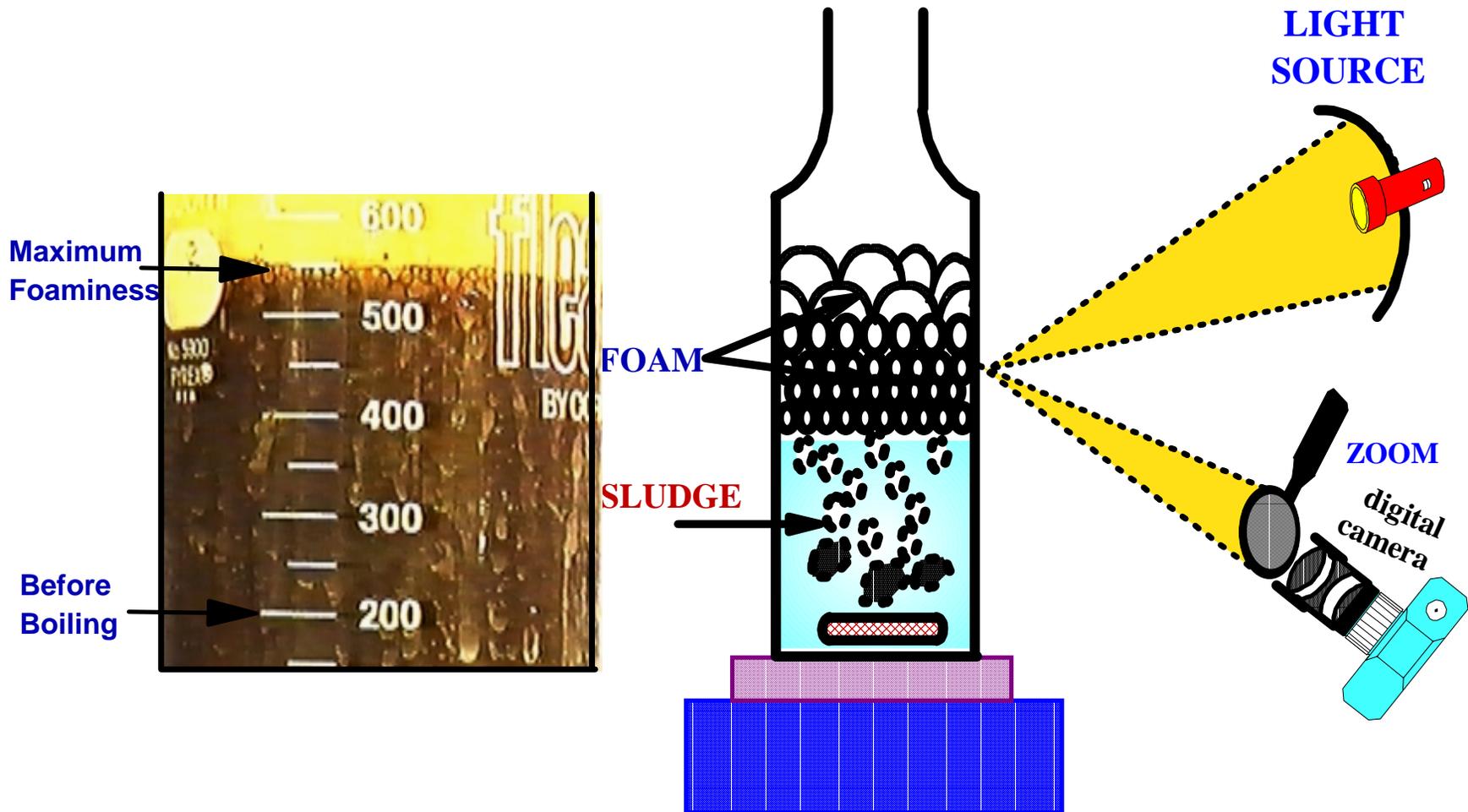
- **Foam is most severe while boiling the radioactive sludge waste.**
  - **Boiling causes generation of water vapor**
  - **Higher reaction rates generate more gas**
  - **Solids present stabilize foam**
- **During processing, waste pH ranges from 3 to 13.**
  - **Commercial antifoams ineffective**
  - **Antifoams degrade**

# OBJECTIVES

- **UNDERSTAND THE PHYSICO-CHEMICAL FUNDAMENTALS OF FOAM FORMATION DURING SLUDGE BOILING**
- **DEVELOP LONG TERM EFFICIENT ANTIFOAMER**
- **WORK CLOSELY WITH SAVANNAH RIVER TECHNOLOGY CENTER RESEARCHERS TO FOCUS ON REALISTIC PROBLEMS**

