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Comparison of Lab-Produced Asphalt Emulsions by Manufacturing Equipment Type

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The RoadHogs Research Group

- Presentation based on spring 2024 graduate course
  - “Manufacturing Asphalt Emulsion”
- RoadHogs research group:
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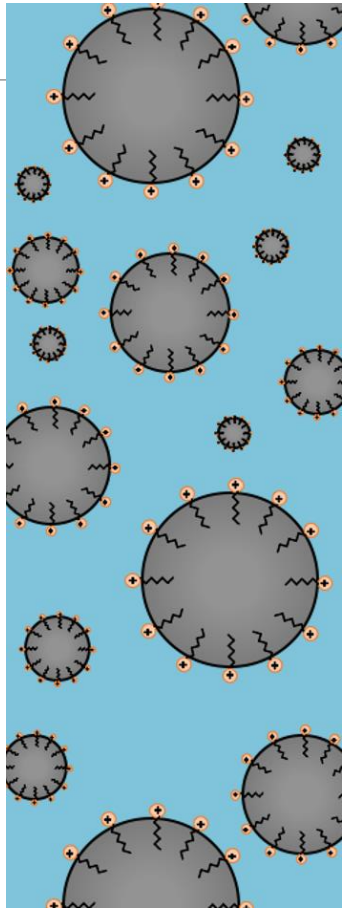
- Scientific Research Technologist:
  - Joey Eiland
- Along for the ride:
  - Andrew Braham

First time manufacturing emulsion!

(civil-engineering.uark.edu)

What is an asphalt emulsion?

- Asphalt emulsion
  - Small particles of asphalt binder suspended in water
  - Asphalt binder can’t be dissolved or mixed into the water
  - Asphalt binder is suspended in water with the help of emulsifiers
- Used in
  - Pavement maintenance treatments (fog seal, rejuvenating fog seal, chip seal, scrub seal, slurry seal, micro surfacing, cape seal, ultra thin bonded wearing course)
  - Pavement rehabilitation treatments (Hot In-place Recycling, Cold In-place Recycling, Full Depth Reclamation)
  - Additional treatments: tack coat, prime coat, base stabilization, soil stabilization



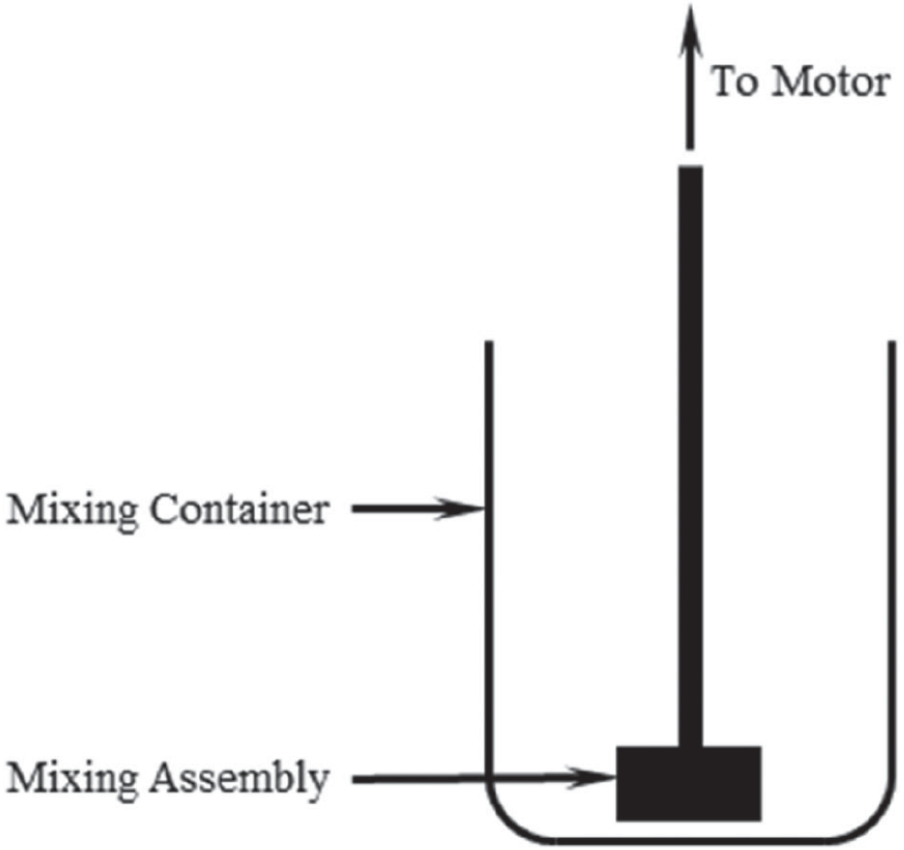
How is asphalt emulsion manufactured?

