

Particle-capturing performance of South African non-corrosive samplers

Cecilia Pretorius

CSIR Centre for Mining Innovation



our future through science

Particle-capturing performance of South African non-corrosive samplers

- Sample the respirable fraction of dust
- Different samplers used world-wide
- Pilot study during 2007/2008 revealed that D50 values were scattered between 2 and 42 μm
- Samplers have an effect on the analysis results of silica
- Project to assess the particle-capturing performance of some South African samplers (also known as cyclones)

Particle-capturing performance of South African non-corrosive samplers

Objectives:

- To compare the performance of two locally manufactured samplers with one another under laboratory controlled conditions
- Not to discredit manufacturers or suppliers
- To illustrate the need for standardisation of samplers within the South African mining industry

Particle-capturing performance of South African non-corrosive samplers

Methodology:

- New samplers from different suppliers (4 μm cut-point)
- Laboratory tests:
 - Physical properties
 - Aerodynamic properties
 - Particle size distribution with standard dusts:
polydisperse particle standard (1 – 10 μm), Arizona dust (3 – 30 μm) and platinum mine ore dust (< 100 μm)

Physical properties of the samplers

Samplers used in the study:

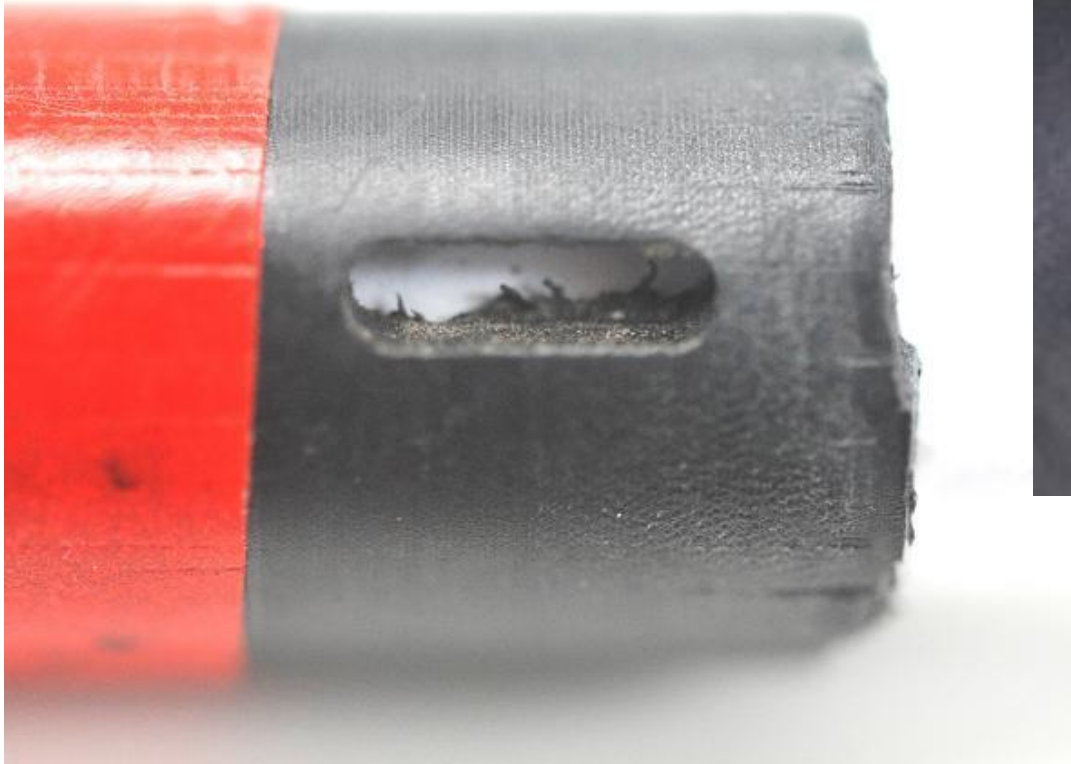
- Samplers obtained from three suppliers: two local and one international
- Locally supplied samplers will be referred to as X-Samplers and Y-Samplers
- Aluminium sampler was used as the control

