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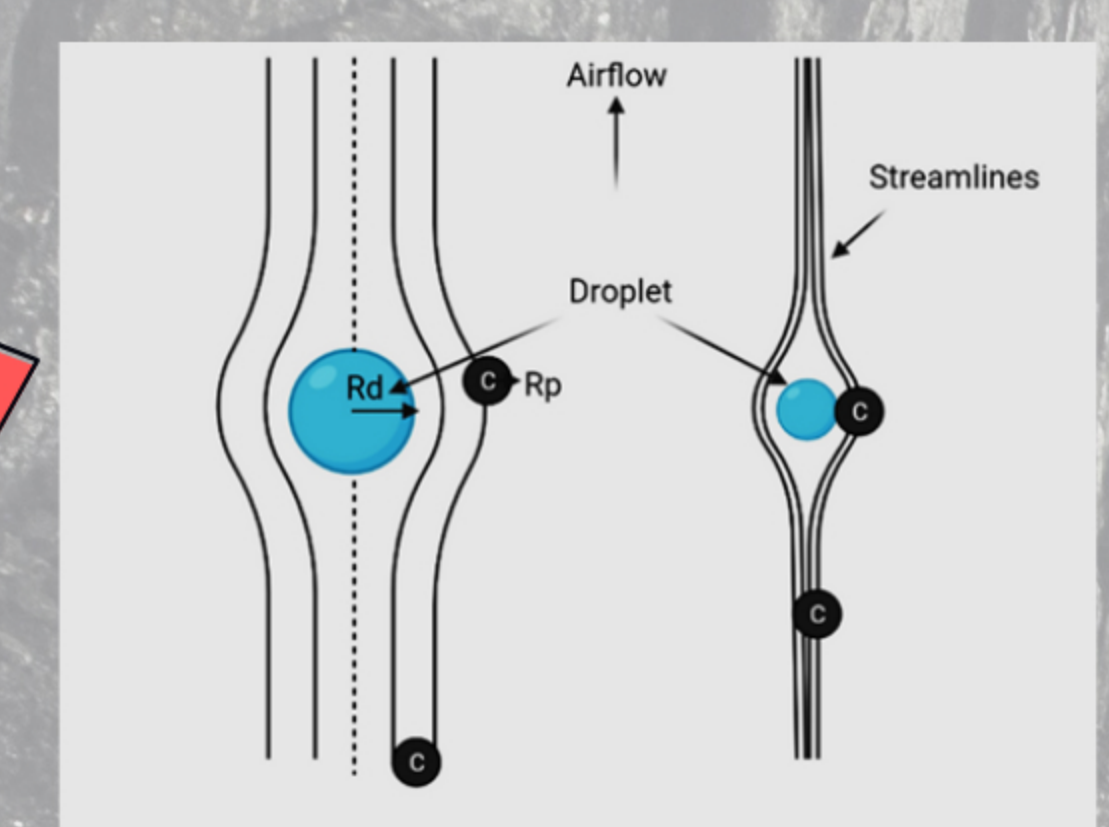
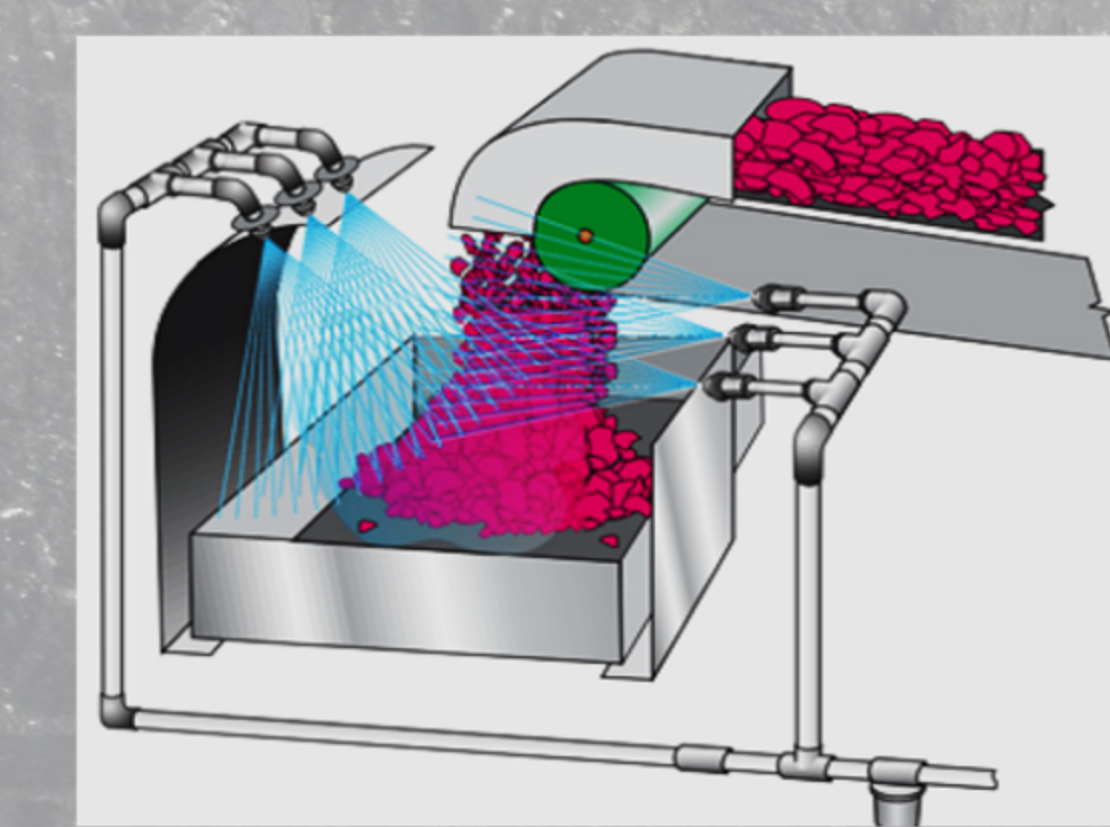
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## 1. Background