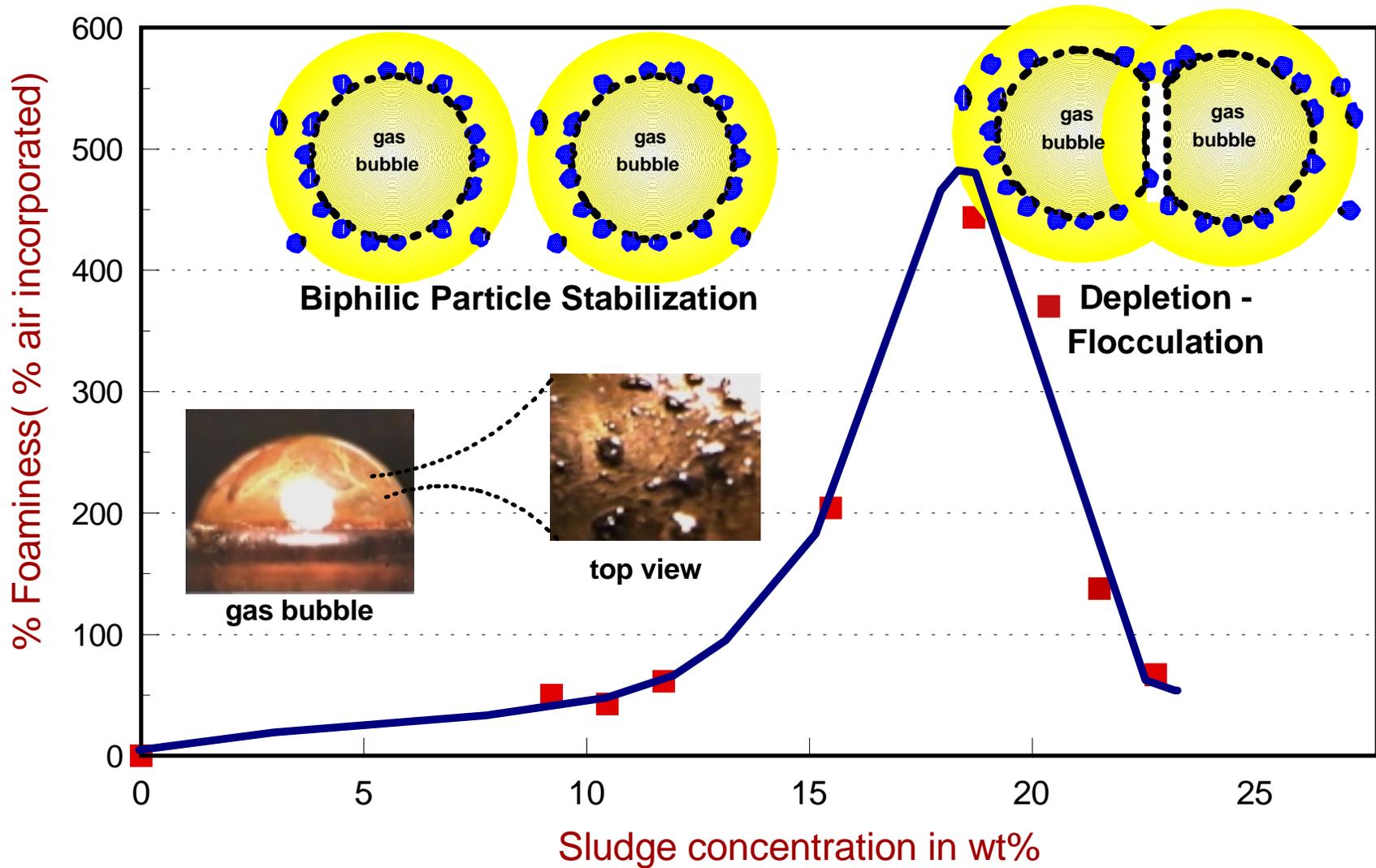
# Lab test

## Experimental set-up to study foaming in the presence of sludge waste



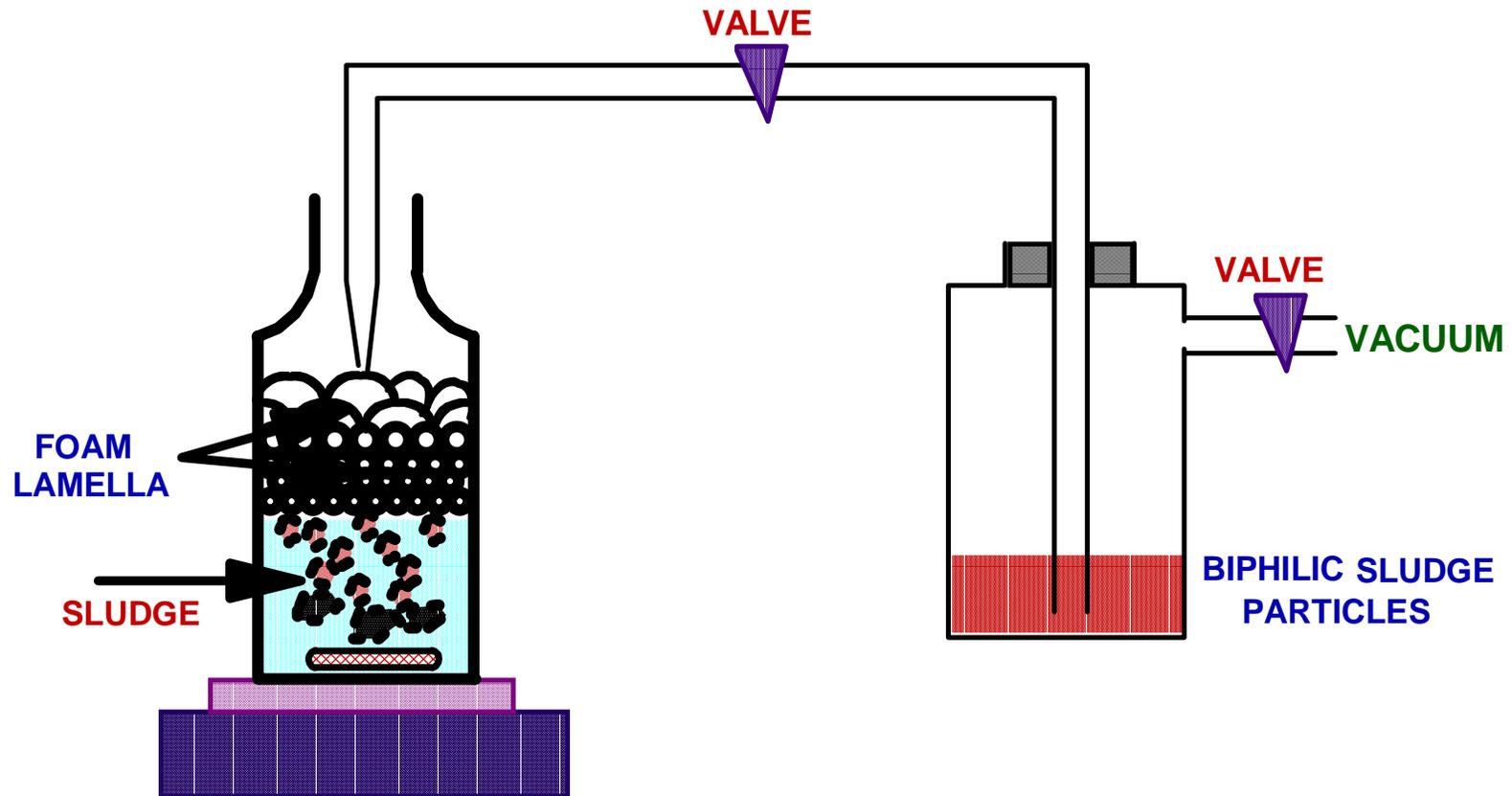
# Foam Lamella Stabilized by Biphilic Particles

