LA-UR-22-29308

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Title:	Dependence of Sound Speed and Density on Particle Size in Diamond Powder
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Intended for:	Report
Issued:	2022-09-08

Dependence of Sound Speed and Density on Particle Size in Diamond Powder

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Outline

- Myself
- Objective
- Diamond Powder
- Predictions
- Sample/Measurements
- Results
- Takeaways
- Going Forward

Introduction

- Upcoming 3rd Year Undergraduate Student attending UC Davis
- Career goal of becoming a vet or pursuing a PhD and conduct biological research
- Major: (B.S.) Biological Sciences

Objective

- Understand dependence of acoustic properties of suspensions on particle size or concentration
- Create a calibration curve with density and sound speed for different diamond particle sizes

Applications of Diamond Powder

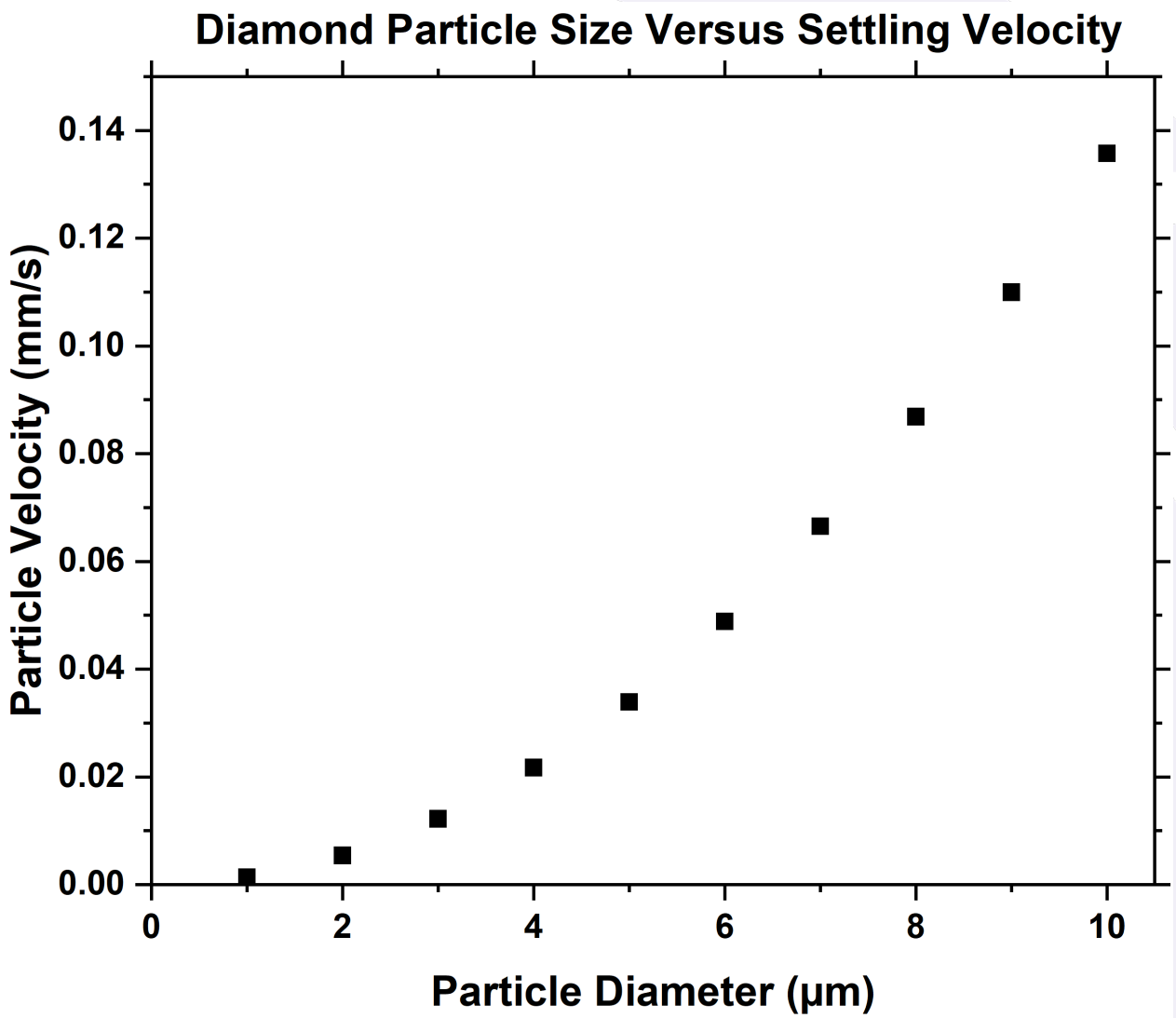
- Commonly, utilized as a polisher for metal surfaces
- However, can be applied in…
  - Acoustics
  - Material Science

