

Demystifying Antimist Agents

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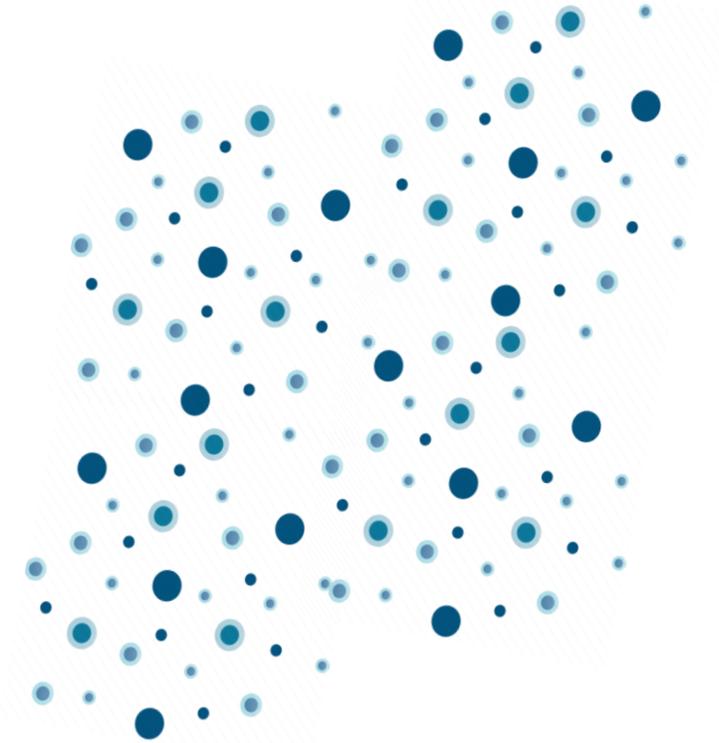
September 20th 2022

STLE Pittsburgh Chapter

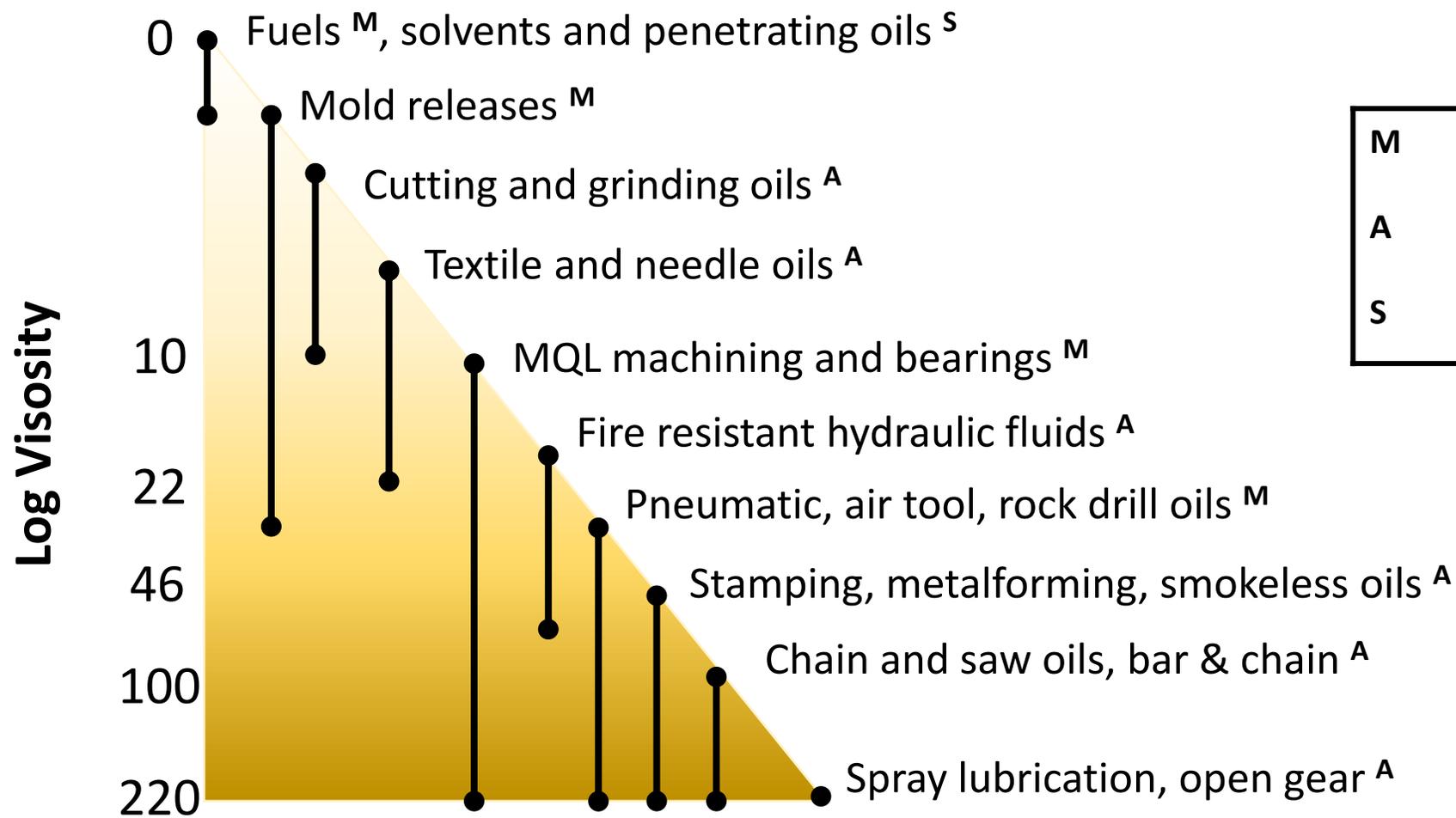


Agenda

1. Intro & Technical Need
2. New Approach to Quantify Misting
3. Survey of Base Oil Mist & Use of Antimist
4. Summary & Future Work