(Foaminess vs. Sludge Concentration)

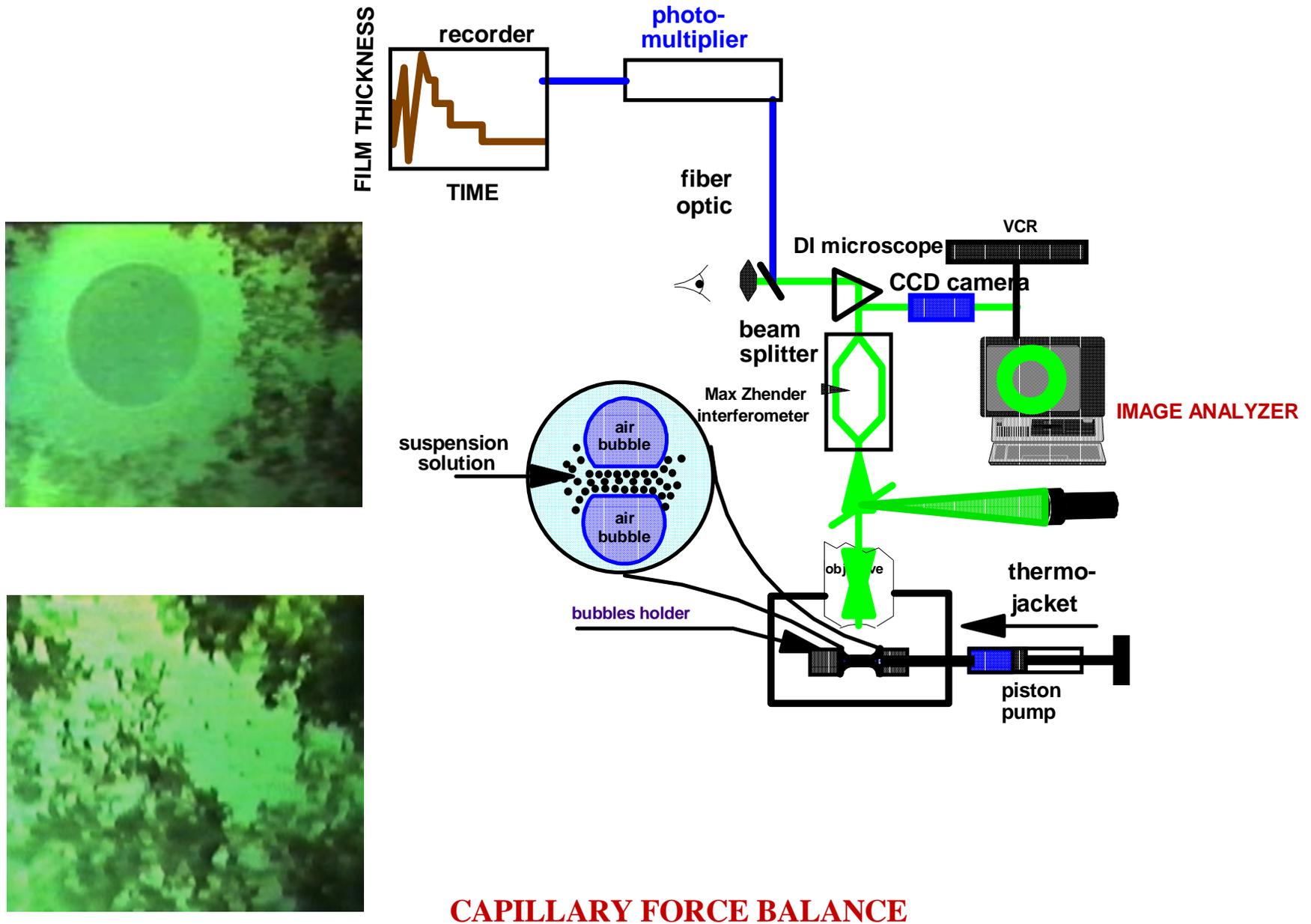


**Foaminess has been observed only during the boiling**

# EXPERIMENTAL SET-UP TO SEPARATE THE BIPHILIC PARTICLES FROM