The Challenge

- The diamond powder needs to be well-mixed
- Diamonds typically need a surfactant to stay suspended in a liquid medium
- The higher the particle size, the faster they drop out of suspension

Suspension of Diamond Powder

- Diamond powder, even in the microns, settles in HPLC water
- Higher particle size made it difficult to experiment with

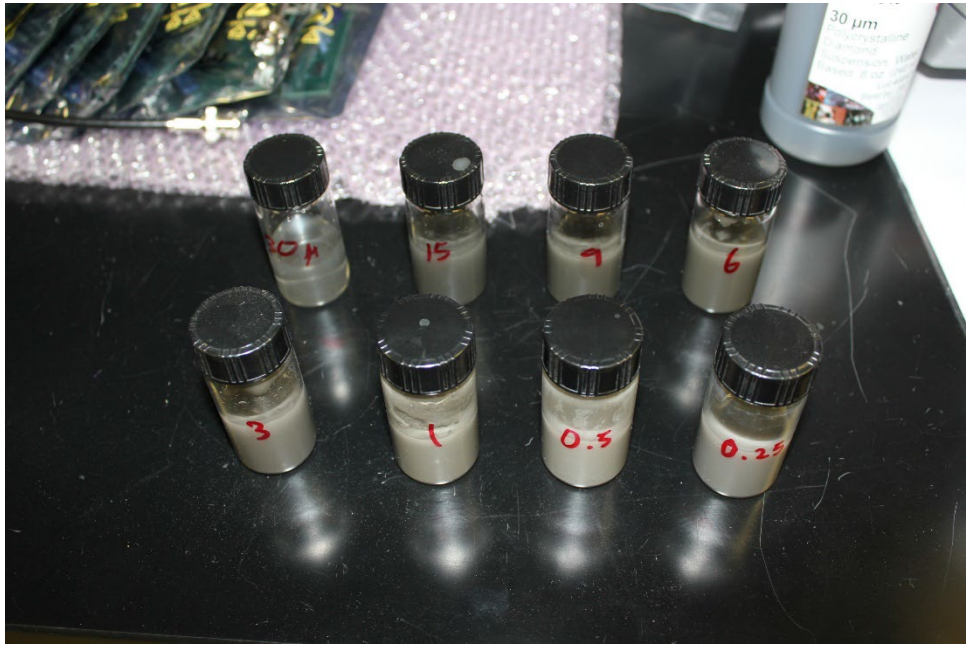


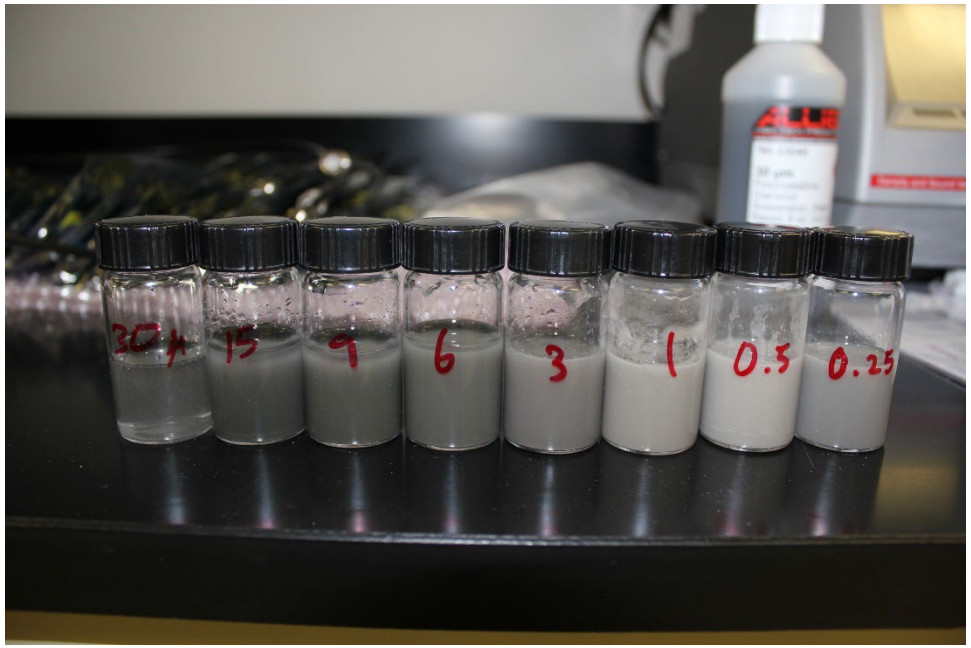
Experimental Predictions

- Prediction: Density will decrease with increasing temperature while sound speed will increase with increasing temperature
- Mixture is mostly water by volume/mass
- Under uniform conditions, we will see a pattern between particle size with sound speed and density

Creating Samples

- 8 different sample containers with different size diamond particles
  - Ranged from 30 microns to 0.25 microns
  - Sourced from Allied High Tech Products, Inc.
- Utilize ultrasonic homogenizer to degas and mix the samples
  - Ensures accurate measurements
  - Density/Sound Speed instrument measurement principle assumes no gas