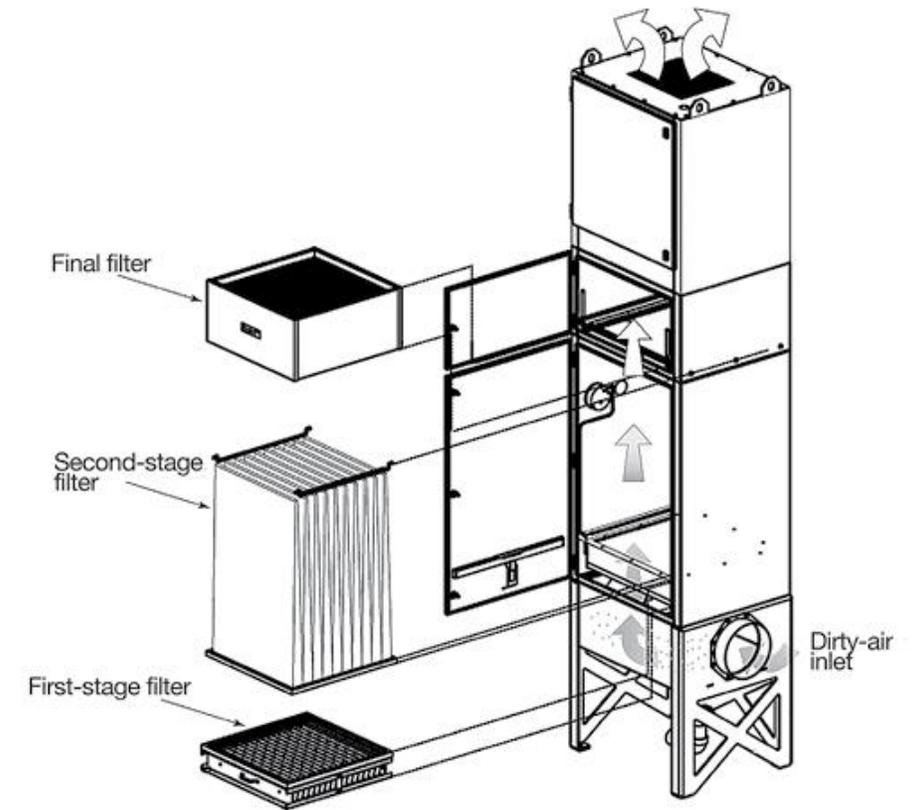


Key Areas for Misting or Antimist Lubes



Oil Mist Issues

- Safety
 - Occupational exposure to oil mist in air (1-10 micron)
 - Migration to environment (oil sheen)
 - Flammability of vapor and oil films
 - Slip and fall
- Economics
 - Cost to replace lost lubricant
 - Cost of mist extraction systems
- Performance
 - System cleanliness
 - Controlled spray pattern in spray lubrication
 - Affects heat dissipation and airflow of sensitive equipment



Petroleum EHS

- Aspiration Toxicity – < 20.5 cSt @ 40°C
 - 100 SUS oils including 4 cSt Group III, PAO4, etc.
- Acute Inhalation Toxicity
 - Low visc PAO i.e. PAO2
- Carcinogenicity
 - Naphthenic oils, process oils, kerosene
 - IP 346 – >3% DMSO extractable content
- Oil Mist Exposure Limit (OSHA/NIOSH) – 5 mg/m³ average, 8-hours



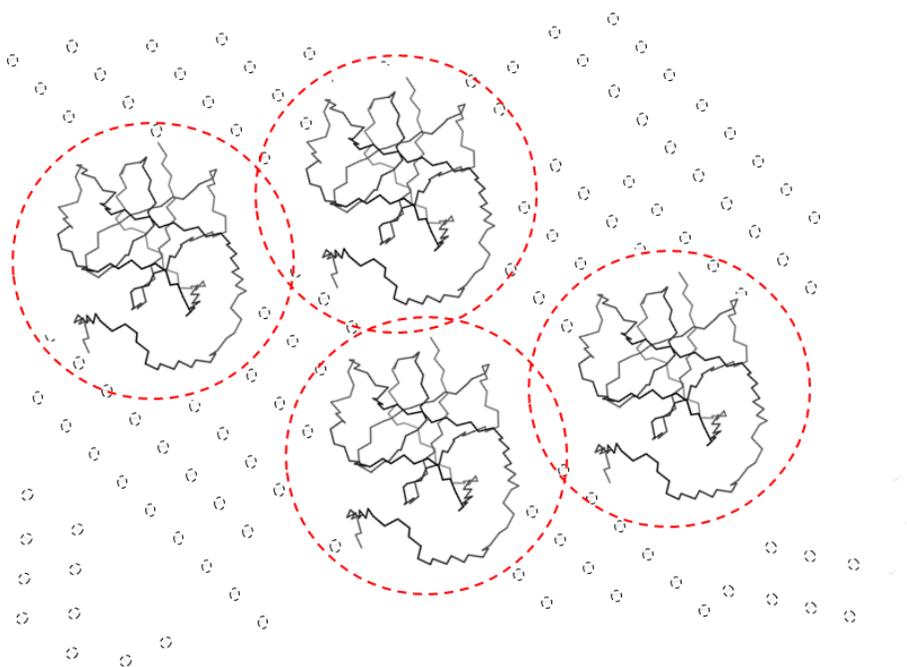
Misting may be desirable?