THE SLUDGE

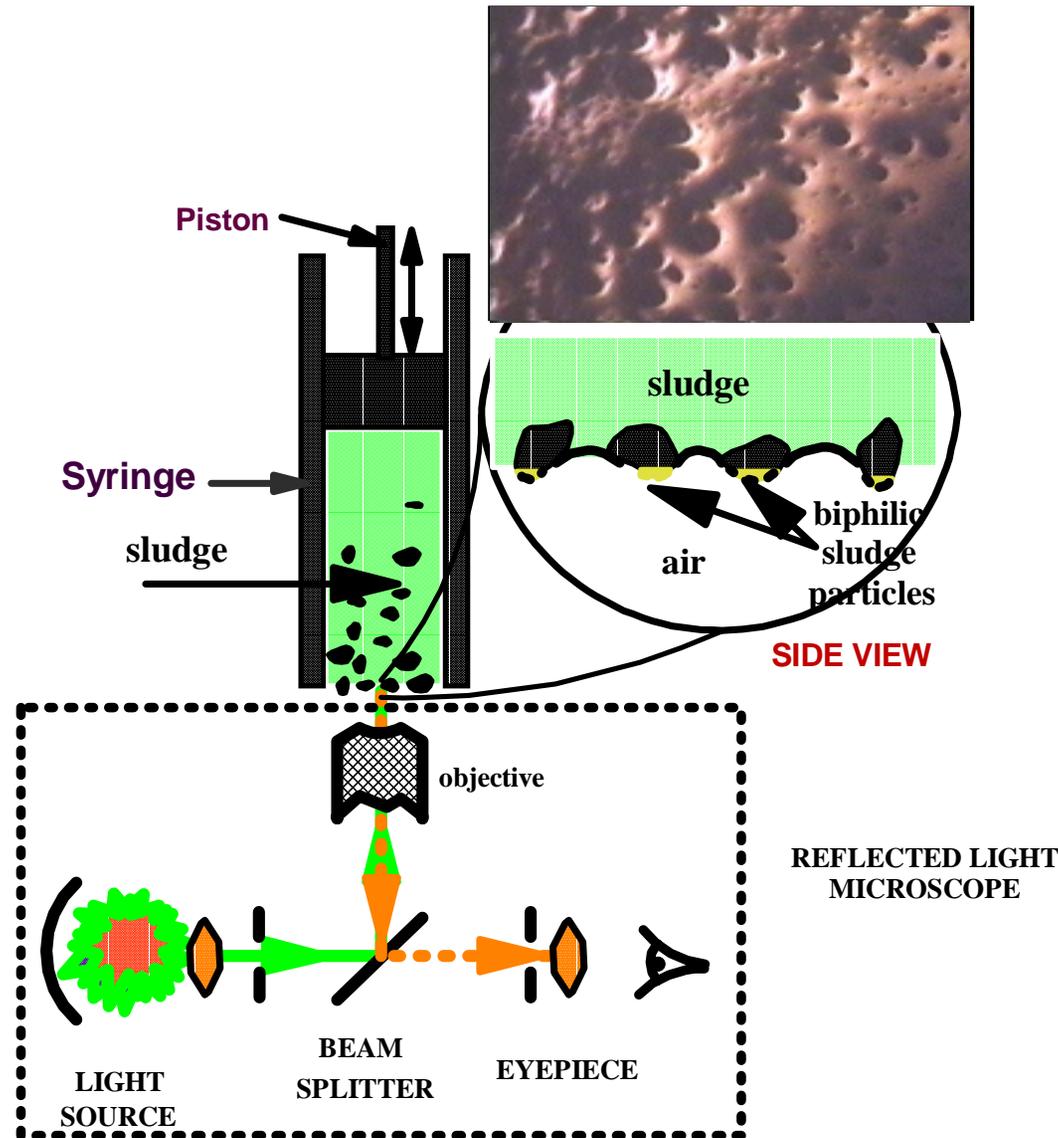


# A schematic of the technique for studying the bubble/bubble interactions in the presence of sludge particles

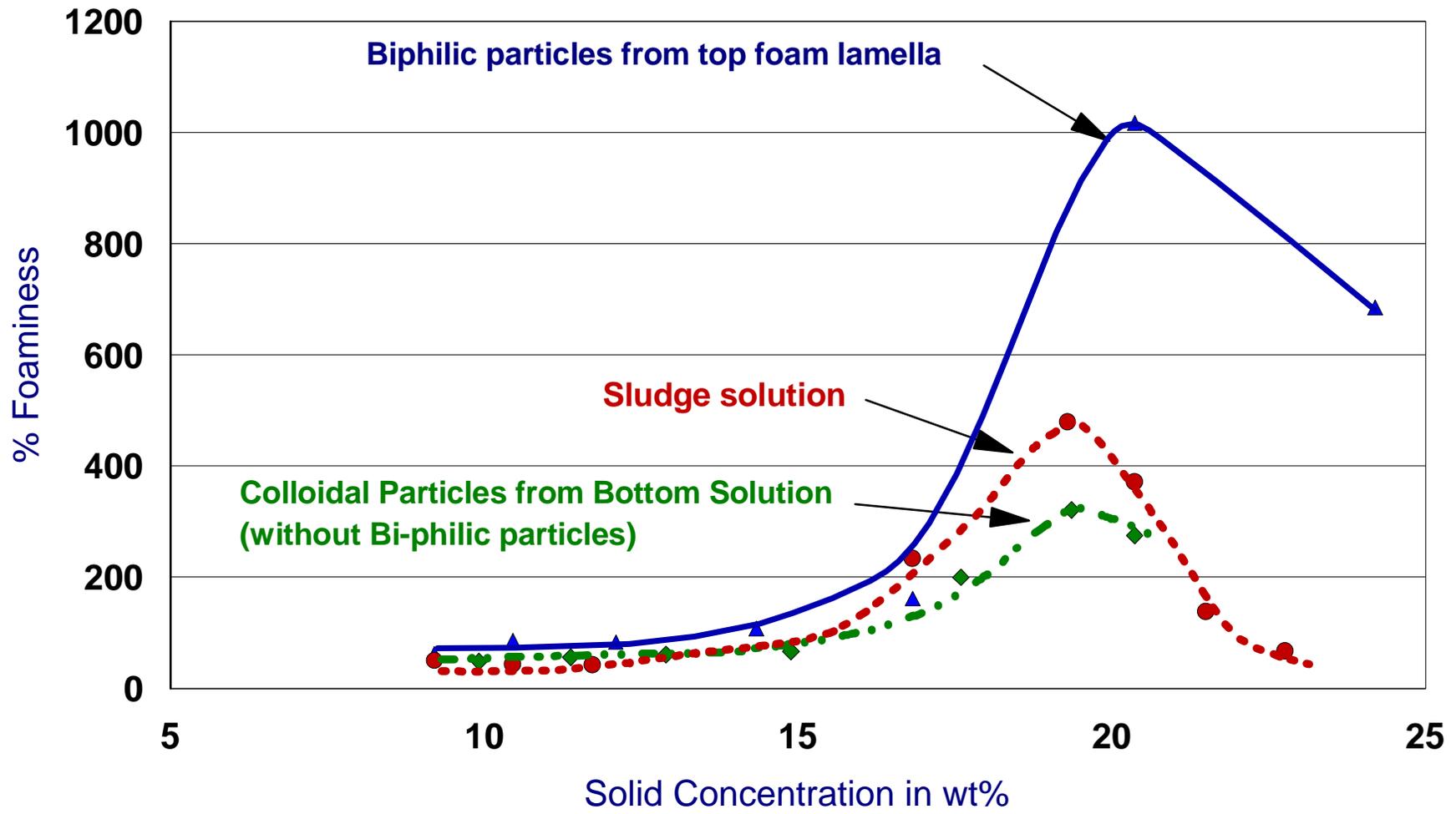