Water sprays are widely used to reduce dust concentration in working areas.

The capturing efficiency of water sprays depends on the dust particles, droplet size, and interaction between them.

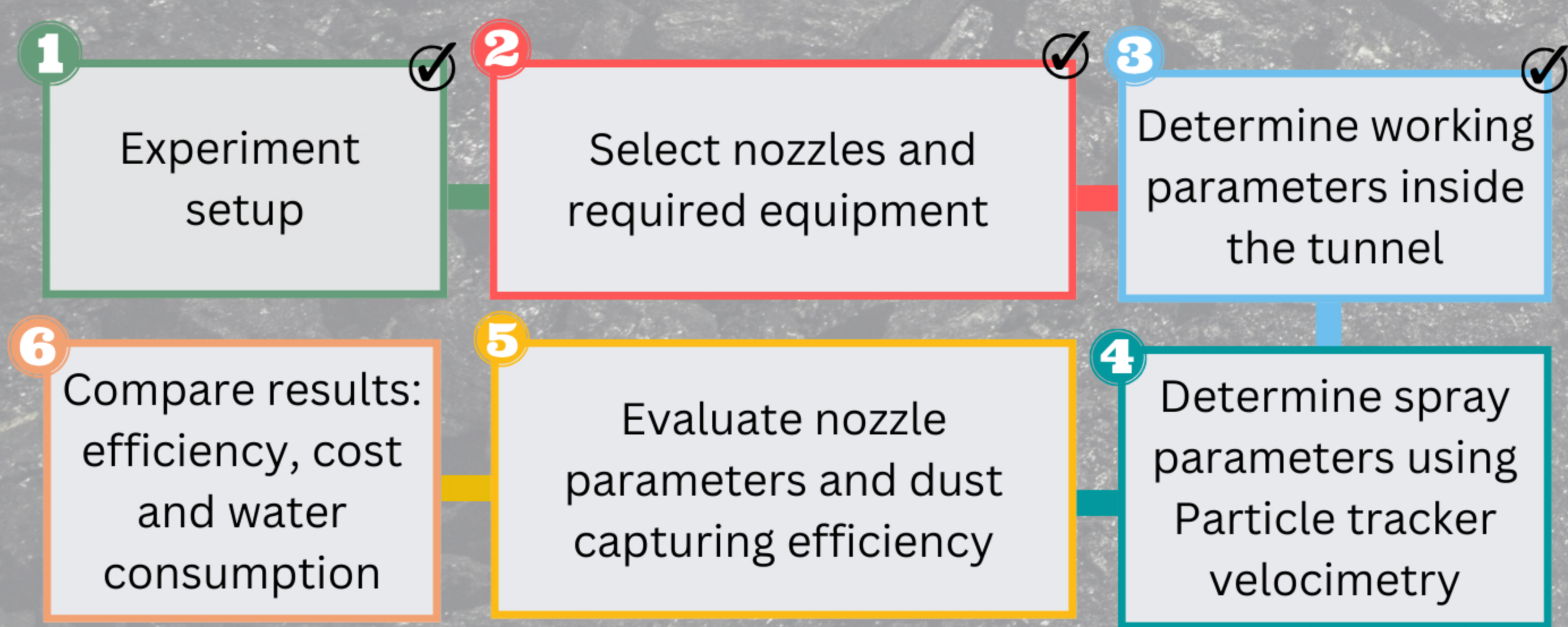


Current spray systems have low efficiency in suppressing submicron coal particles since their characteristics (such as physical property and wettability) are significantly different from those of larger ones.