- We could optimize for less or more misting
 - Minimum quantity lubrication (MQL)
 - Spray lubrication on open gearing
 - Fuels and fuel additives
 - Pneumatic air tool and rock drill lubricants
 - Aerosol sprays for consumer goods



Use of Antimist Agents

- High MW polymers that add a slight **viscoelastic** behavior
 - Non-Newtonian
- Cohesion from viscoelasticity prevents droplets from splitting
 - Can even affect ICP mass spec nebulizers



Current Mist Testing

- ASTM D3705 (\$500-1000) aka 'oil mist reclassification'
 - Few test labs; complex
- Field trials (\$1000-10000)
 - Trial & error; antimist additives can be added tankside
- Factory Mutual (\$50,000+)
 - Spray combustion test; typically after all testing has been done

Volatility and VOCs

- Not quite what we want - more static, no pressure/physical inputs
 - Vapor pressure curve (ASTM D2879)
 - VOC (ASTM E1868-10)
 - NOACK loss (ASTM D5800)
 - Flashpoint (ASTM D92 COC and D93 PMCC)

A More Convenient Mist Test?

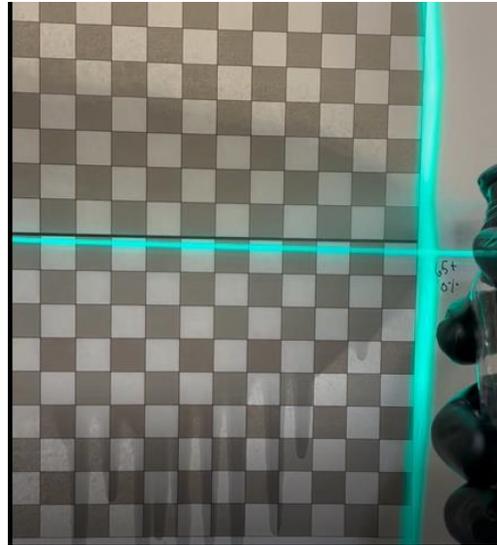
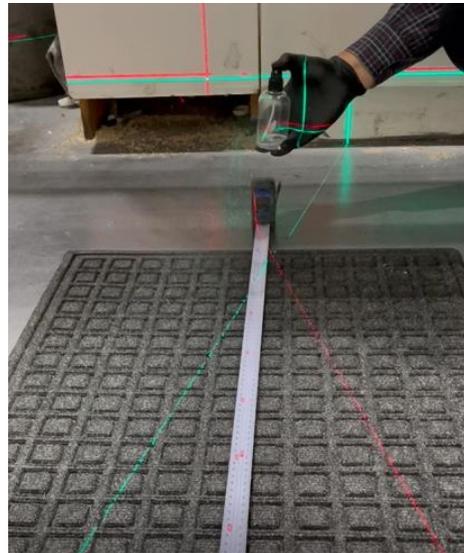
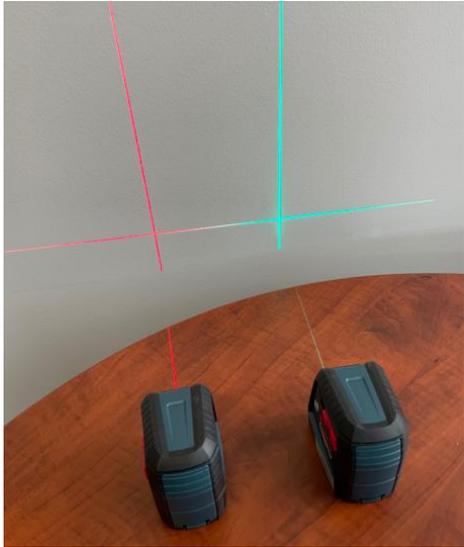
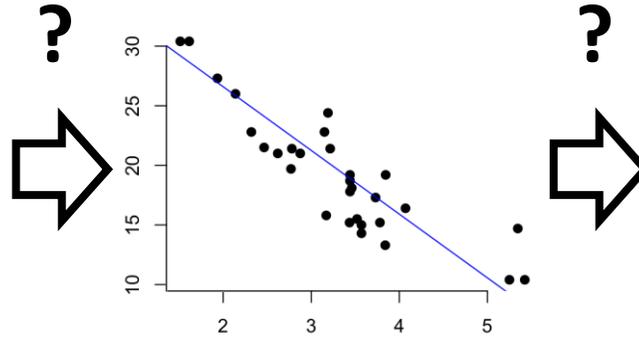
- Wish list for testing
 - Fast results for formulators
 - Easy to interpret
 - Low cost
 - Portable for use in the field
- Won't be all things to all people

Spray Bottle Test

- Low cost: ~\$1/each
- Repeatable: 0.44 grams per spray (+/- 2.2%)
- Portable: *Yes*
- Simple to operate: *Yes*
- Simple to interpret: ??