Physical properties of the samplers

- X-Samplers: cone shaped top
- Y-Samplers: flat top => differences in outlet shape could affect the dust distribution on the filter
- Differences in barrel length
- Area of inlet apertures were different between the samplers types => different air velocities through the aperture
- Although there were differences between each type of sampler, physical properties were consistent within a group

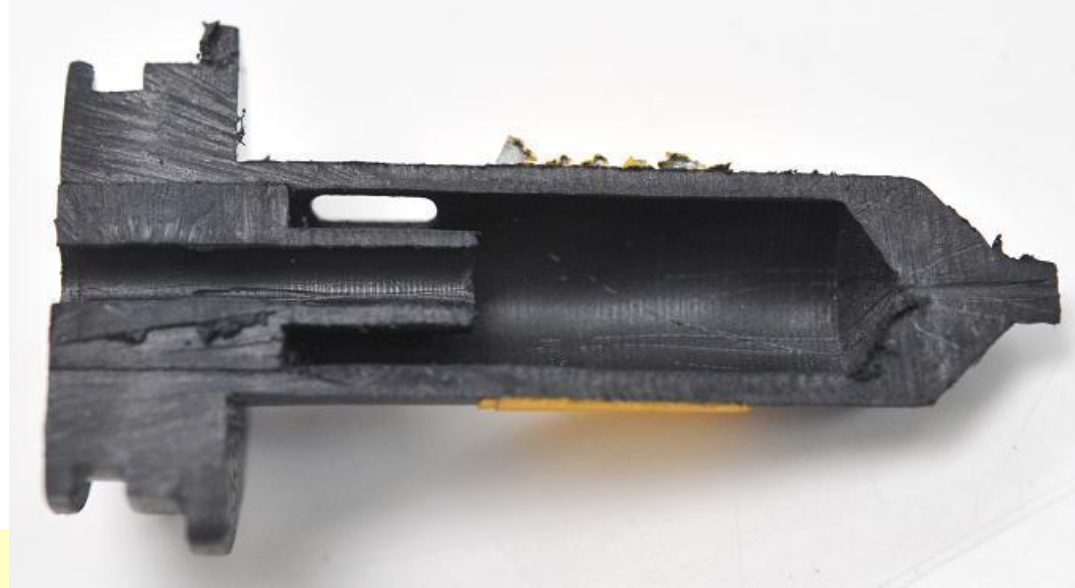
Physical properties of the samplers

Burrs are visible in outlet (right) and inlet (below) – poor finishing



Physical properties of the samplers

Inside of Y-Sampler (right)



Rough inside of X-Sampler
(below)



Visible differences between dust distributions



Aerodynamic properties of the samplers

- Pressure loss through X-Samplers showed poor consistency
- Pressure loss through Y-Samplers showed good consistency
- Air velocities compared well between the X- and Y-Samplers