## 2. Objectives

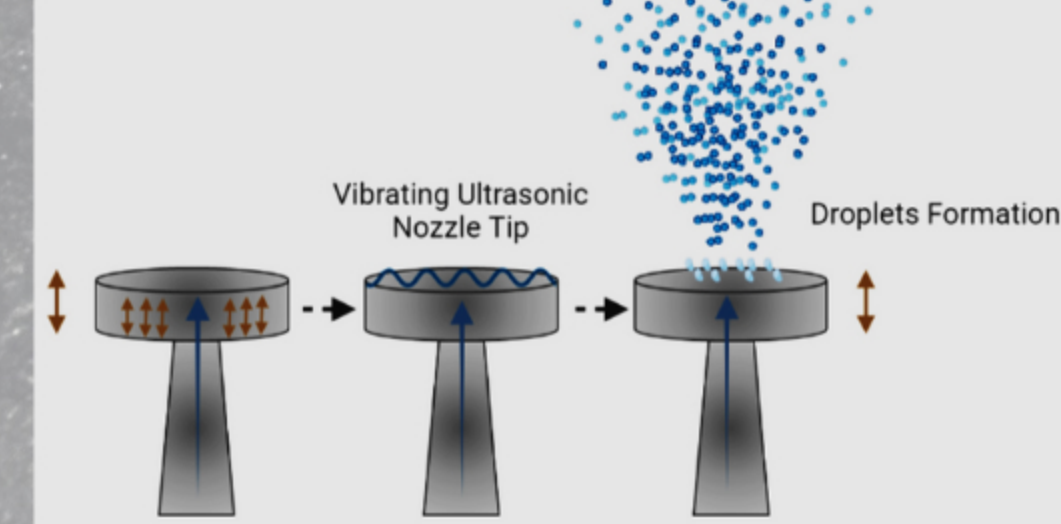
Evaluate the efficacy of ultrasonic and atomizing nozzles to control submicron particles of coal

## 3. Research Methodology



### Selected Nozzles

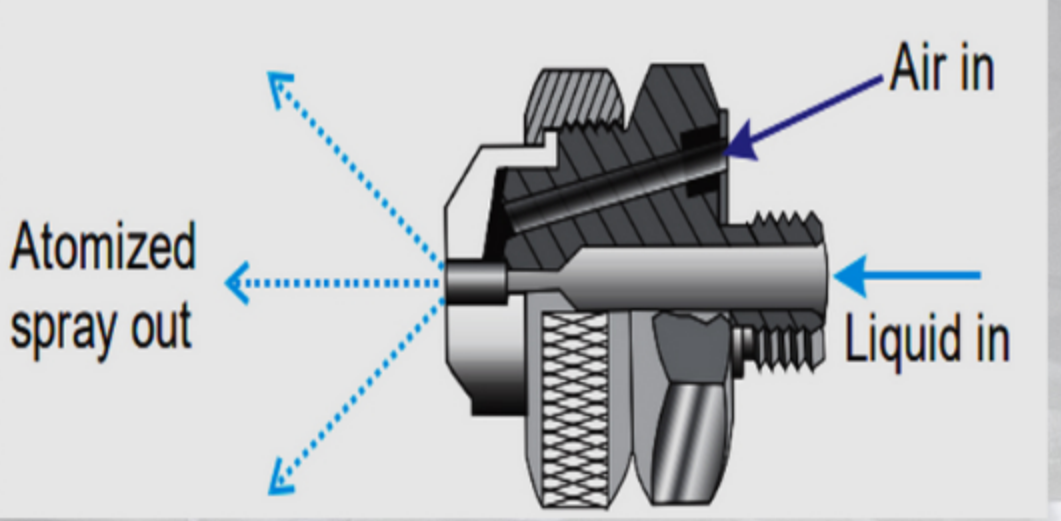
#### Ultrasonic nozzles



Air/Water pressure: 73psi/7-14psi  
Droplet size: 3-10µm

The nozzle design forces the water/air mixture to hit a small cup in front of the nozzle. The energy is reflected creating a sonic shock wave that produces the droplets

