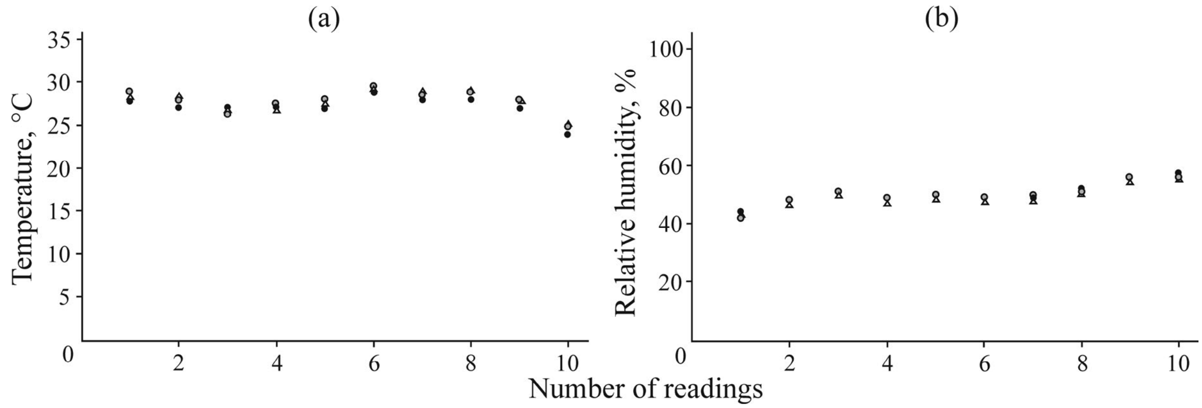

Fig. 5. Readings of temperature (a) and relative humidity (b) measured by reference instrument (▲), real time sensor (●) and sling psychrometer (⊙).

In addition the calculation of relative humidity from the T_{dbt} and T_{wbt} readings obtained from the sling psychrometer was also prone to have parallax effect. Maximum effort was given to minimize such parallax effects while readings were taken and interpreted on the sling psychrometer. Similarly, low scale resolution and limited gradations may affect the interpretation of the readings obtained from the sling psychrometer. The sling psychrometer was held at arm's length while taking readings, whereas the real time and reference instruments were held at a farther distance, hence the psychrometer may be slightly influenced by the presence of a human body. From manufacturer's specifications, the sensing accuracy of the real time relative humidity is $\pm 5\%$ whereas the accuracy of the reference instrument's relative humidity is $\pm 2.5\%$. The accuracy of sling psychrometer relative humidity is $\pm 5\%$. Similarly, the accuracy of real time temperature is 1% and the accuracy of the reference instrument's temperature is $\pm 0.7^{o}$c.

4. Overall comparison and limitation

The comparison of readings obtained from the experiments under the simulated conditions between IS real time and reference devices that:

—IS relative humidity instrument consistently shows a slightly higher relative humidity readings up to 6% and IS temperature instrument shows a variation in temperature readings within –6% to +3% in comparison to the reference instruments;

—when compared to the relative humidity readings obtained using the sling psychrometer intervals in an external uncontrolled environment, the readings obtained from real time instruments are within $\pm 2\%$ and readings obtained from reference instrument are within –3%;

—the real time T_{dbt} reading variations are –4 to 2%, and reference instruments reading variations are $\pm 2\%$ when compared to the sling psychrometer T_{dbt} readings for identical environmental conditions.

Conclusions are based on a limited number of samples obtained in a known environment, where the temperature and relative humidity data obtained with the real time IS instrument were compared and contrasted with that obtained using a calibrated instruments and a sling psychrometer. A larger number of sample readings taken under more environmental scenarios and with a representative number of IS instruments, reference instruments and sling psychrometer would provide a better degree of confidence in using the tested IS instruments. As per the IS real time relative humidity sensor specifications, the instrument has a sensing range of relative humidity of 10 to 90% with sensing accuracy of $\pm 5\%$. This working range does not cover the whole spectrum of the relative humidity encountered in the underground coal mines. In some places in underground coal mines, the relative humidity measures up to 100%. The high humidity areas are the areas where the mine operators are most concerned.

Conclusions

It is found that the IS real time instrument exhibits a variation of dry bulb temperature by as much as –6% and up to +3% and always shows higher relative humidity readings by as much as +6% when compared to the standard calibrated non-IS instrument readings. Within the limitations of the current study, the tested IS real time relative humidity and temperature monitoring instruments could be considered. However, this conclusion is based on a limited sample size, limited number of instruments and the measurements were taken in a limited number of controlled environmental scenarios of temperature and relative humidity. A larger number of readings taken under more realistic underground environmental scenarios and with a representative number of IS instruments would provide a better measure of confidence. It can be inferred from the work that presently, there is a definite need for the development of a reliable IS real time humidity measurement system suitable for use in Australian underground coal mines. The underground coal mines operate in the relative humidity range spanning up to 80 to 100%. The only IS approved instrument at the moment measures up to 90% relative humidity (as per manufactureэs specification). It is valuable to investigate the possible development of a new IS approved instrument which can measure up to 100% relative humidity.

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