Method Development

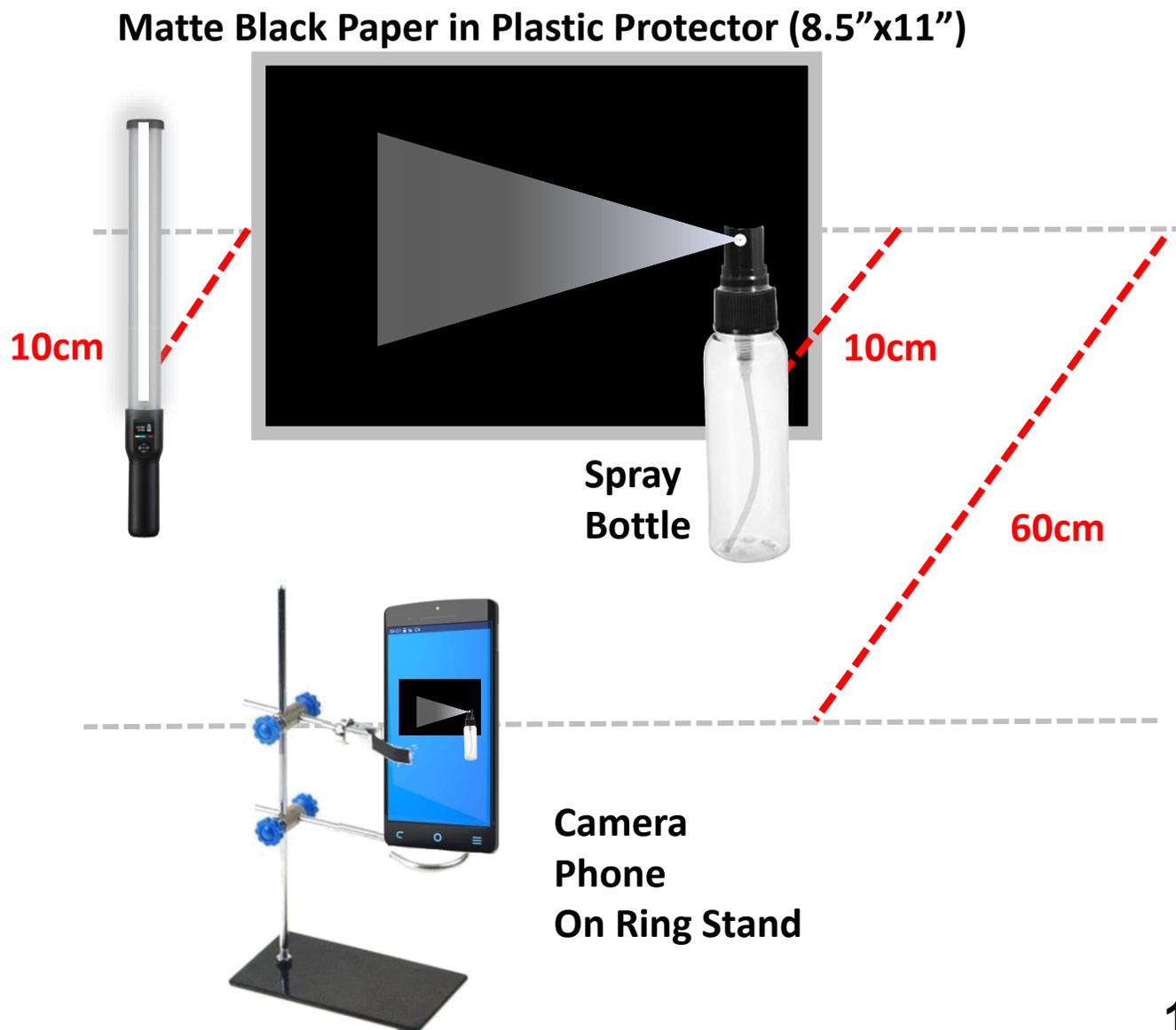


Final Setup

- In fully open fume hood...

Fine Points:

- Matte black background
- Bottle in front of background
- Spray into bright light
- Distances are relative



Data Collection

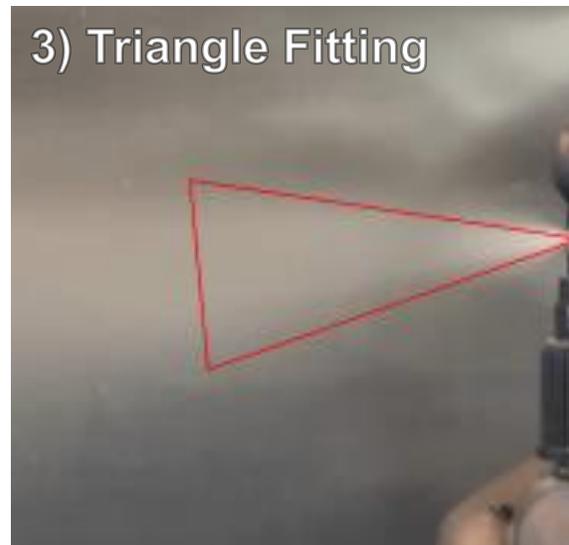
1) Spray Video



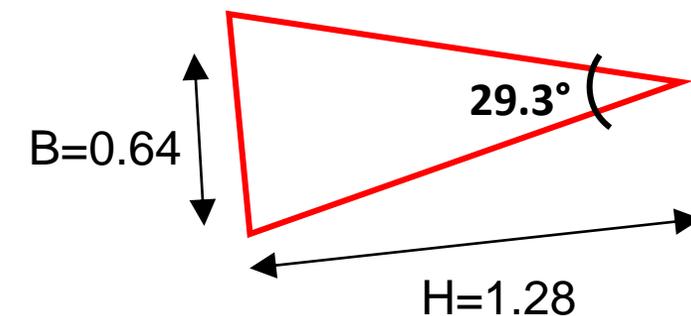
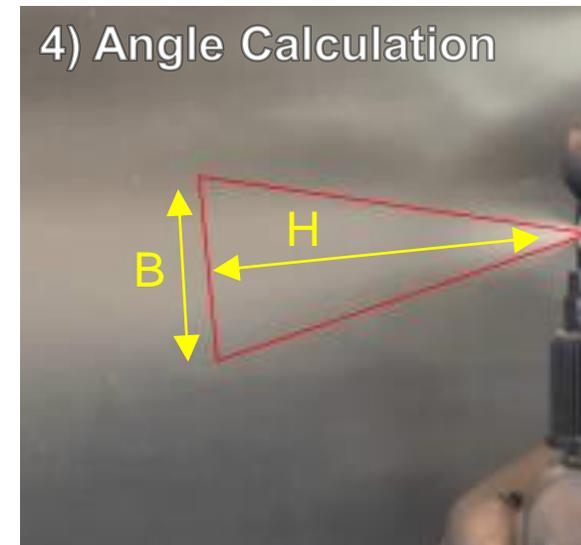
2) Capture Image Frame