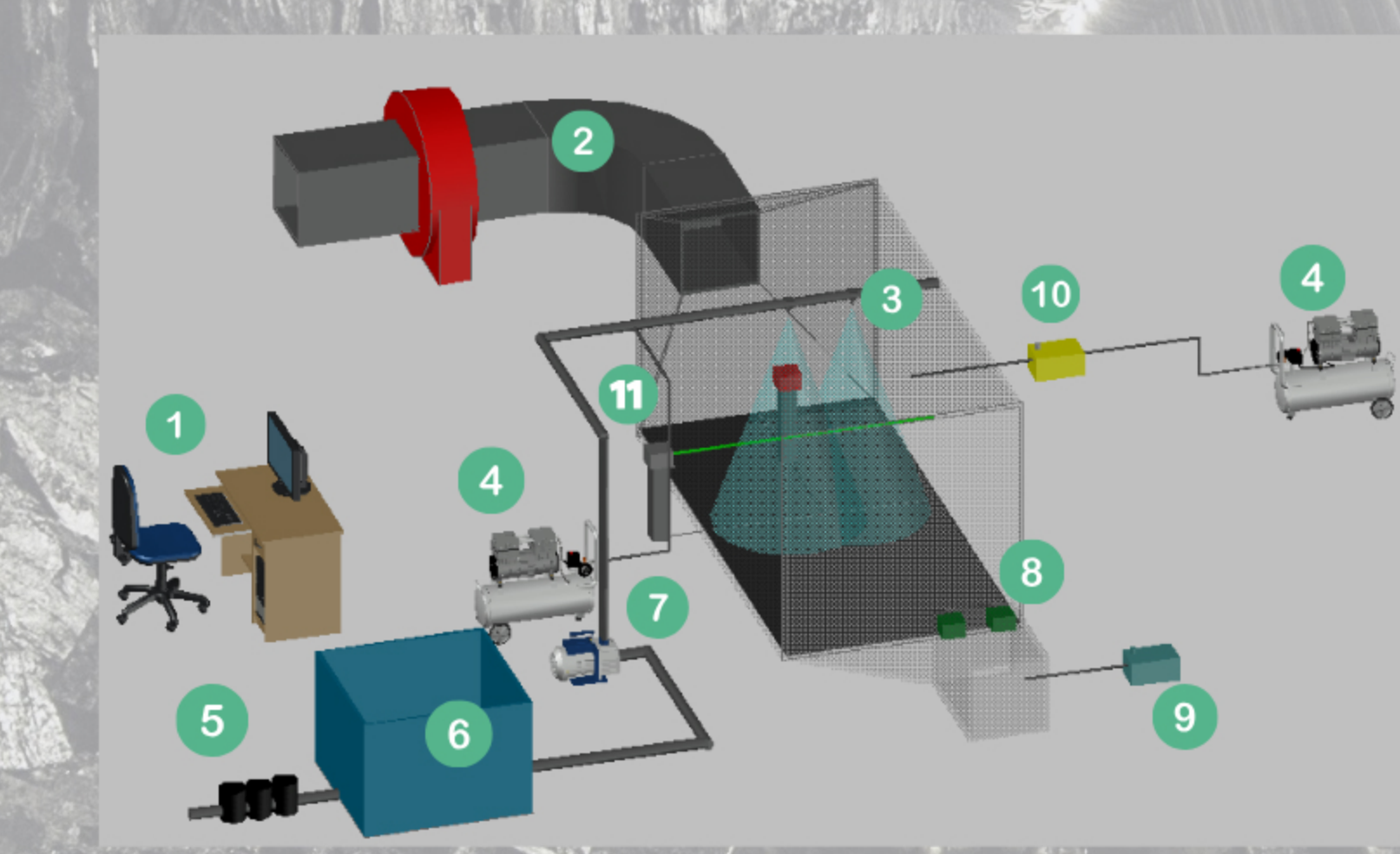
#### Atomizing nozzle



Air pressure: 16-95 psi  
Water pressure: 10-60 psi  
Droplet size: 35-100µm

Uses a water-air mixture to produce an atomized fluid as mist. A high-velocity air is injected into the water producing high shear forces that break up the water into droplets

## 4. Experimental Setup



1. Monitoring computer
2. Wind tunnel
3. Nozzles
4. Air compressor
5. Reverse osmosis equipment
6. Water tank
7. Water pump
8. Dust monitoring system
9. Particle sizer
10. Aerosol generator
11. Particle tracking velocimetry

#### Wind tunnel parameters



40% feed rate from aerosol generator + 10Hz fan frequency  
Dust concentration: 0.5mg/m<sup>3</sup>

#### Nozzle rail



4 nozzle supports were installed to provide full coverage in the cross-section area of the tunnel with droplets