Particle size distribution of sampled dust

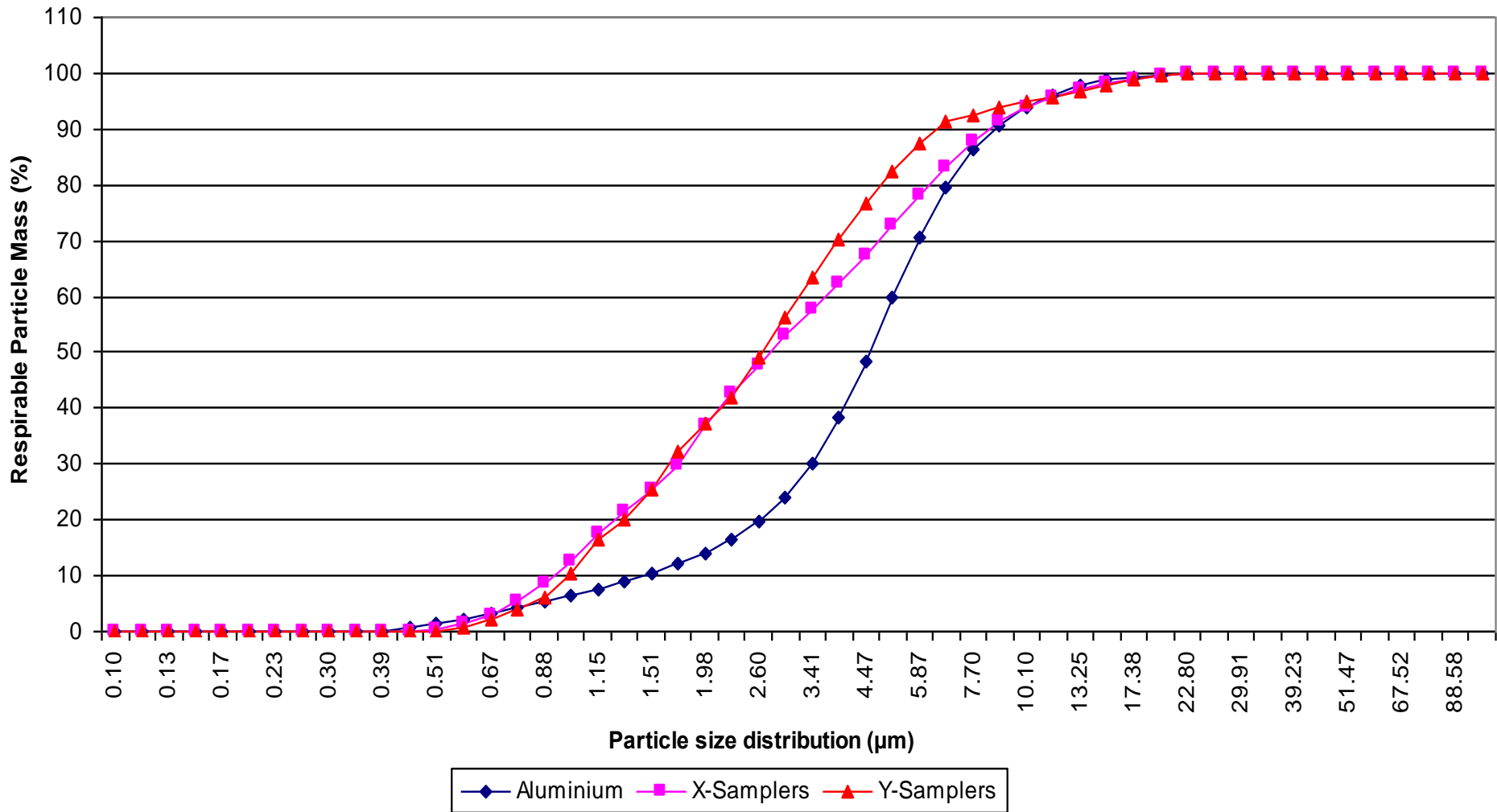
- Particle size distribution of sampled filters was analysed using the laser light scattering technique
- Light scattered by particle into detector depends on particle size, shape and refractive index
- D50 = 50% of the sample has a particle size below this value
D90 = 90% of the sample has a particle size below this value

Particle size distribution of sampled dust

- Respirable dust is defined as particulate passing through a cyclone with an efficiency that will allow:
 - 100% of 0 μm Aerodynamic Equivalent Diameter (AED);
 - 50% of 4 μm AED;
 - 30% of 5 μm AED; and
 - 1% of 10 μm AED.