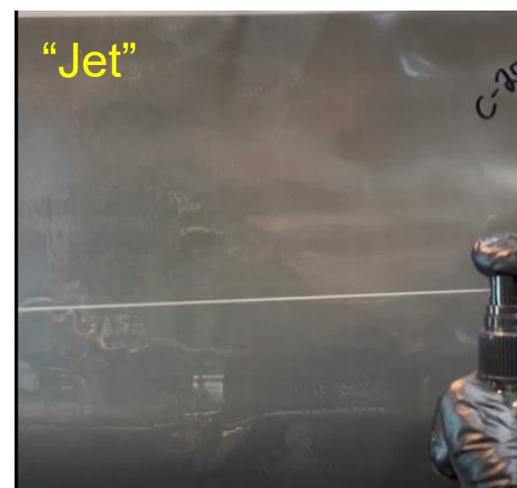
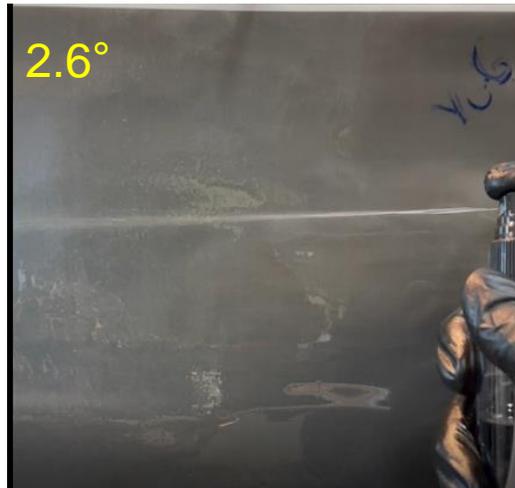
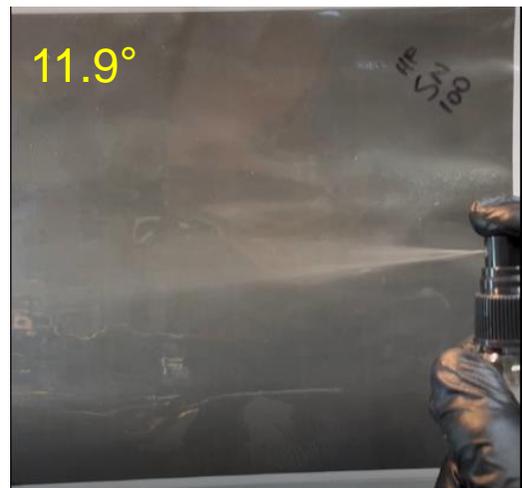
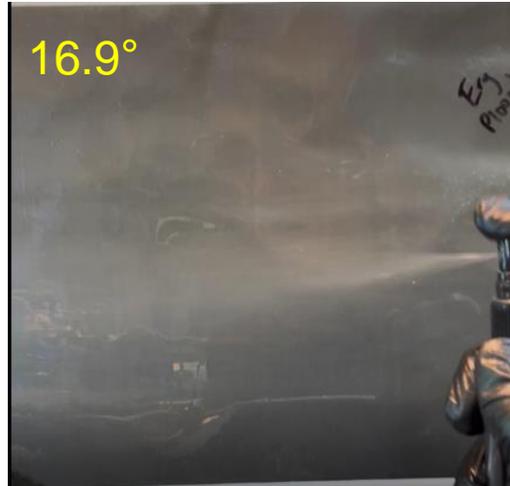
3) Triangle Fitting