Manufacturing fundamentals: 2 components

1. Mechanical energy
   - Provided by mill/shear mixer (equipment)
   - Divides asphalt binder into fine particles
   - Common mill: colloid (disk, cylindrical, conical)
   - Colloid mills have rotor (rotates) and stator (fixed) with teeth
   - Key parameters: speed of rotor, gap between rotor and stator
2. Physicochemical energy
   - Provided by emulsifier in soap solution
   - Reduce interfacial tension between asphalt binder and water
   - Create protective film around asphalt binder

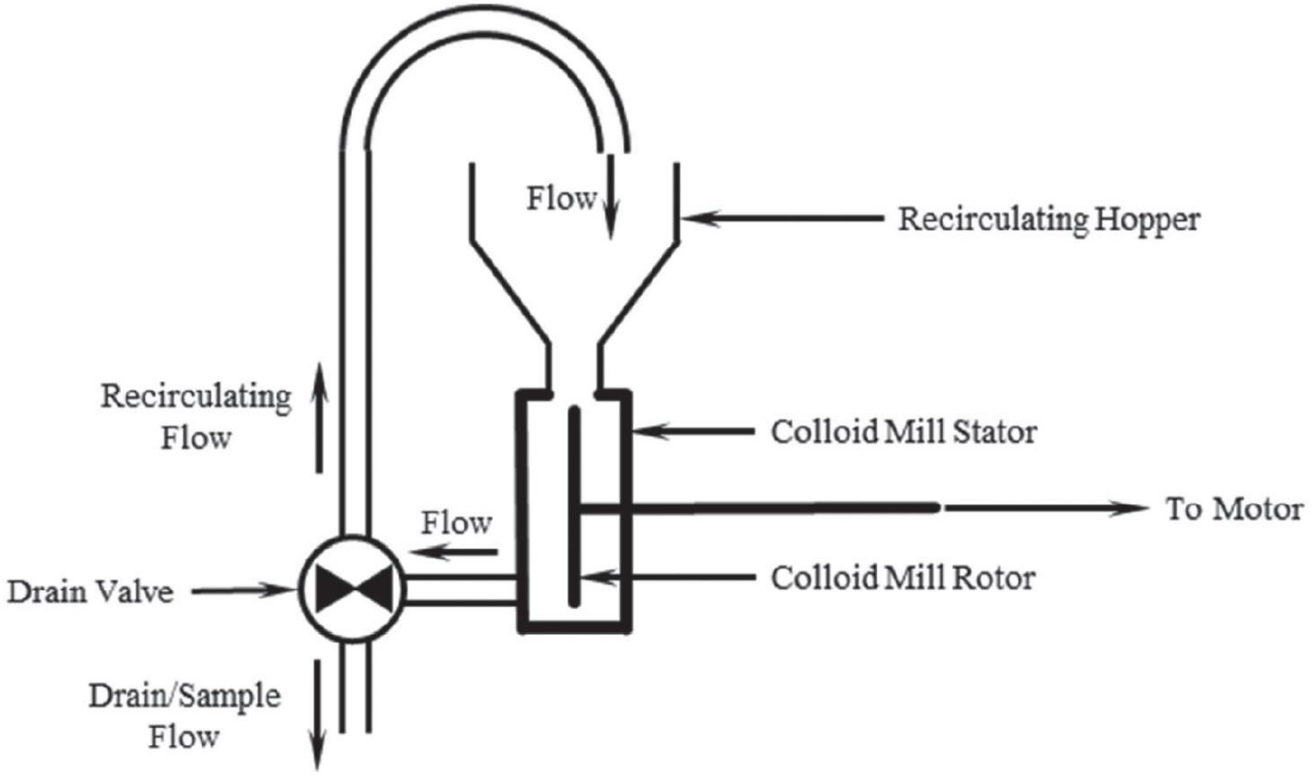
Types of lab-scale manufacturing equipment?

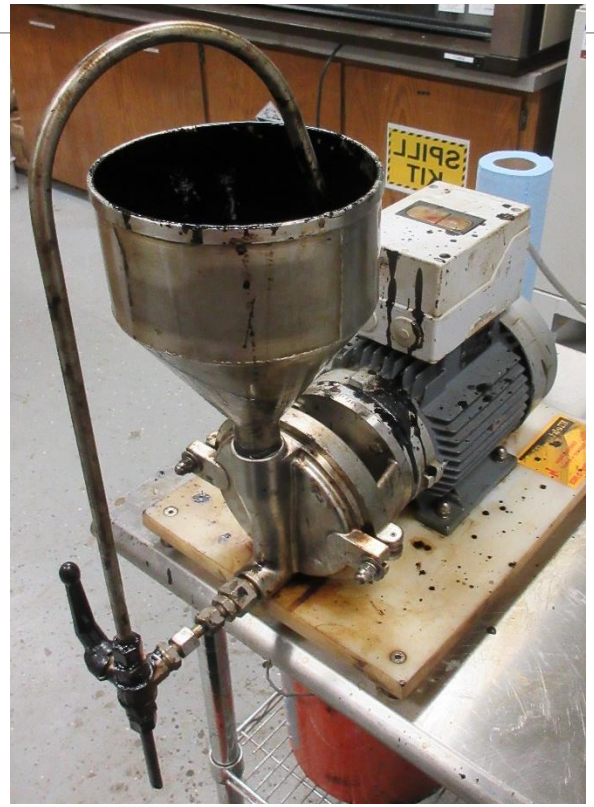
Type 1: high speed shear mixer



- Mixing head ~1/4” above base of container
- Start at ~1200rpm
- Add asphalt binder to soap solution
- Increase to ~3000 rpm
- Mix until “homogenous” but <3 minutes

