The Effects of Humidity on Respirator Performance

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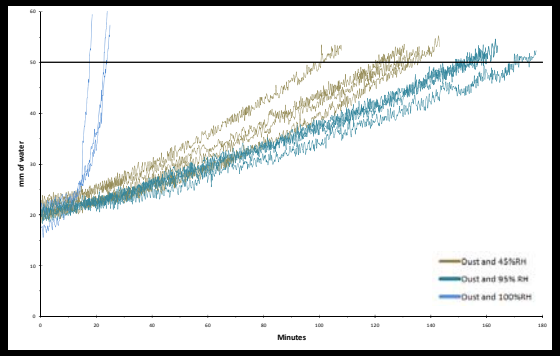
Background

Respirators are used in a wide variety of workplace settings that produce excessive dust concentrations to protect workers. As respirators are used particles collect on the filter media which results in an increase in pressure drop across the filter. This makes it more difficult for the worker to breathe while using the respirator.
This study looked at the effect that humidity has on the increase in pressure drop.

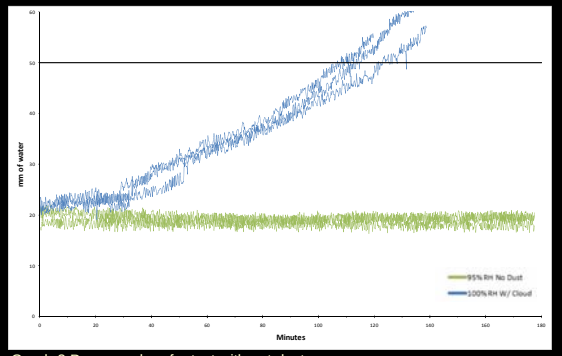
Methods

- The end point of the experiment for each trial was when a pressure drop of 50mm of water across the filter or the trial was run for no more than 3 hours. Pressure drop was monitored by a pressure transducer and logged by a computer.
- A horizontal testing chamber with a humidifier and dust input was used in testing the respirators. The flow rate was 42L/min and monitored using a manometer attached to a calibrated venturi meter.
- The test were carried out using 3 humidity levels 45%RH, 95% RH, and 100%RH. For the 100% RH tests water was inputted in excess so that a cloud formed in the test chamber. Humidity was monitored during each test using a TSI Q-Trak.
- Arizona Road Dust was generated at a concentration of 130 mg/m^3. Dust concentration was calculated using an IOM.

Results



Graph 1. Pressure drop for test with dust.



Graph 2 Pressure drop for test with out dust

	45% RH and Dust	95% RH and Dust	100% RH and Dust	100% RH and No Dust
Minutes to reach end point	99 121 127 133	158 170 152 151	18 24 23	122 108 112
Average	120	158	22	114

Table 1. Time taken to reach the end point

- The time it took the filters to reach the end point in the 3 conditions with dust were significantly different from each other, $P<0.05$.
- The time difference between the end points of dust and 45% RH and dust and 95% RH and dust was significantly different, $P=0.005$.

Conclusions

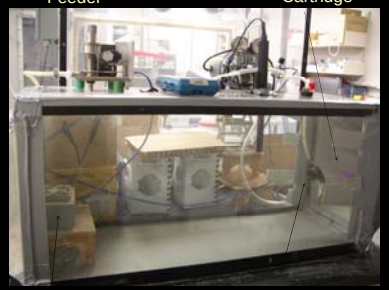
The result that high humidity increases the time it takes for the end point to be reached is surprising. This can likely be explained by humidity affecting the formation of the dust cake on the filter.

Future Research

Future research will look at the effects of different types of dust.

Humidity Generation and Air Intake

Test Chamber



Flow Control

Acknowledgements

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