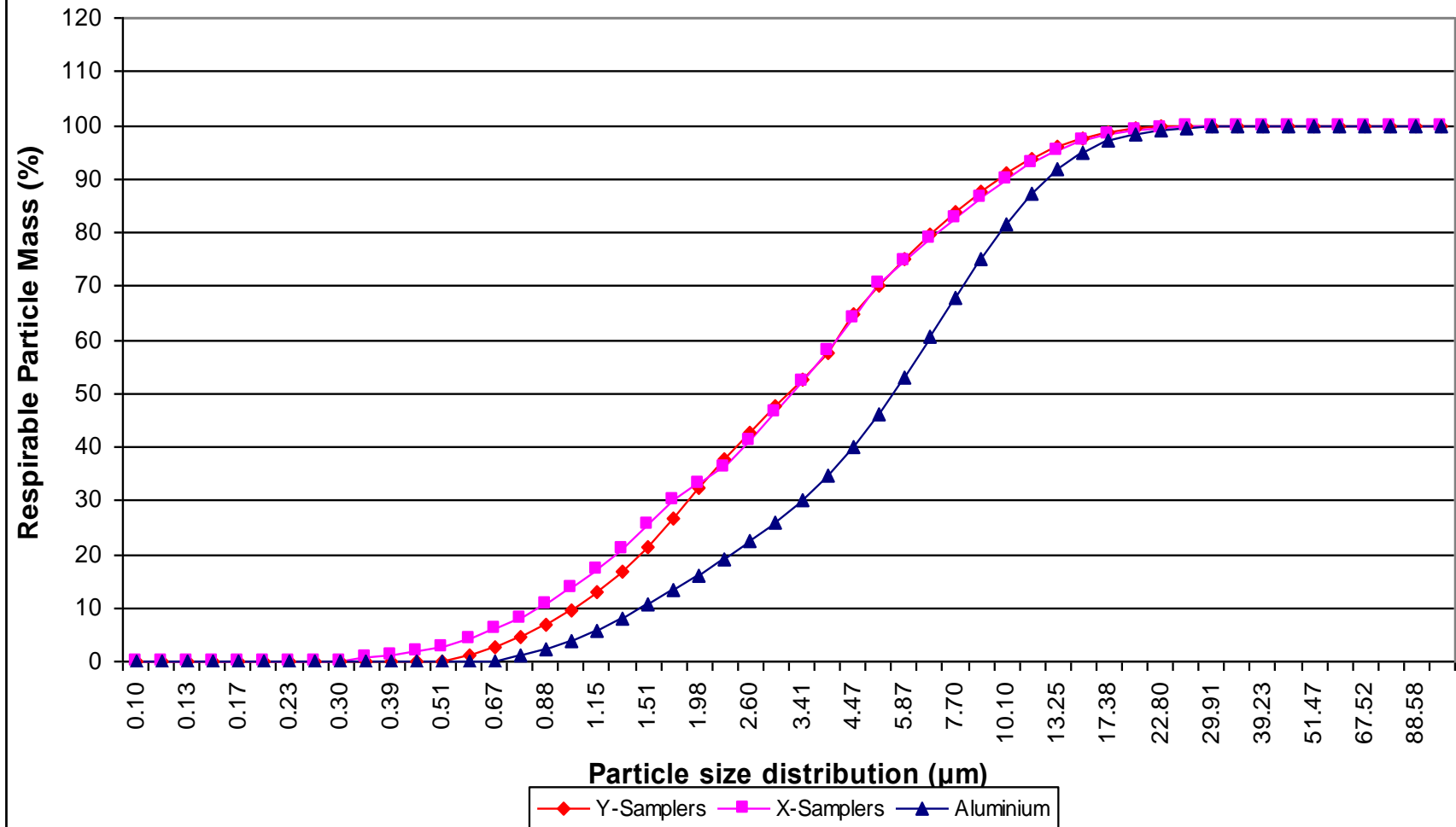
Particle size distribution of sampled dust

Polydisperse Particle standard (1 - 10 micron)