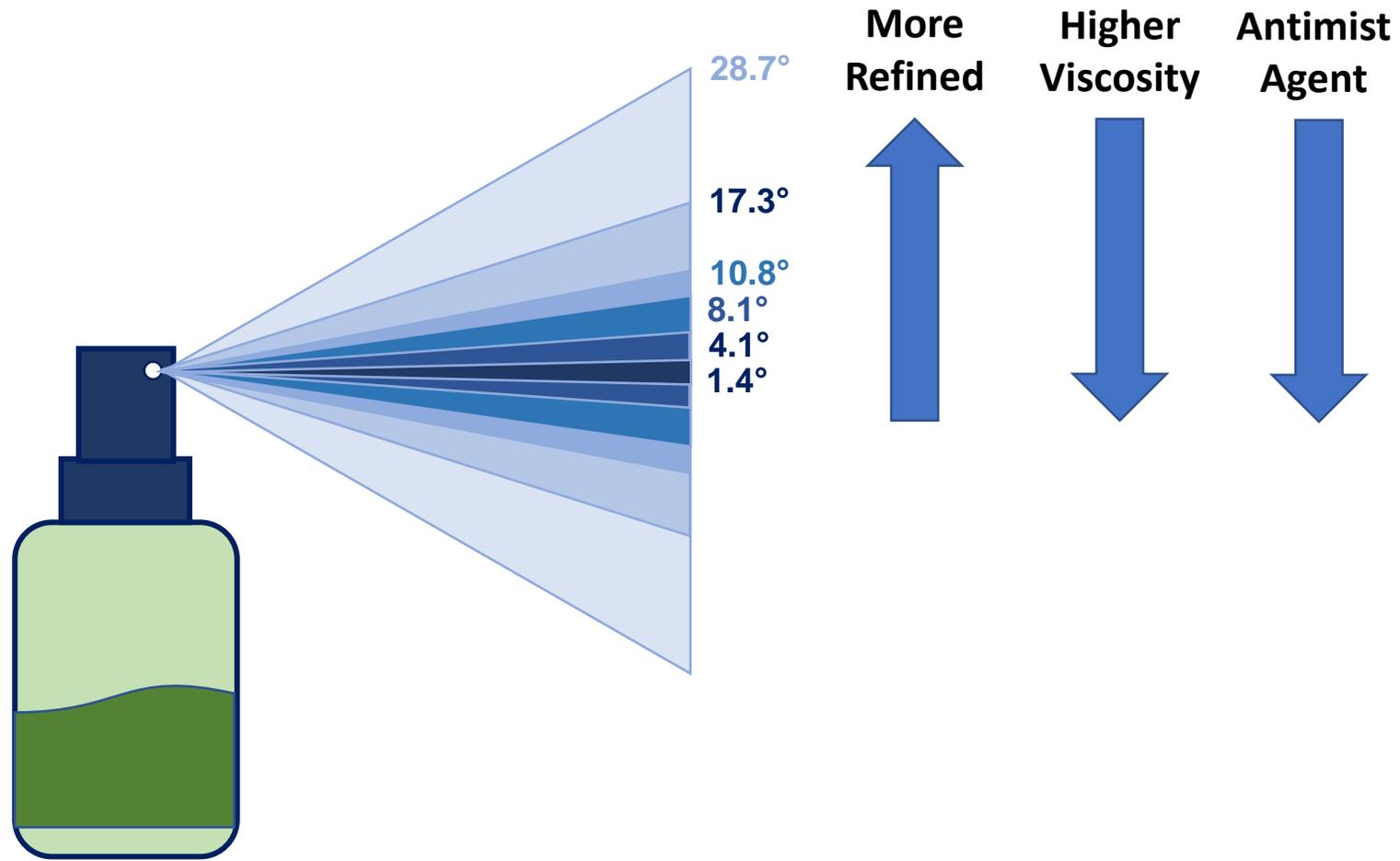
4) Angle Calculation



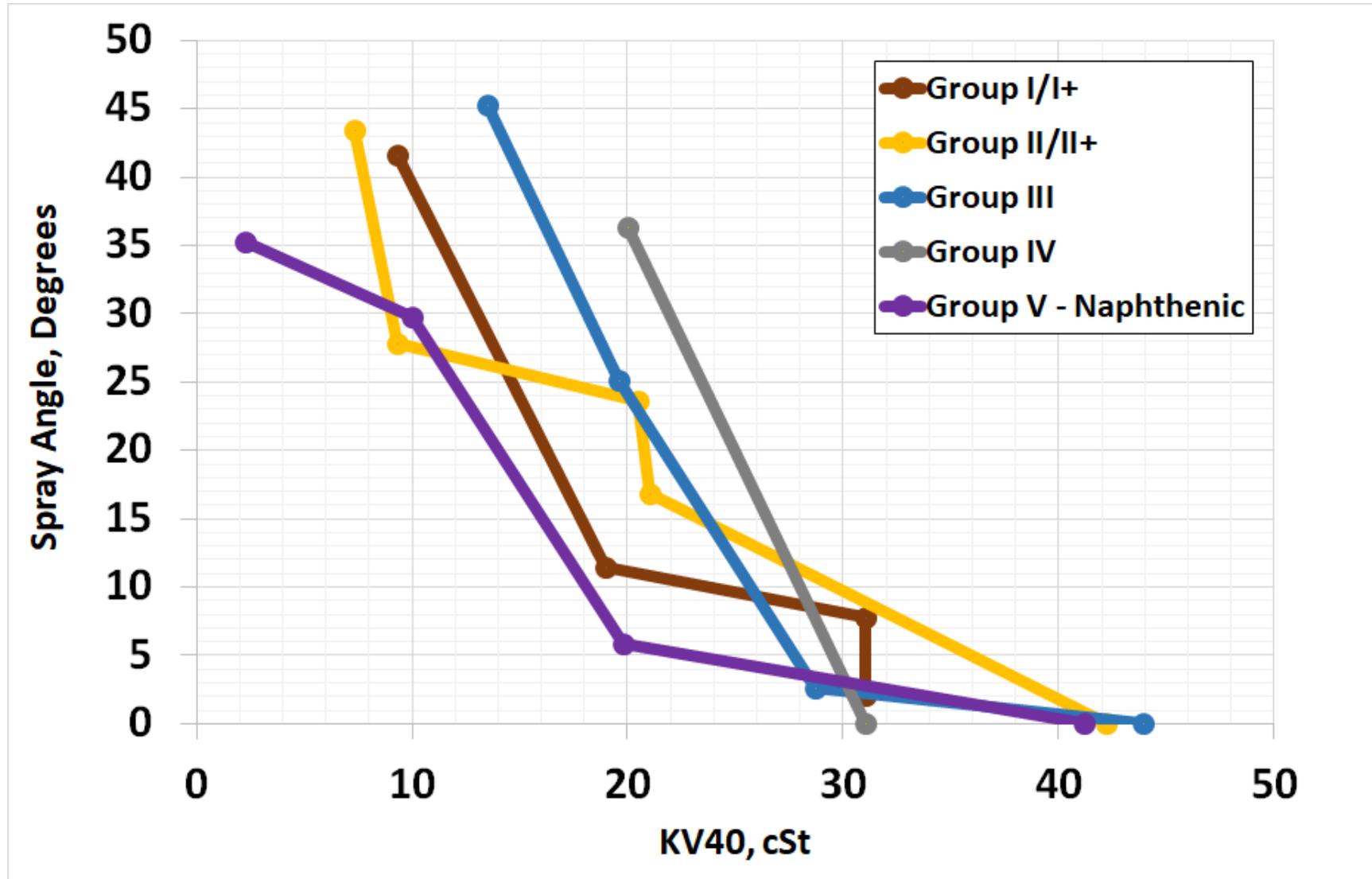
Spray Angles from 45 to 0°



Misting Angle



