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# THERMOCOUPLE HEATING IMPACT ON THE TEMPERATURE MEASUREMENT OF SMALL VOLUME OF WATER IN A COOLING SYSTEM

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## Highlights

- Heating impact of measuring temperature using thermocouple is first-time investigated in a commercially available Centeo-TG40 cooling device.
- Heating impact causes an overestimation in temperature thus requiring a correction.
- Size of thermocouple affects the heating impact.
- Challenges associated with the temperature measurement are addressed.
- Validation with compressive analysis is performed by numerical modelling.

## Abstract

Experimental and numerical analyses have been performed to investigate the heating impact of using a thermocouple for the temperature measurement of a small volume of cold water ( $\sim 24\text{mm}^3$ ), due to thermal conduction through the wires. Two sizes of K-type thermocouple,  $80\mu\text{m}$  and  $315\mu\text{m}$ , were used to measure the temperature of cold water inside a small, thermally regulated chamber within a Centeo TG40 cooling system. The results show that thermal conduction from the ambient environment into the cold water produces a heating effect. This effect decreases for greater submersion depth of the thermocouple junction and is eliminated when the thermocouple junction is close to the copper bottom of the chamber. The inclusion of an insert into the chamber increases the thermal resistance between the copper block and the water, raising the heating effect of the thermocouple. The cooling effect of the copper block on the water is diminished when the air gap between copper block and plastic insert is increased, consequently raising the temperature inside the small well. Moreover, increasing the water height inside the large well has a negligible effect on the temperature of the small well.

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