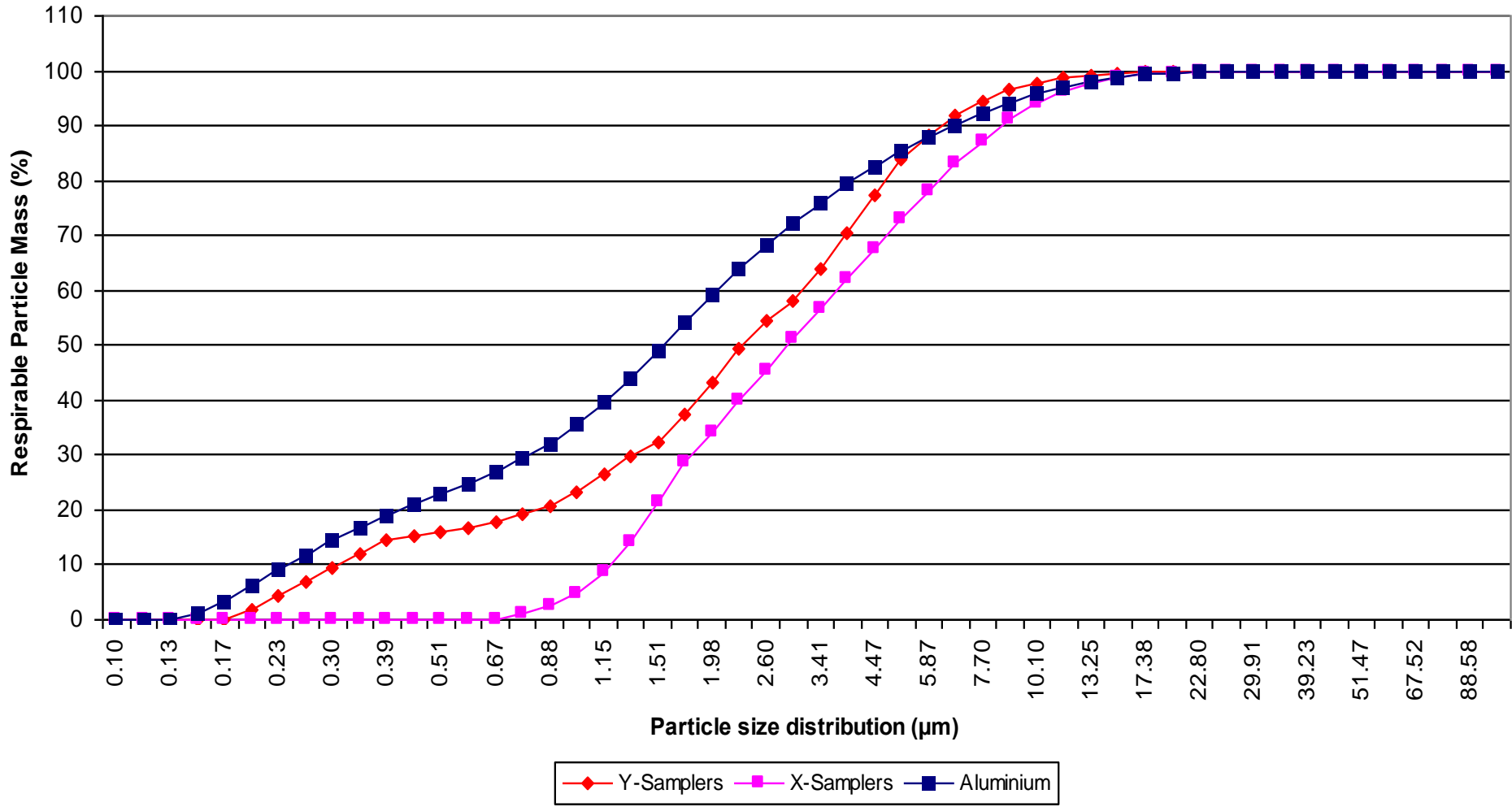
Particle size distribution of sampled dust

ARIZONA TEST DUST (3 - 30 micron)