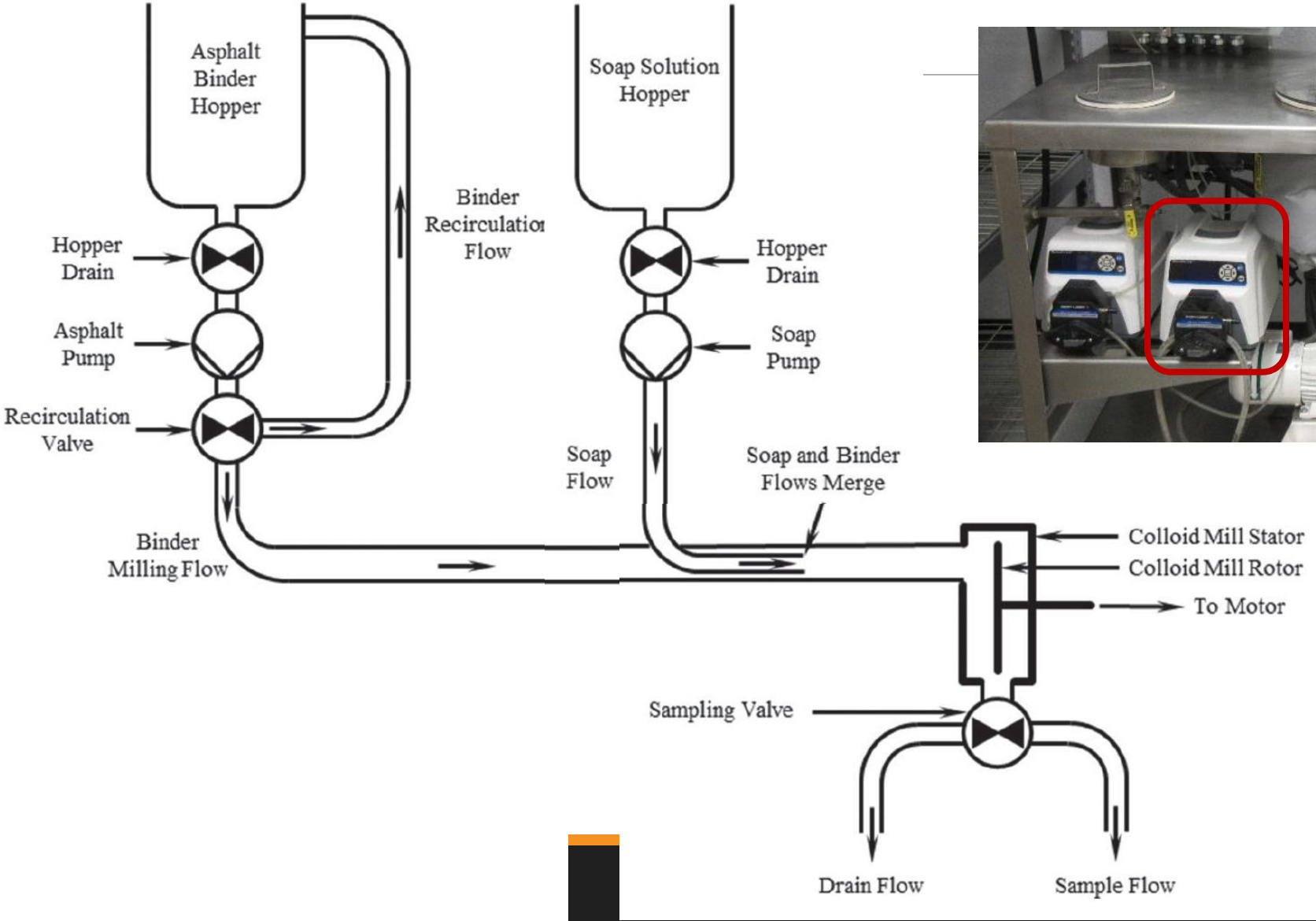
Type 2: recirculating colloid mill

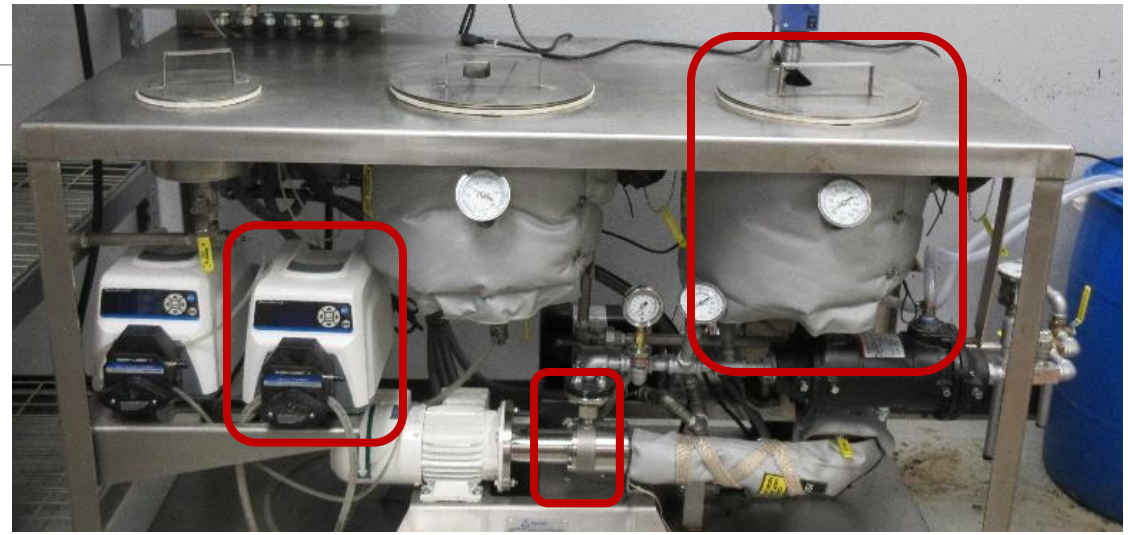




Circulate soap, add asphalt binder

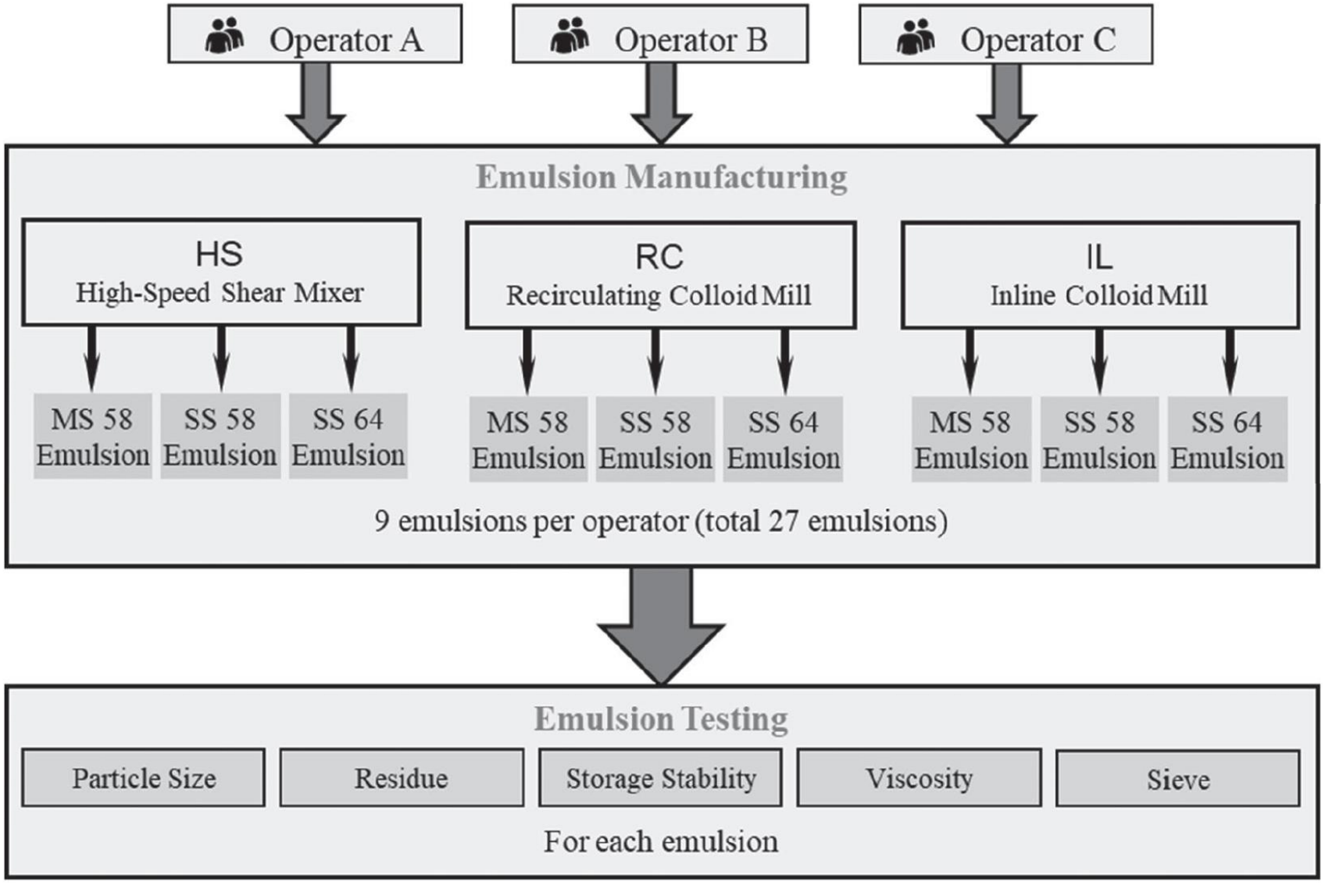
Type 3: in-line colloid mill





Start soap, turn mill on to 10,000 rpm, add asphalt binder

The experimental matrix

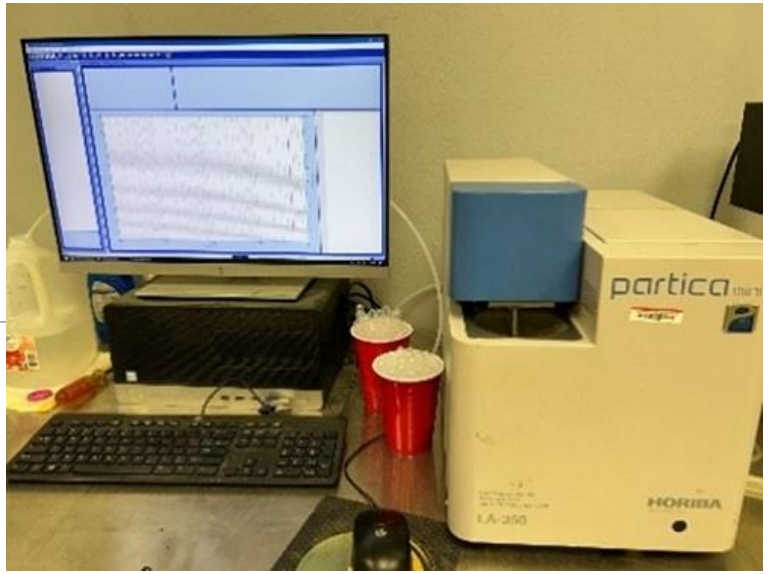


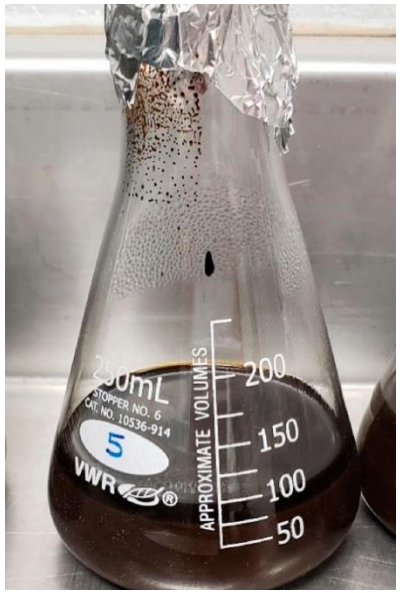
- MS: medium set
- SS: slow set
- 58: PG58-28
- 64: PG64-22

Objective: compare manufacturing devices and operators

The tests

- Particle size
  - Laser diffraction
- Retained on sieve
  - 100 g, #20 sieve
  - “simplified” AASHTO T 59
- Storage stability
  - 125 g in Erlenmeyer flask
  - 7 days, “simplified” AASHTO T 59
- Paddle viscosity
  - AASHTO T 382
- Residue (no further testing)
  - 50g in 150C oven, 24 hours





What were the results?