## Challenges

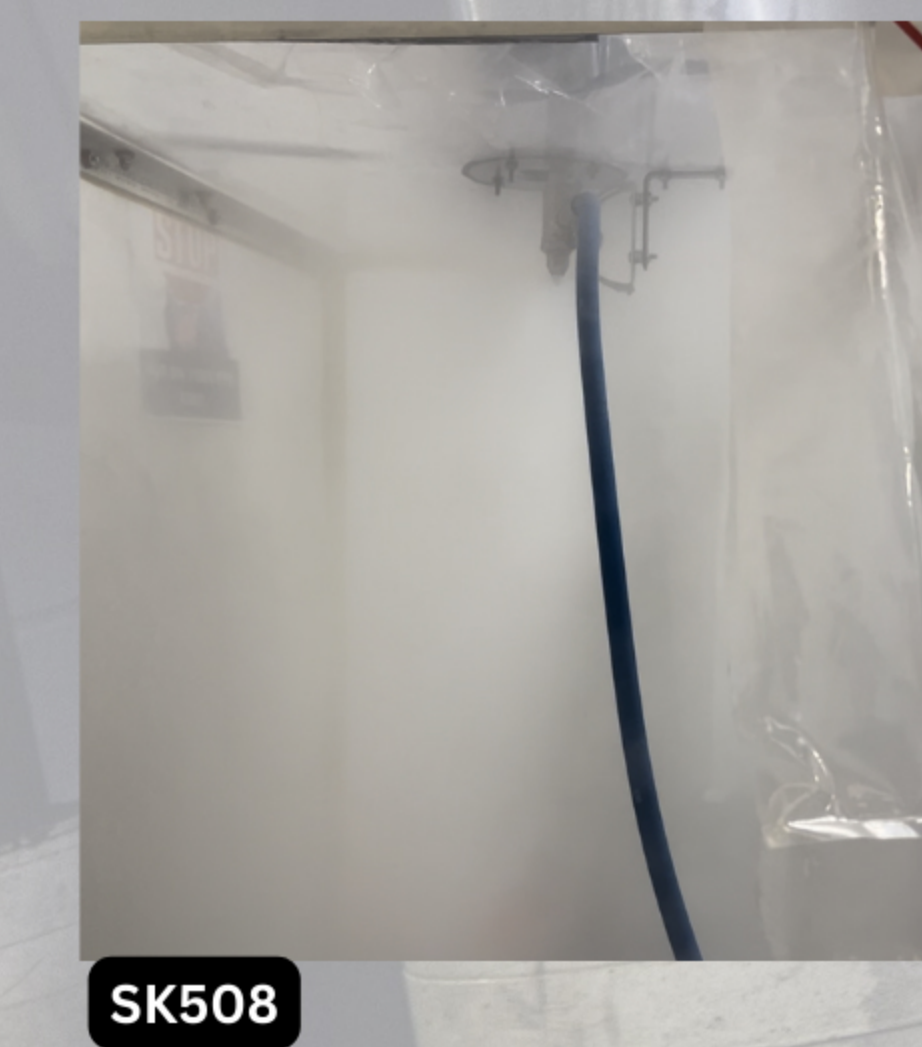
Water hardness → Osmosis reverse equipment