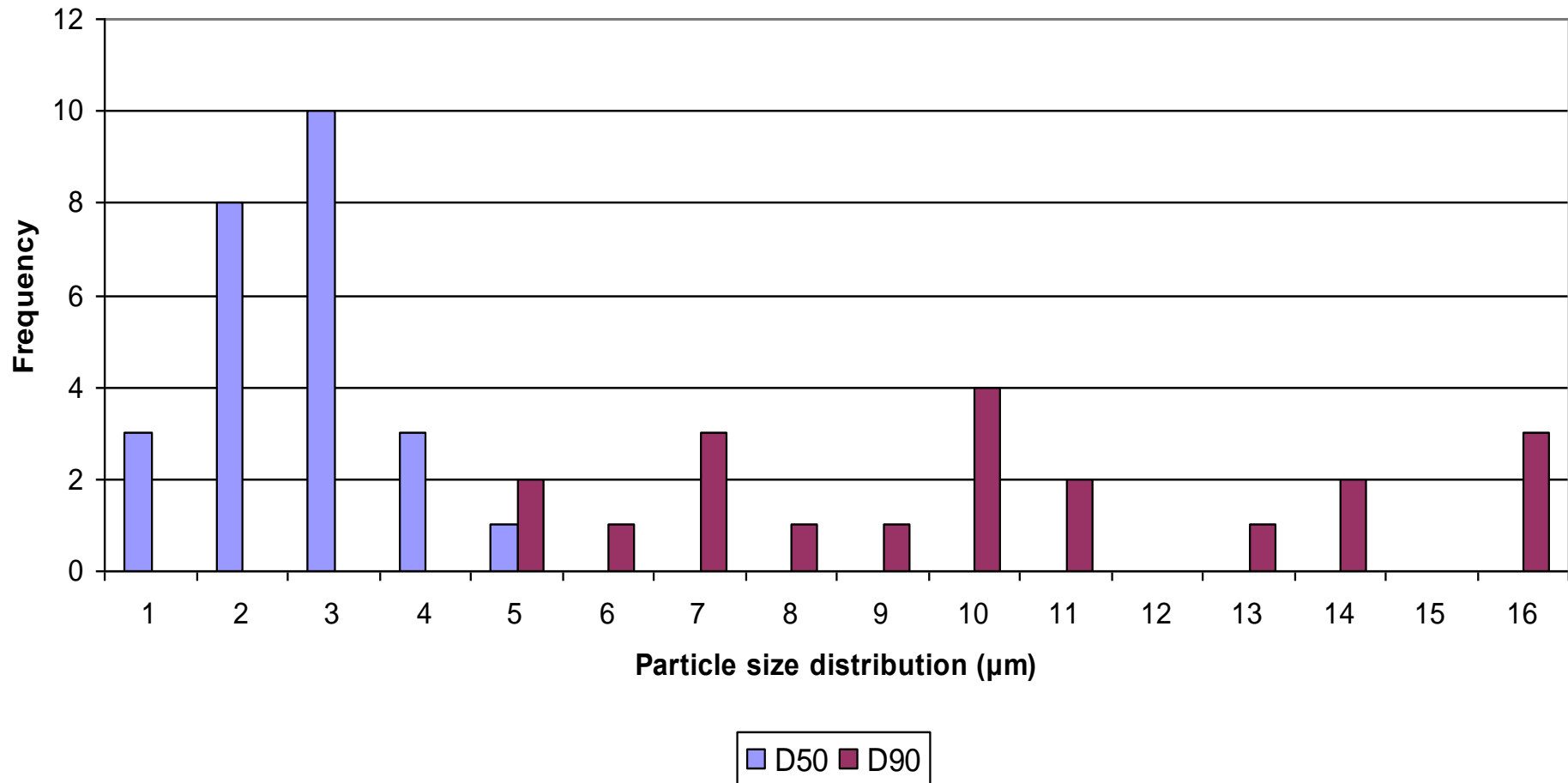
Particle size distribution of sampled dust

Platinum mine ore dust (< 100 μ m)