# EXPERIMENTAL SET-UP TO STUDY PARTICLE BIPHILICITY

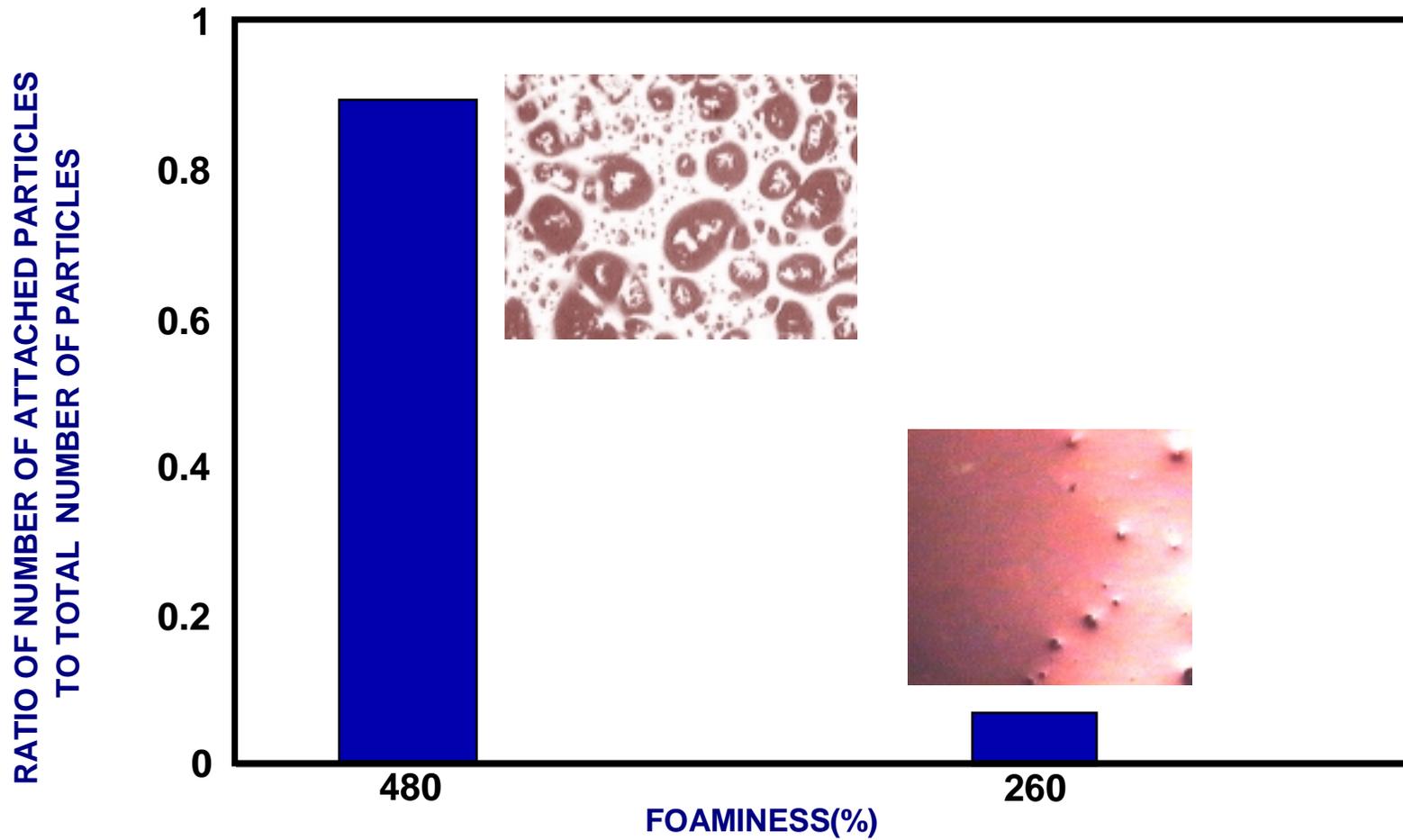
**BOTTOM VIEW : Photomicrograph depicting slurry particles attached at air/ water surface**