Air requirements → 50 CFM air compressor

## 5. Results



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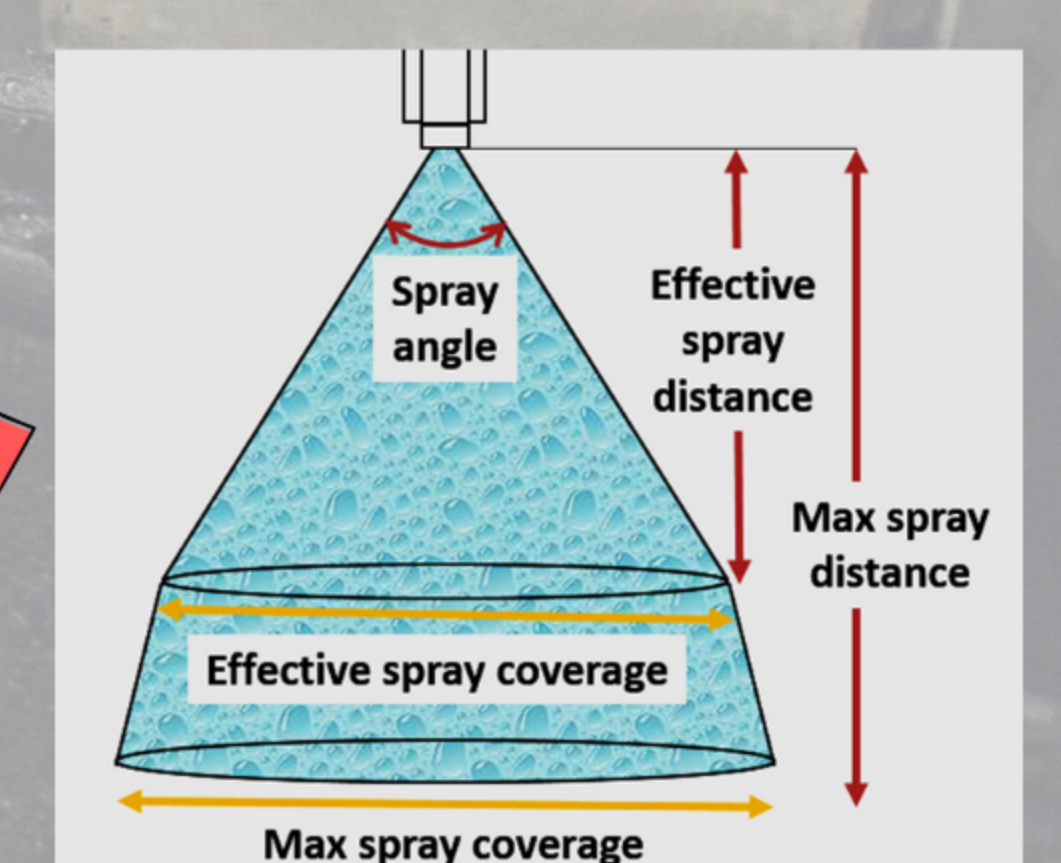
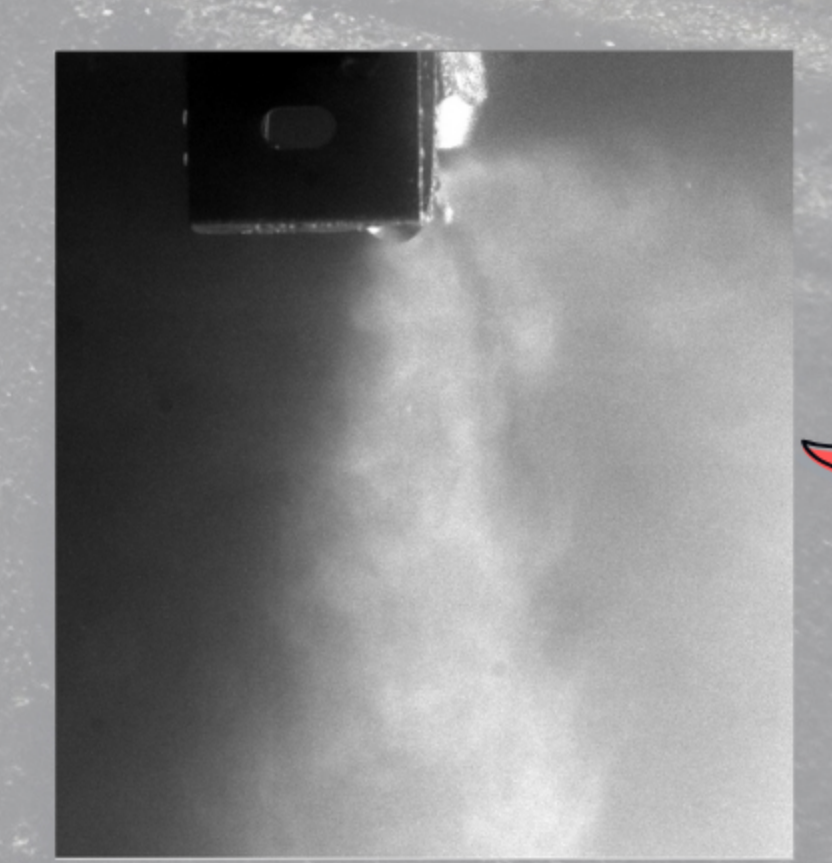
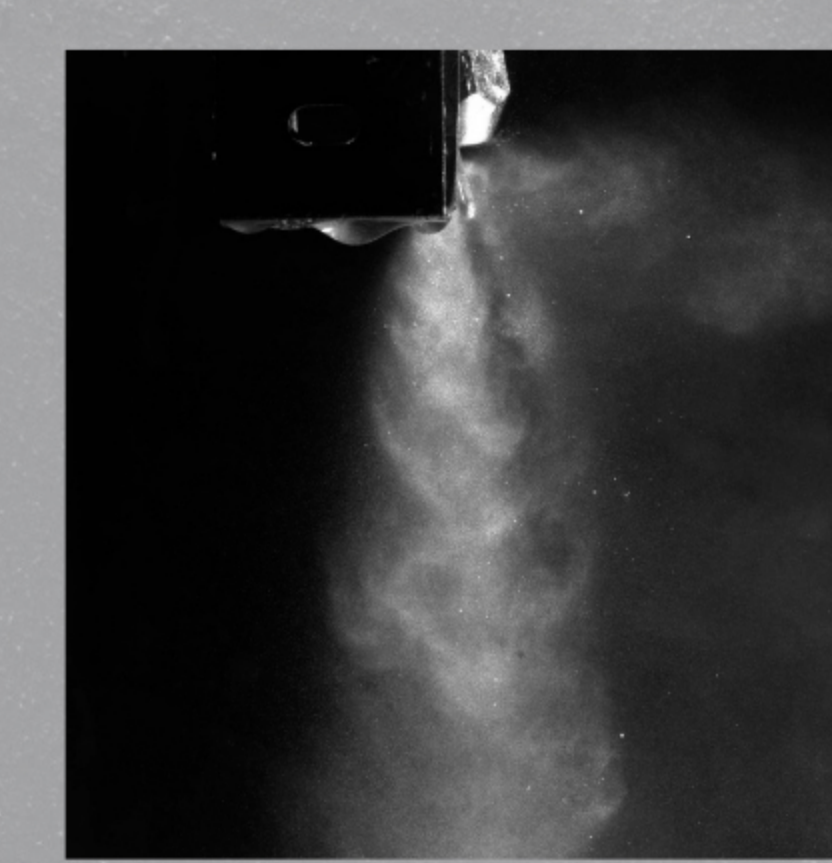
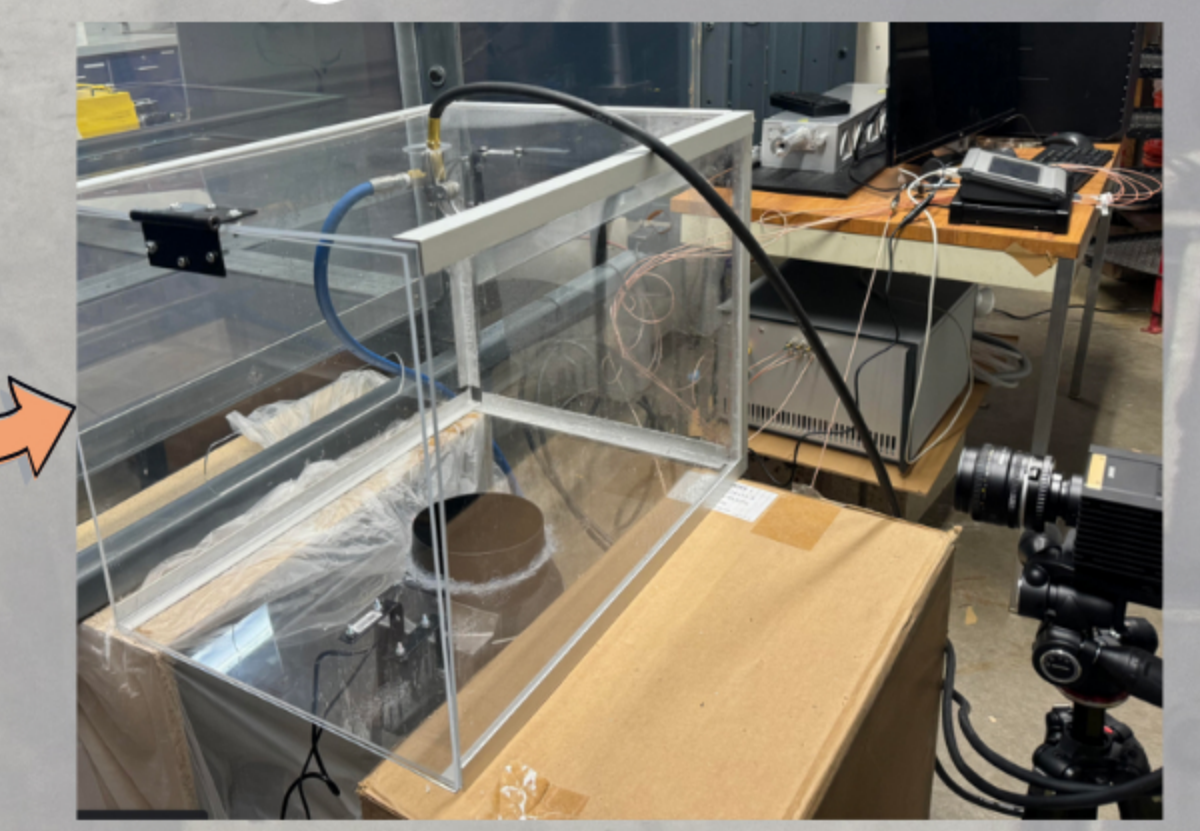
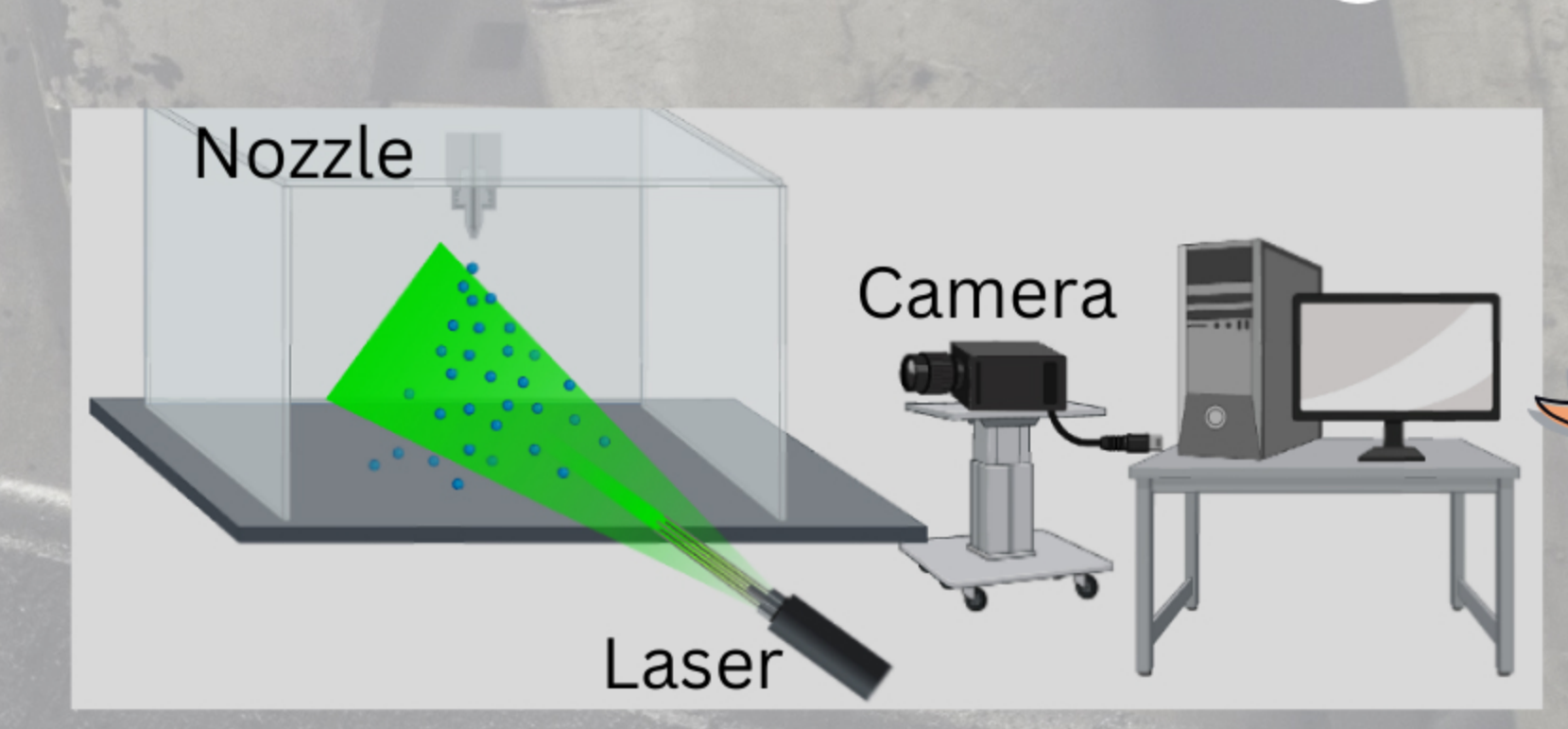


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### Particle Tracking Velocimetry (PTV)



## 6. Conclusions

- Calibrating the working parameters of nozzles is crucial for achieving the desired droplet size. It also helps to determine the suitability of the equipment that provides air and water flow.
- PTV images need to be processed to find spray parameters therefore, the water-air pressure must be the same as the ones to be used for the tests inside the wind tunnel.

## 7. Acknowledgements

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## 8. References

Cecala, A. et al. (2019). Dust Control Handbook for Industrial Minerals Mining and Processing-RI9689 Report of investigations (Second). Department of Health and Human Services.