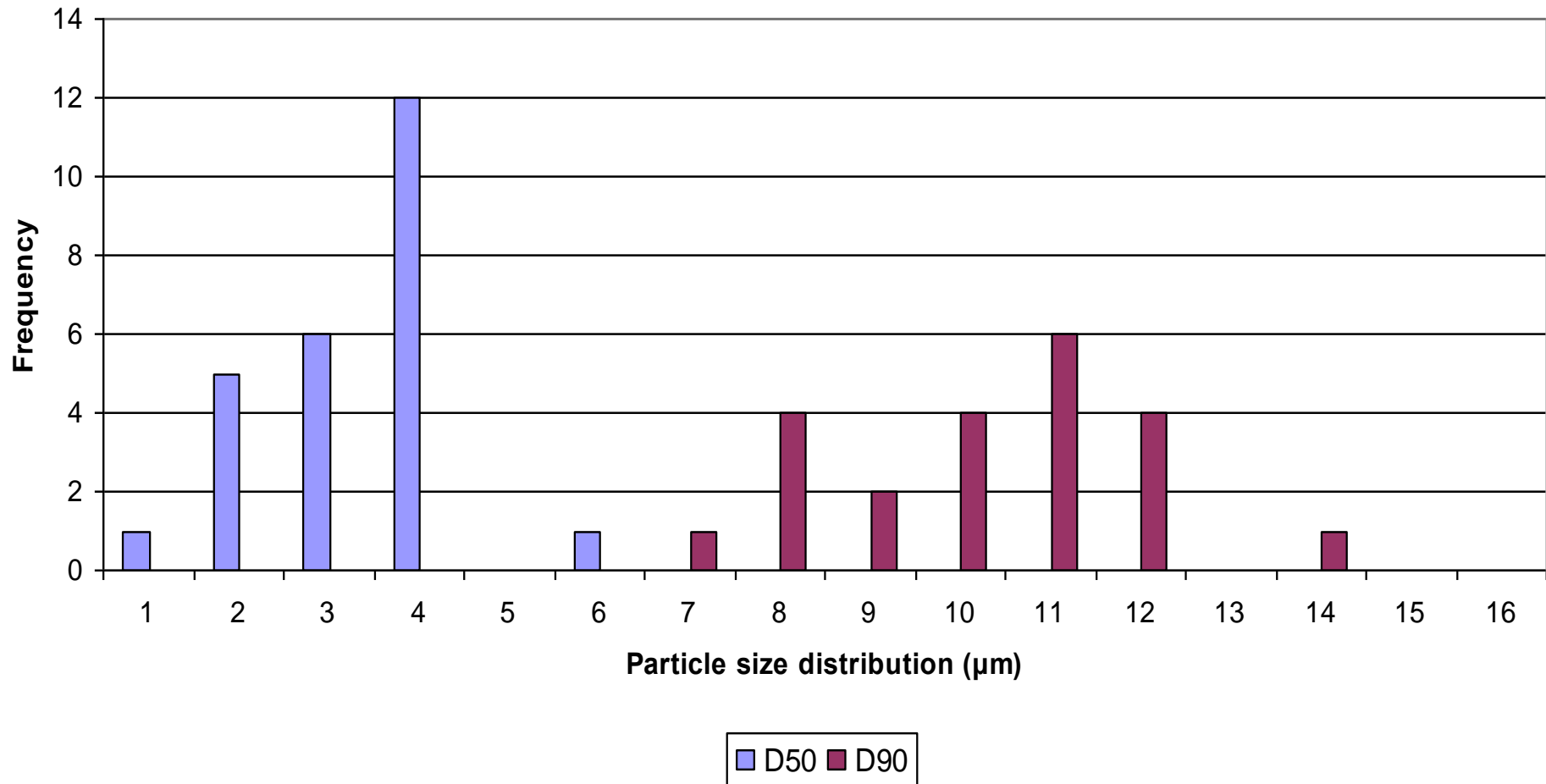
Particle size distribution of sampled filters taken in three platinum mines