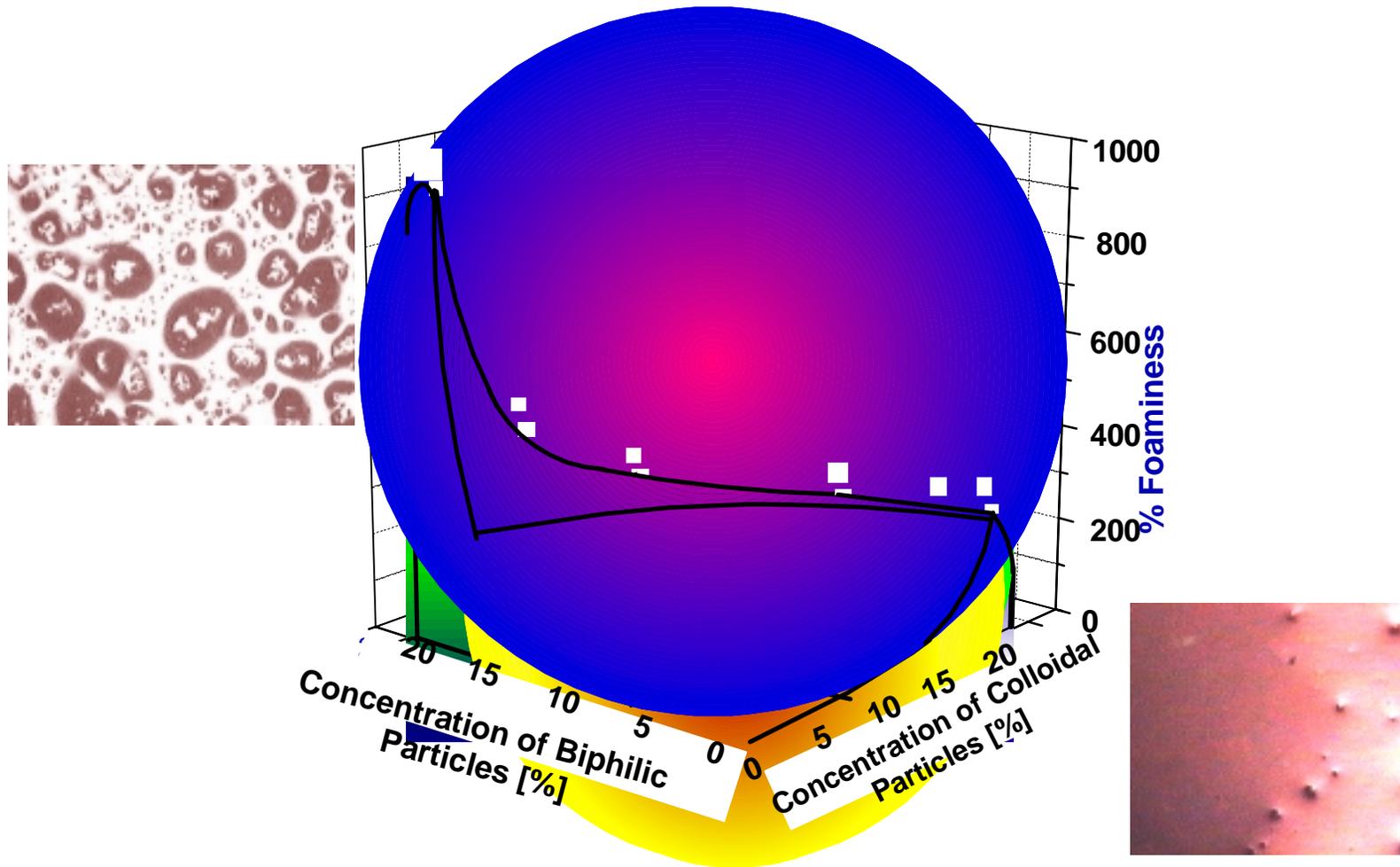
# Foaminess as a function of particle concentration and their biphilicity