30 µm
30
15
9
6
3
1
0.5
0.25


30
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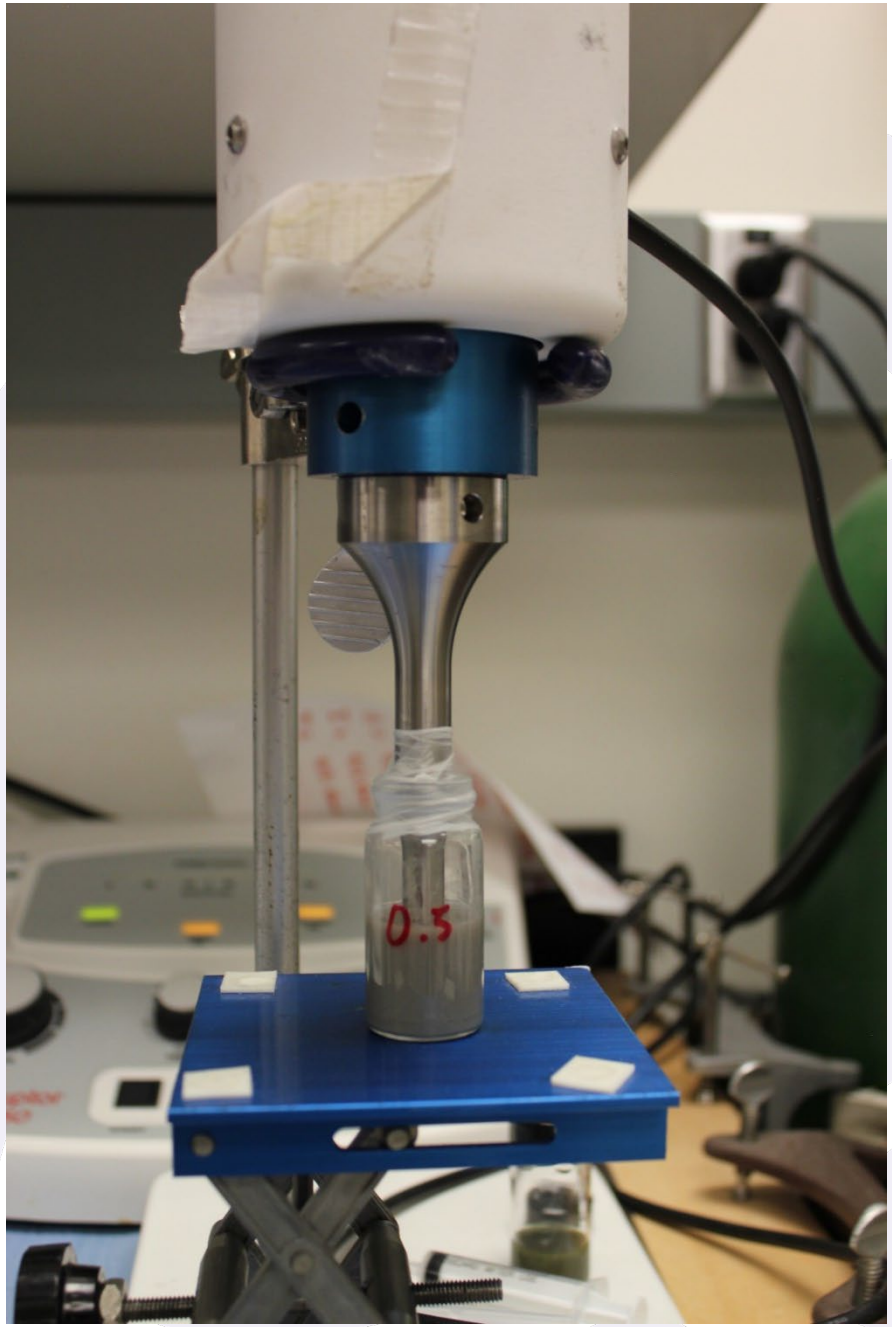

0.5

Taking Measurements

- Add suspensions via disposable syringe into Anton Paar
- Optimal settings for Anton Paar
  - Temp. scan (20 C – 60 C)
- Anton Paar will provide precise and accurate density and sound speed data