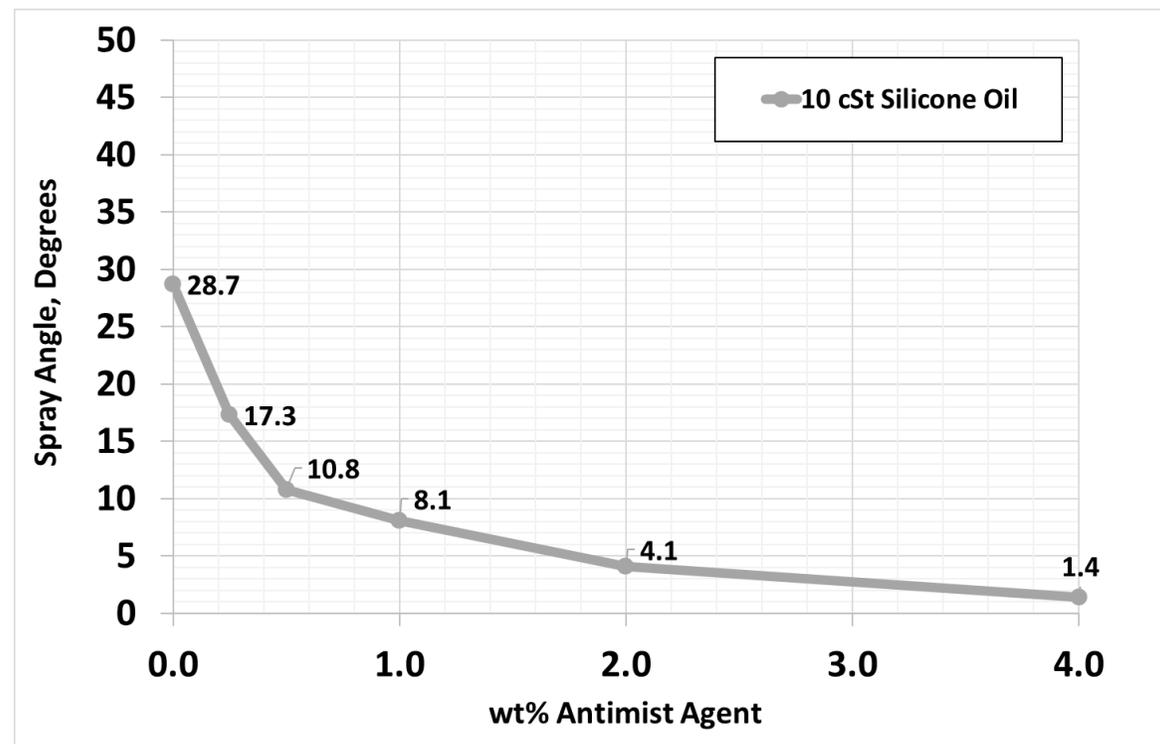
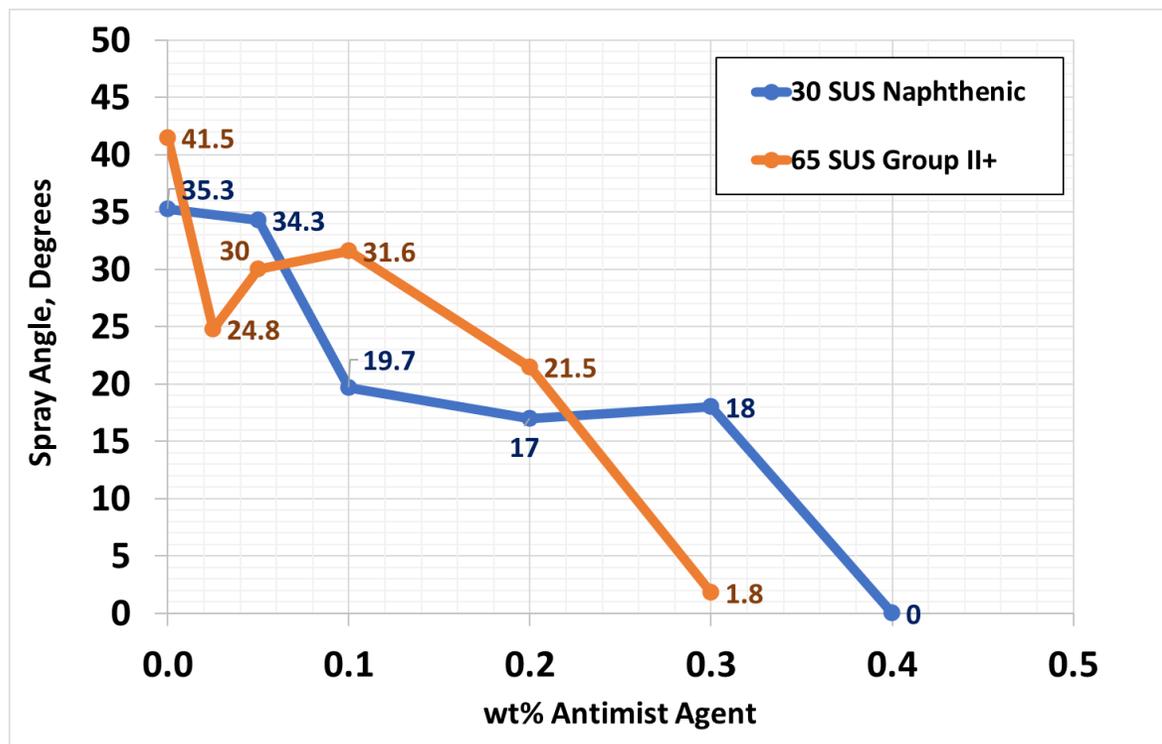
Misting Angle by API Group and Viscosity



Any angle <3% taken to be a 'jet' and assigned as 0.