# Effect of biphilic particles on foaming



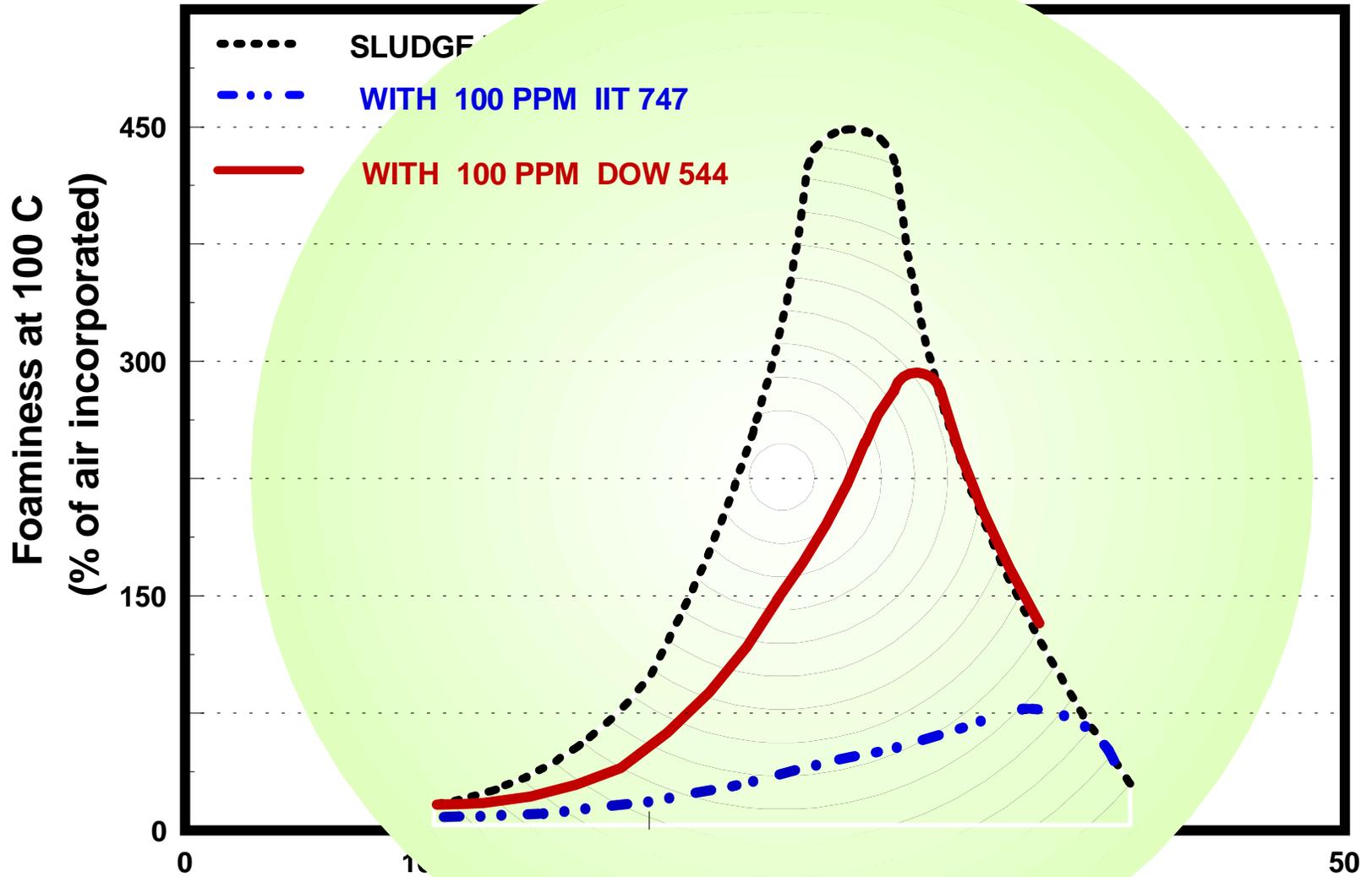
# Effect of Hydrophilic to Hydrophobic Particle Ratio on Foaminess During Boiling