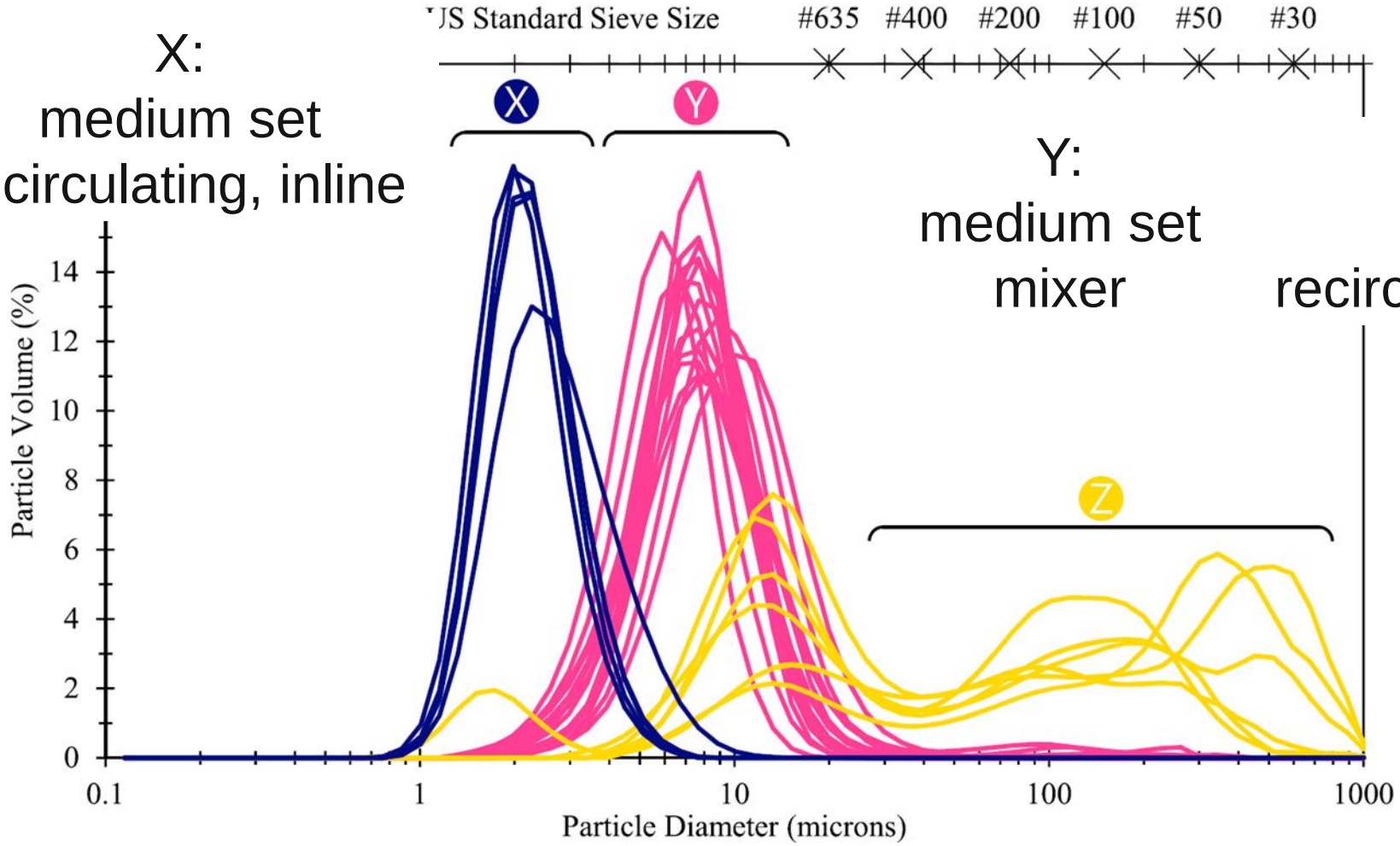
Particle size results

X:
medium set
recirculating, inline

Y:
medium set
mixer

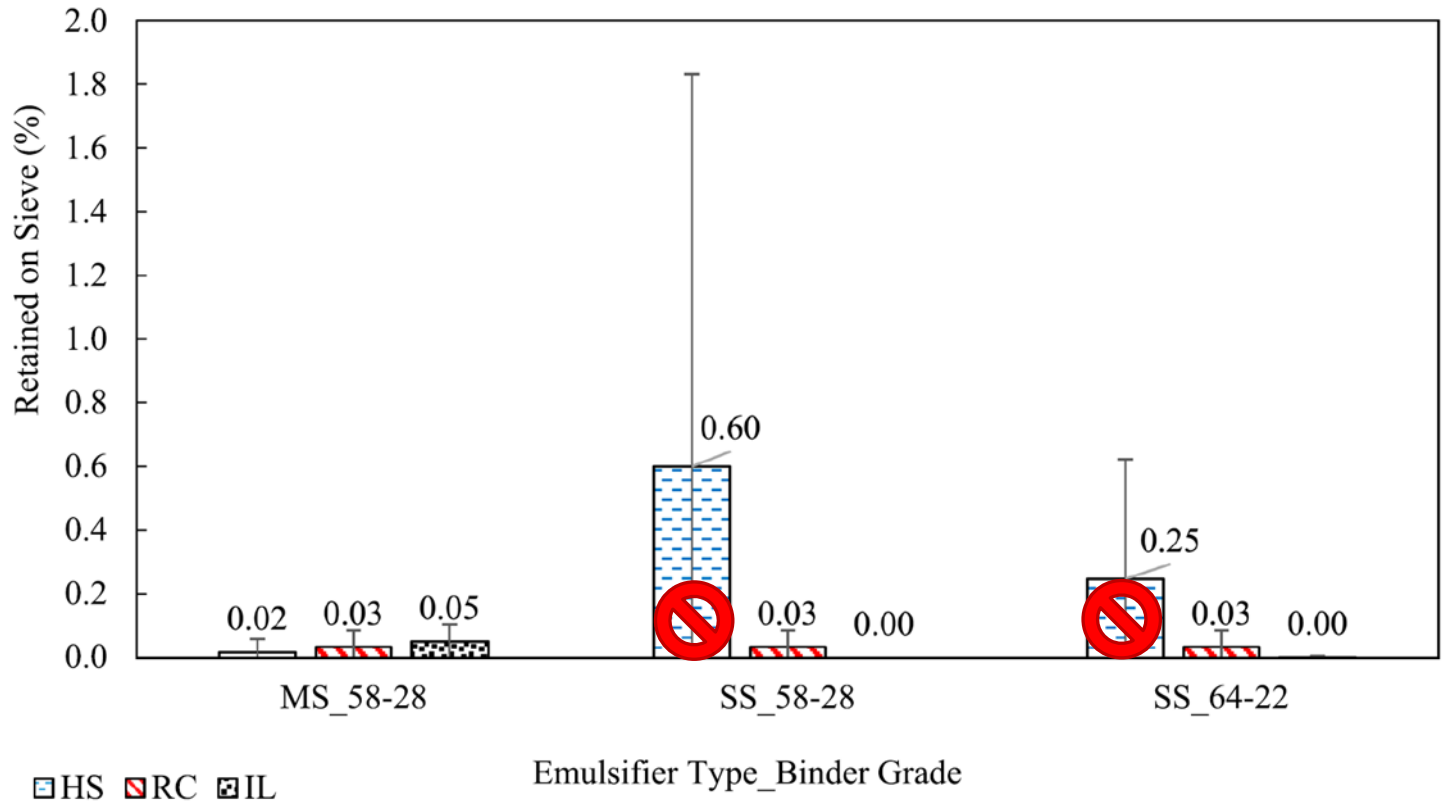
Y:
slow set
recirculating, inline

Z:
slow set
mixer



Recirculating, inline had smaller, tighter particle size

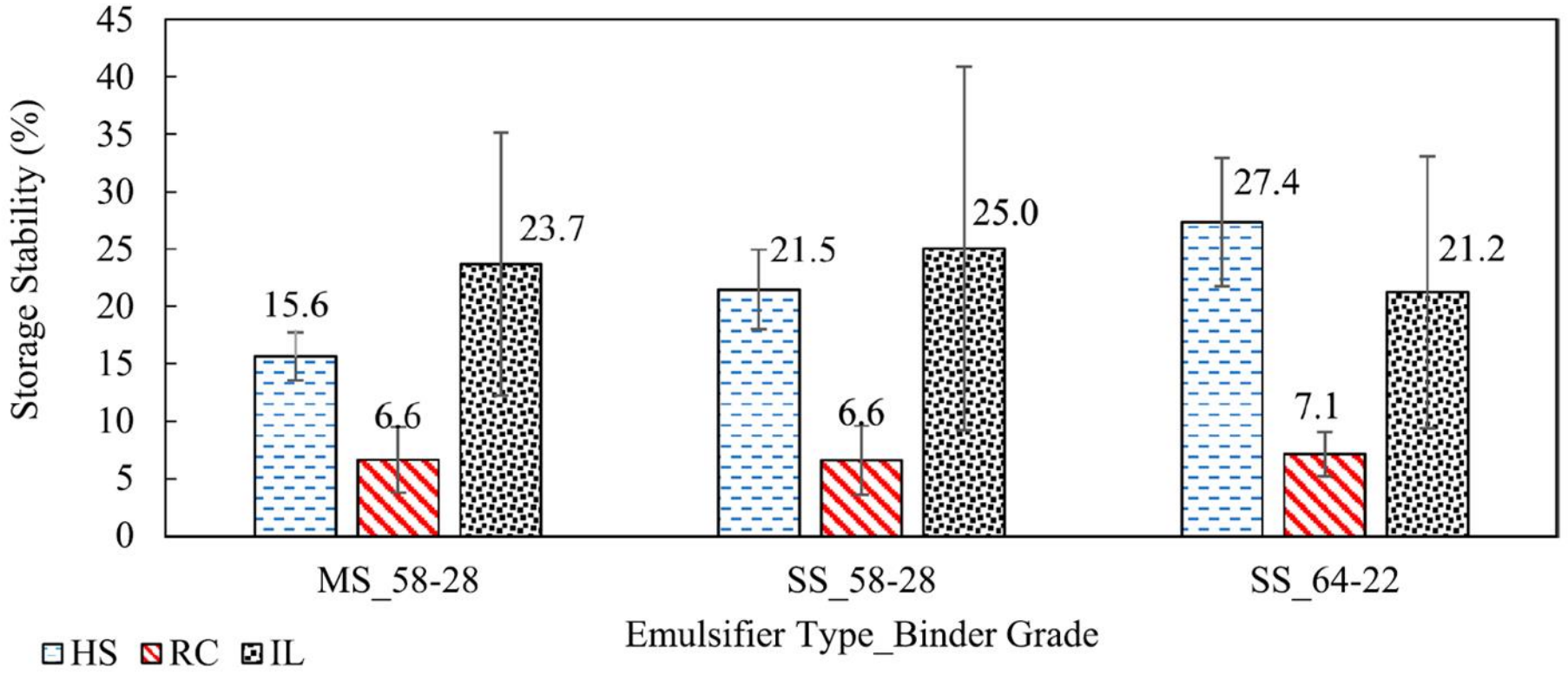