Antimist Agents vs. Spray Angle

- High spray angle can be reduced by antimisting agents
- Spray bottle test captures this effect



Summary

Motivation

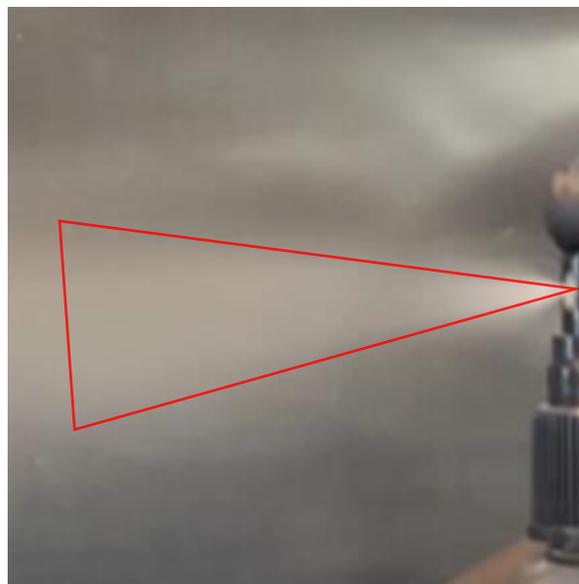
- Oil mist is performance parameter or hazard for different applications
- Very few test methods, tend to be complex
- An easy rapid test could allow us to control misting
 - Eliminate, or
 - Just enough misting without excessive exposure and overspray

Key Findings

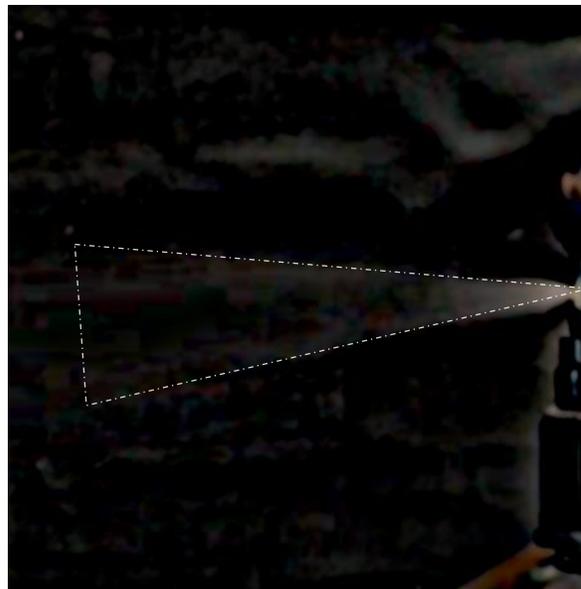
- ‘Spray bottle mist test’
 - Widely accessible, cheap, simple
- Test is limited to 120-150 SUS oils
 - Need more pressure to atomize thicker oils
- High molecular weight antimist agents reduce misting at low treat
 - Works for petroleum, silicone, etc.

Future Work

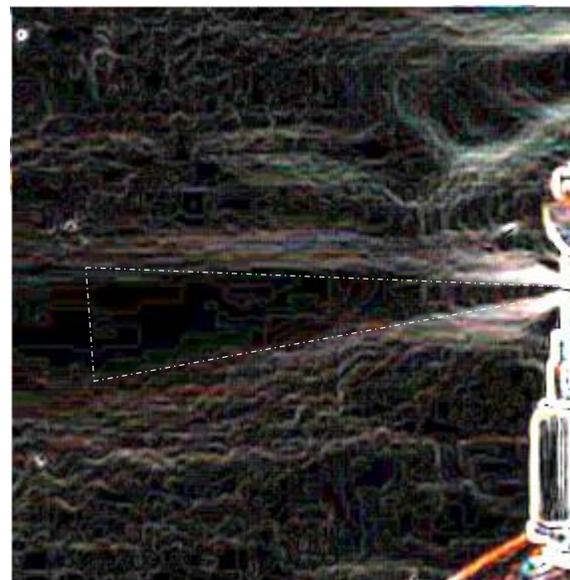
- Image processing to make spray angle calculation more repeatable



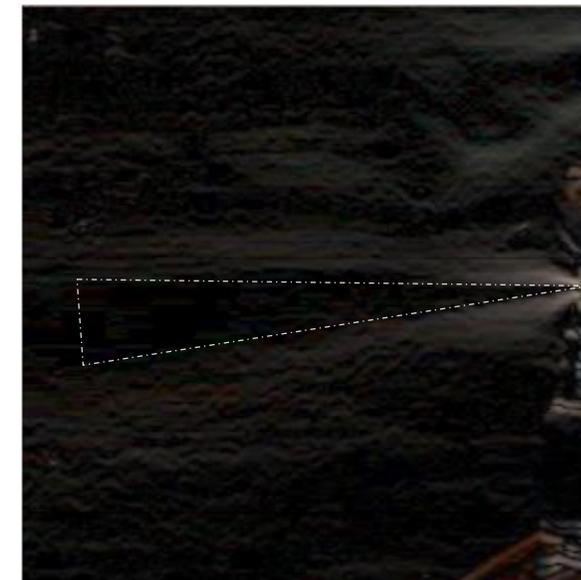
Full Color: 28.1°



'Difference of Gaussians'
Edge Detection: 18.1°



'Prewitt compass'
Edge Detection: 12.8°



'Sobel'
Edge Detection: 9.6°

Thank you for attending today's session!

Contact:

ewillett@functionalproducts.com



*Ask for a
spray bottle*