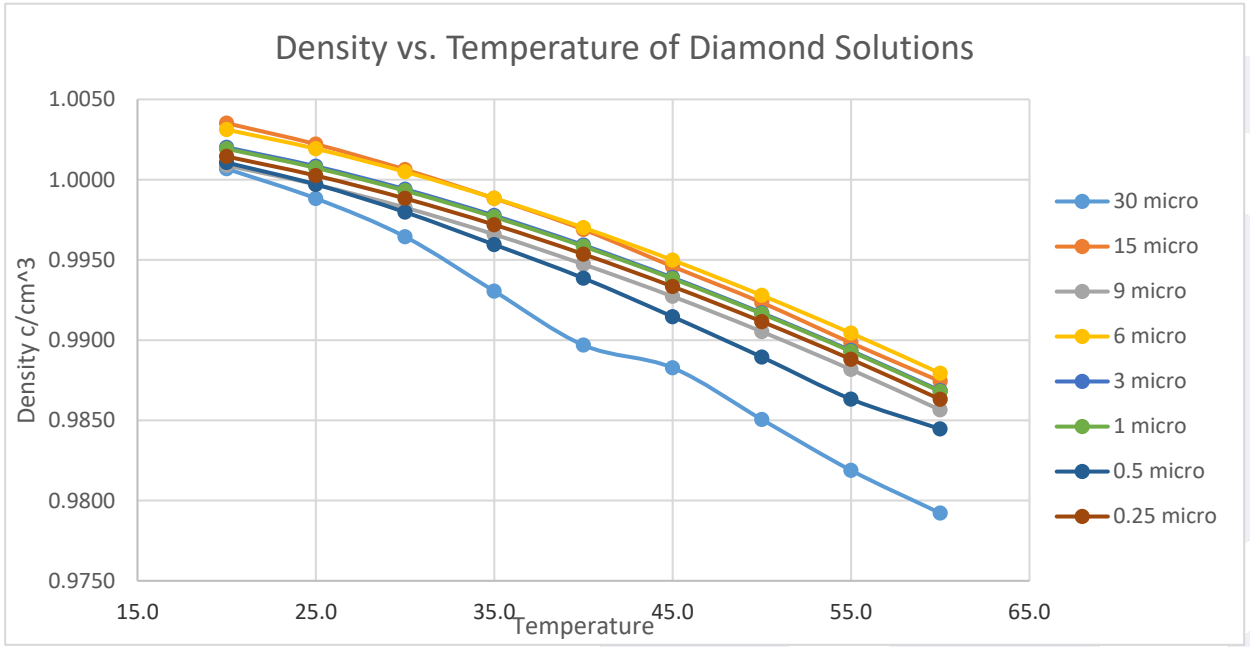

SVM 1001
Anton Paar
Density and Sound Velocity Meter
DSA 5000 M
KIMTECH

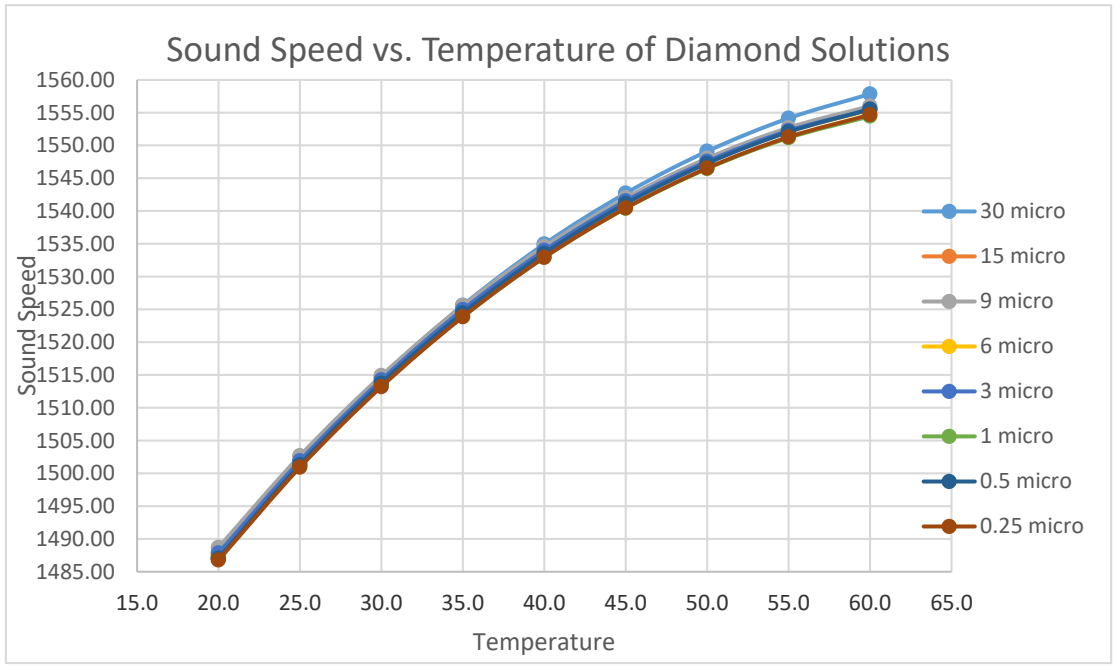

KIMTECH
280

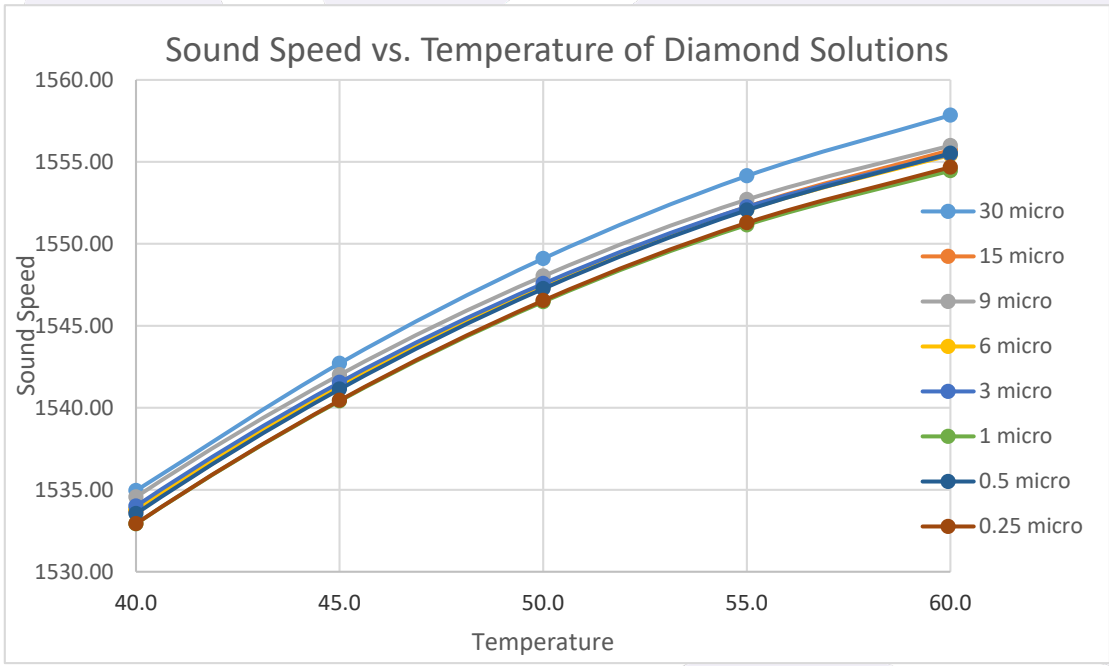
How the Anton-Paar Works

- Model: DSA 5000M
- U-tube with exact volume filled with liquid to be studied
- Uses vibrating U-tube method for density and through-transmission method for sound speed