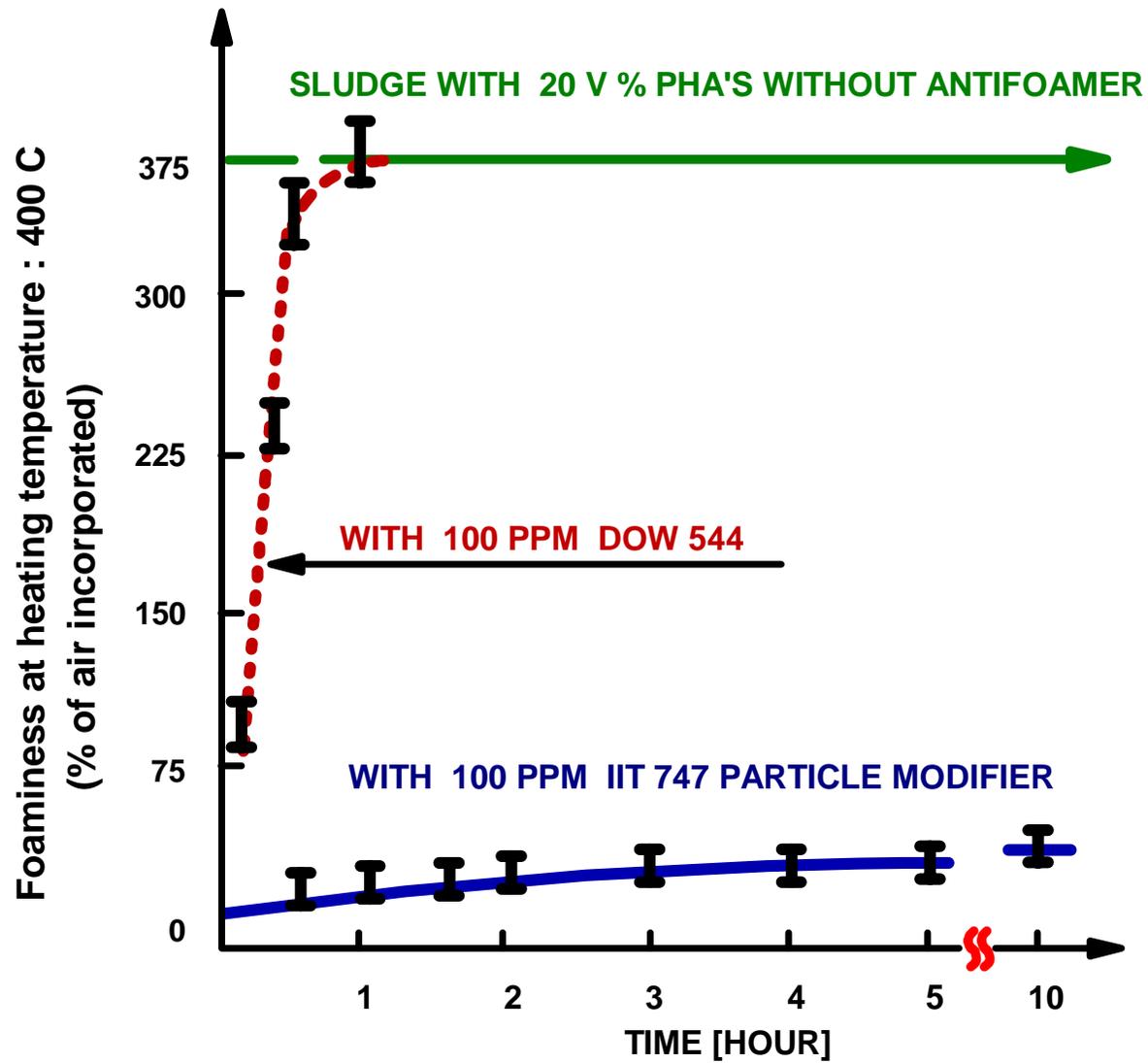
HEATING TEMPERATURE : 445-450 C

# FOAMINESS vs. CONCENTRATION

## EFFECT OF ANTIFOAMERS: IIT 747 AND DOW 544



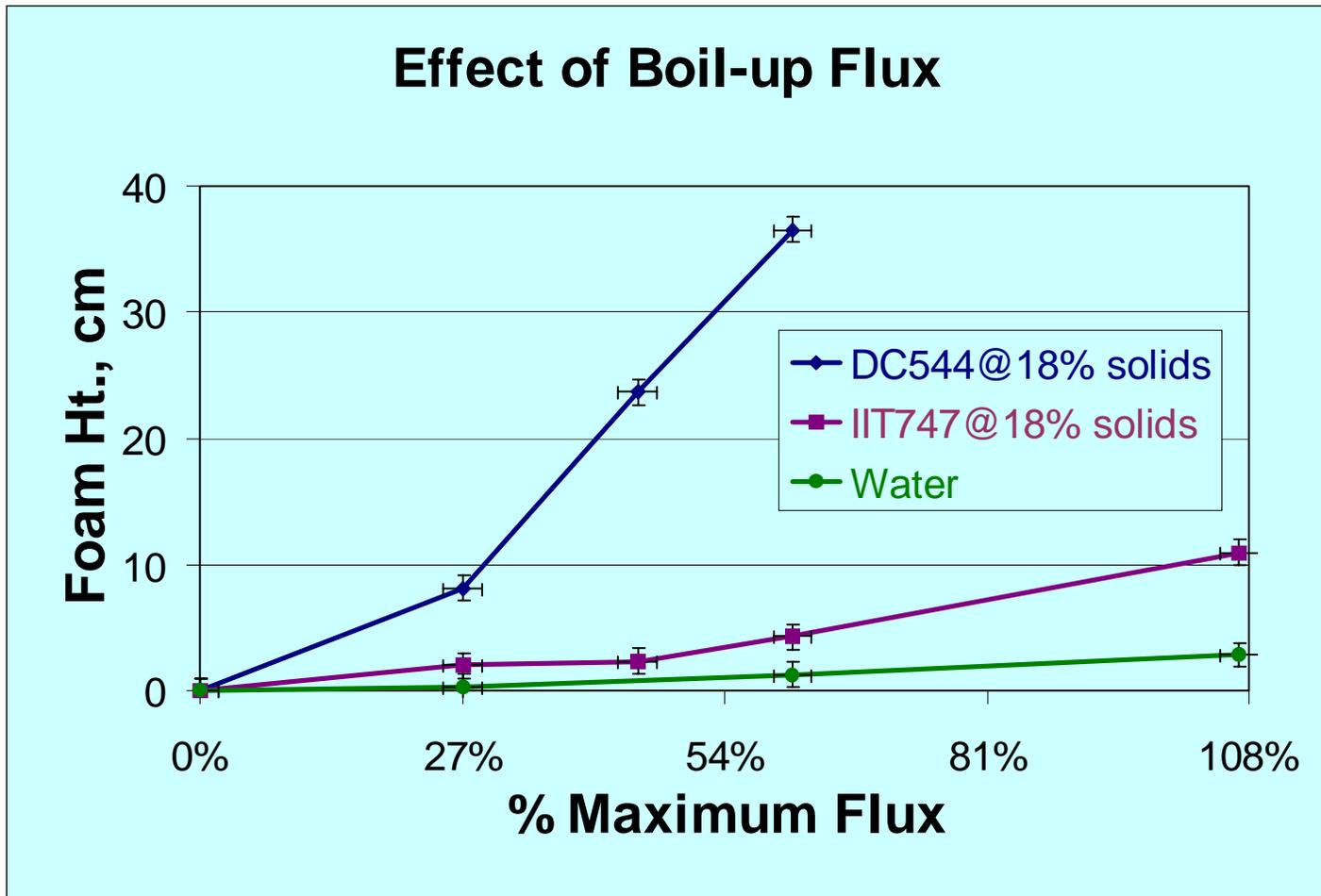
# EFFECT OF BOILING TIME ON THE ANTIFOAMER EFFICIENCY



# PILOT TEST EXPERIMENT



# PILOT TEST RESULTS



# SUMMARY

- **Foaminess of sludge waste as a function of particle concentration during boiling has been studied.**
- **It was observed that the foaminess has a maximum.**
- **Maximum in foaminess(e.g. its amplitude and the related particle concentration) depends on particle surface properties such as biphilicity (Hydrophilic/Hydrophobic ratio).**
- **Based on experimental observations, a physical model of the effect of particle biphilicity on foaminess has been proposed by us.**
- **The antifoaming efficiency of two antifoamers: DOW 544 and IIT 747 has been tested both in lab and pilot plant at SRS.**

# SUMMARY( contd...)

- **New Antifoam (IIT747)**

- Effective in laboratory scale experiments
- Effective in pilot experiments at DWPF flux
- Will be implemented at DWPF soon

- **Need additional antifoam solutions**

- SRS Salt Alternative Tetraphenyl borate process
- Radioactive waste evaporation (SRS, BNFL)