Supplier X: D50 & D90 of actual underground sampling



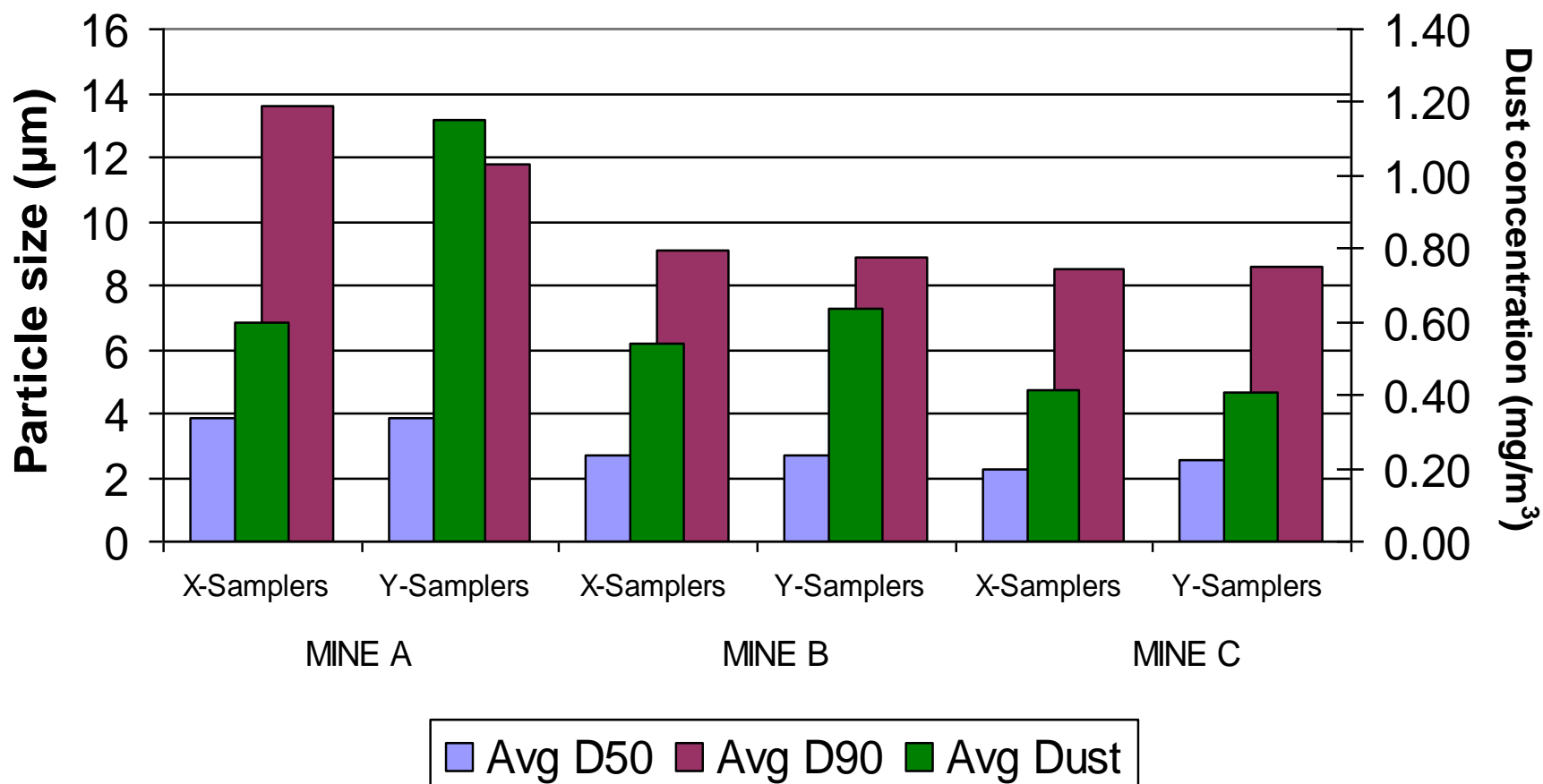
Particle size distribution of sampled filters taken in three platinum mines

Supplier Y: D50 & D90 of actual underground sampling



Particle size distribution of sampled filters taken in three platinum mines

PSA results according to mine



Particle size distribution of sampled dust

- Particle larger than 10 μm were deposited on the filters => larger XRD response
- Different performance with different standard dusts
- Different performance with dust from different mines within the same commodity

Conclusions & Recommendations

- Samplers within the South African mining industry needs to be standardised to ensure reliable, consistent and comparable results
- Quality assurance protocol for manufactured samplers

Future research

- ISO SC2 Workgroup 7: Silica measurements
- Two new work items: X-ray diffraction method
- Effects of samplers
- Internationally used samplers – laboratory tested and compared
- Both X- and Y-Samplers were submitted for this study

Future research

- CSIR Centre of Mining Innovation to continue research on these and other samplers used in the SA mining industry
- The effect on XRD Response due to varying performance of national samplers
- Collaboration with users of samplers
- Collaboration with manufacturers of samplers to ensure consistent and comparable performance

Acknowledgements

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Thank you

Cecilia Pretorius

cpretorius@csir.co.za

011-358 0052