Results

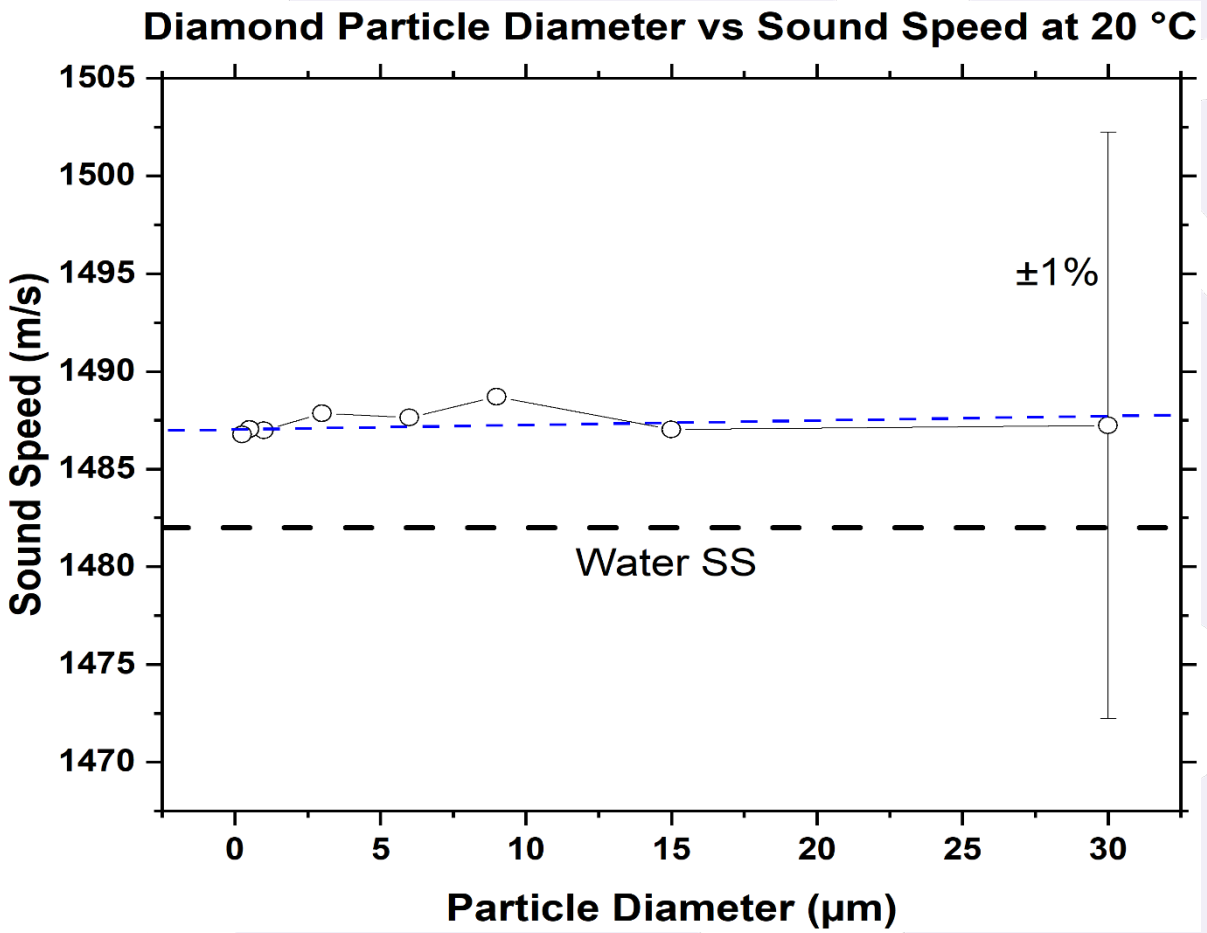

Density vs. Temperature of Diamond Solutions
Density c/cm^3
1.0050
1.0000
0.9950
0.9900
0.9850
0.9800
0.9750
15.0
25.0
35.0
45.0
55.0
65.0
Temperature
30 micro
15 micro
9 micro
6 micro
3 micro
1 micro
0.5 micro
0.25 micro


Sound Speed vs. Temperature of Diamond Solutions
Sound Speed
1560.00
1555.00
1550.00
1545.00
1540.00
1535.00
1530.00
1525.00
1520.00
1515.00
1510.00
1505.00
1500.00
1495.00
1490.00
1485.00
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
Temperature
30 micro
15 micro
9 micro
6 micro
3 micro
1 micro
0.5 micro
0.25 micro


Sound Speed vs. Temperature of Diamond Solutions
Sound Speed
1560.00
1555.00
1550.00
1545.00
1540.00
1535.00
1530.00
40.0
45.0
50.0
55.0
60.0
Temperature
30 micro
15 micro
9 micro
6 micro
3 micro
1 micro
0.5 micro
0.25 micro

Dependency of Particle Size on Sound Speed

- Faster than HPLC water sound speed
- Should see a relationship **IF** there is a correlation between particle size and sound speed
  - Suggests alternative or no factors
    - Concentration



If…Then…

- Uniform conditions
- Controlled environment
- Known concentration

Next Steps

- Experiments
  - Obtain raw diamond powders and mix exact concentrations in HPLC water
  - Much higher concentrations (>10x)
  - Repeat experiments for particle size versus density and sound speed

Thank You