Retained on sieve results



M 140 spec:
<0.10 %

Issue with high speed shear mixer

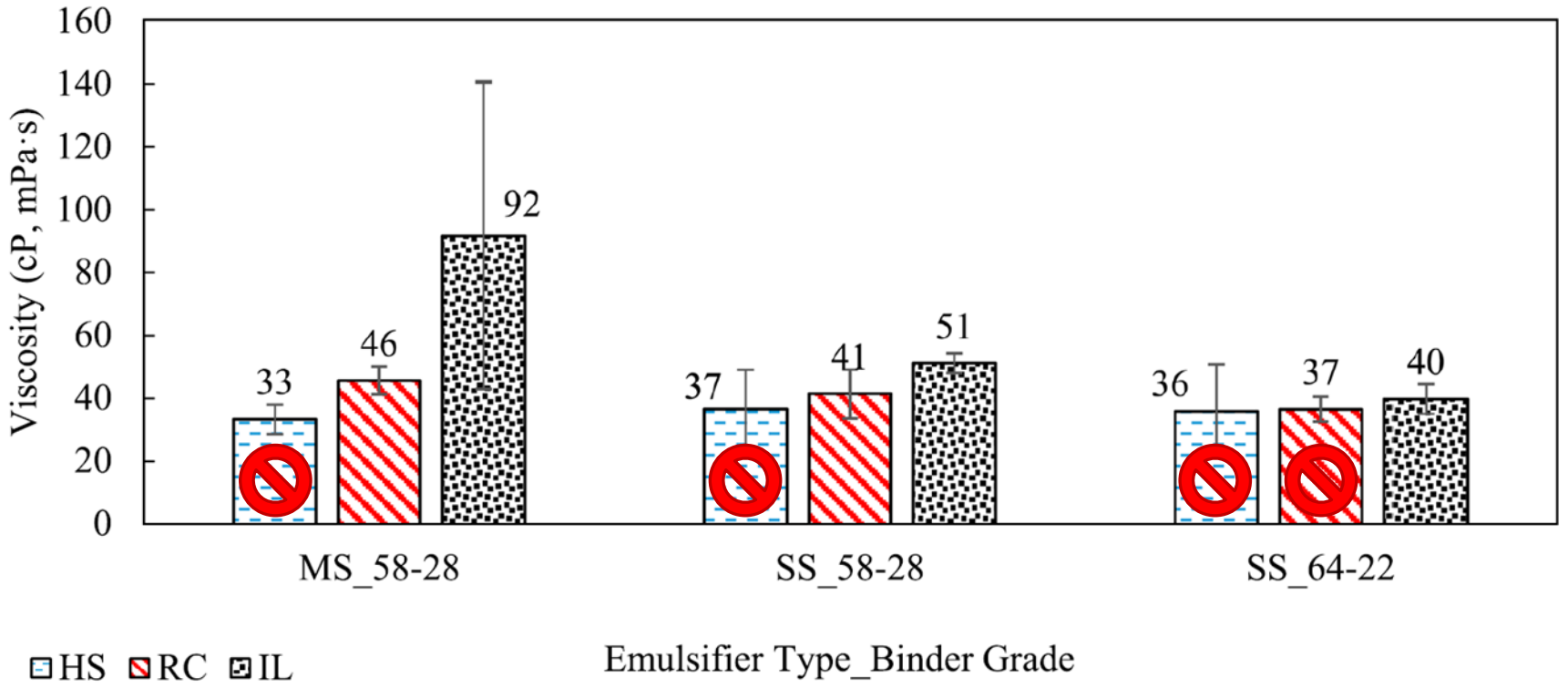
Storage stability results



M 140 spec: not applicable modified test indicates trends

Recirculating mill provides best storage stability

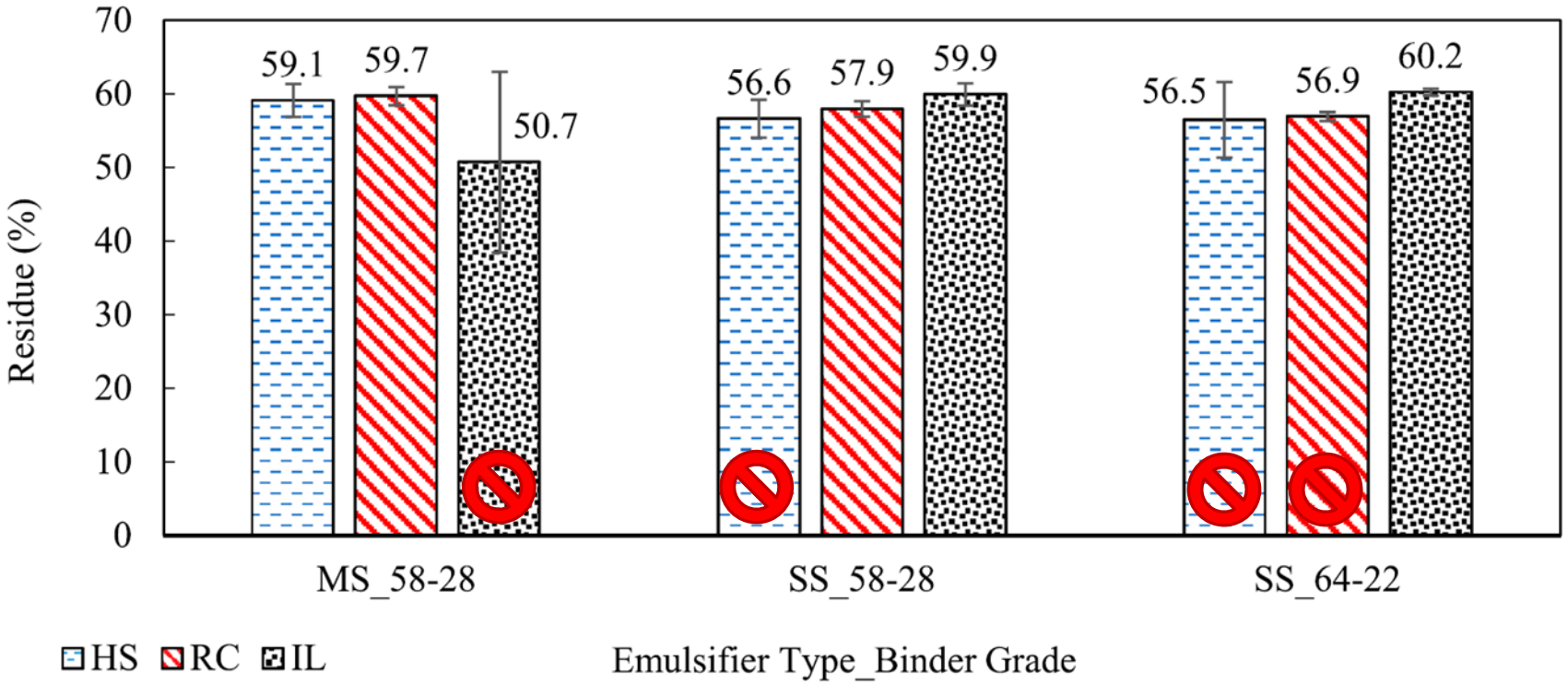
Viscosity results



M 140 spec:
40 – 200 mPa•s

High speed shear mixer and PG 64-22 struggled

Residue results



M 140 spec:
MS: >55%
SS: >57%

Should not be an issue – problem on our end

Conclusions

Particle size: issues with high speed shear mixer

Retained on sieve: issues with high speed shear mixer

Storage stability: recirculating mill provided “best” results

Paddle viscosity: on the low end, or below minimum all around

Residue: four of nine below minimum

Please take findings with a grain of salt
More practice = more consistent results

Questions? Thank you!
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THANK YOU!

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