FINAL REPORT **DURATION: 00-01**

WTFRC Project #__________ Battelle Project # 28836

Project Title: ***Evaluation of Relative Humidity Sensors for CA Storage***

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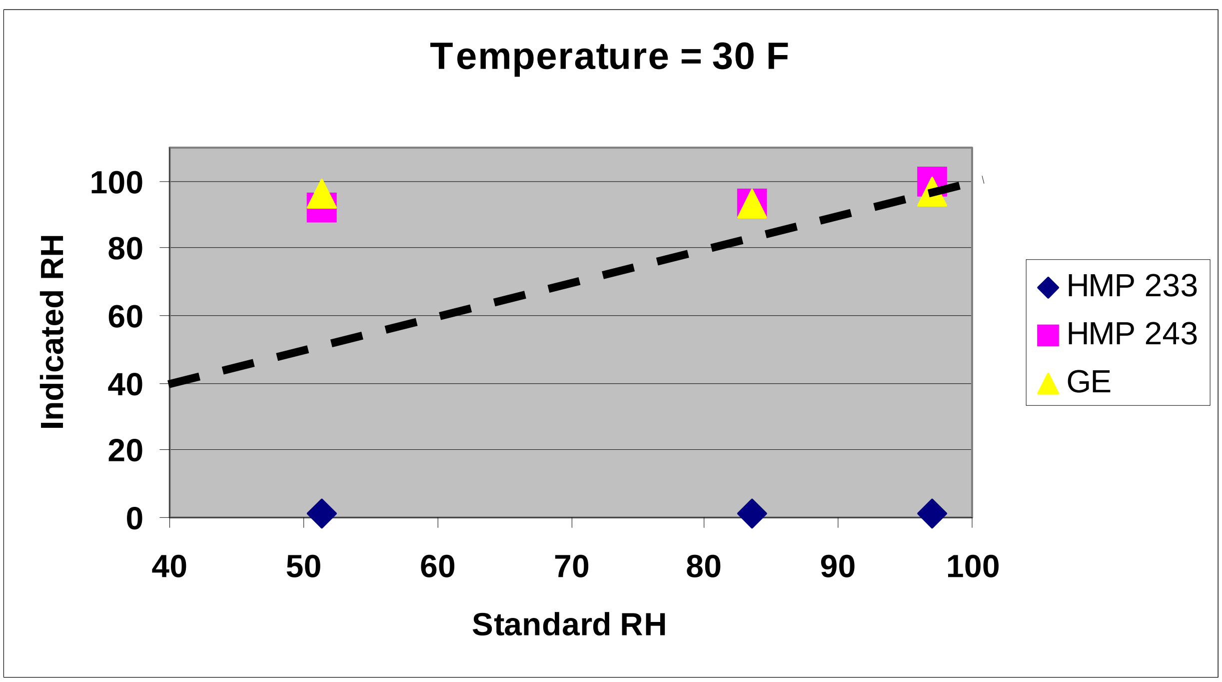
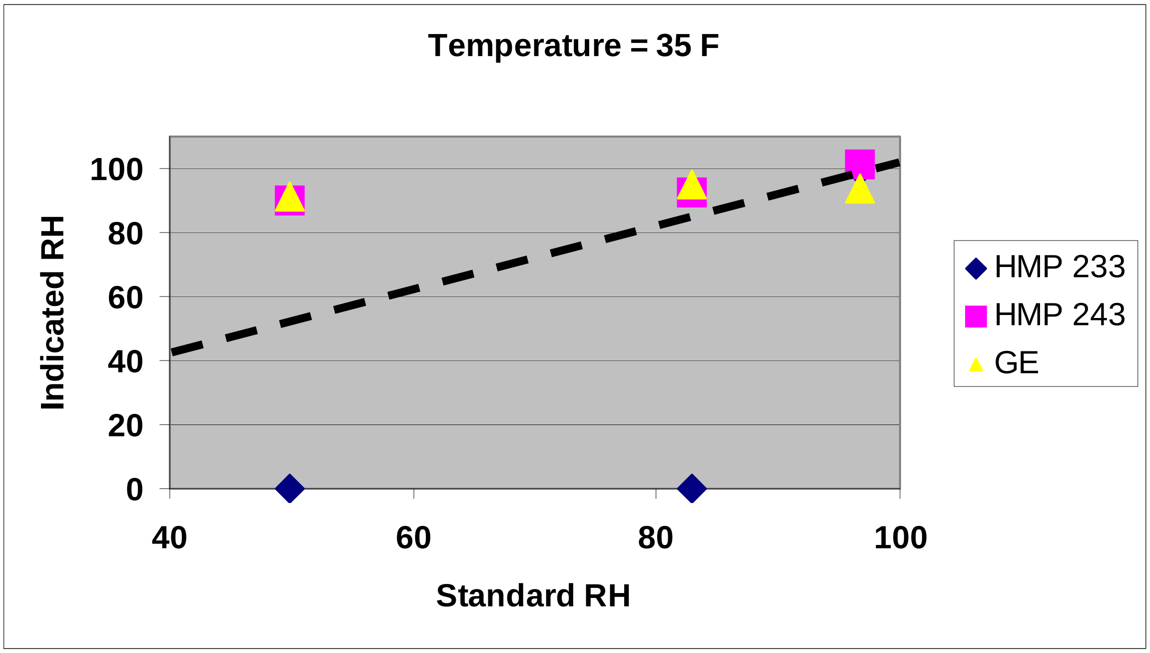
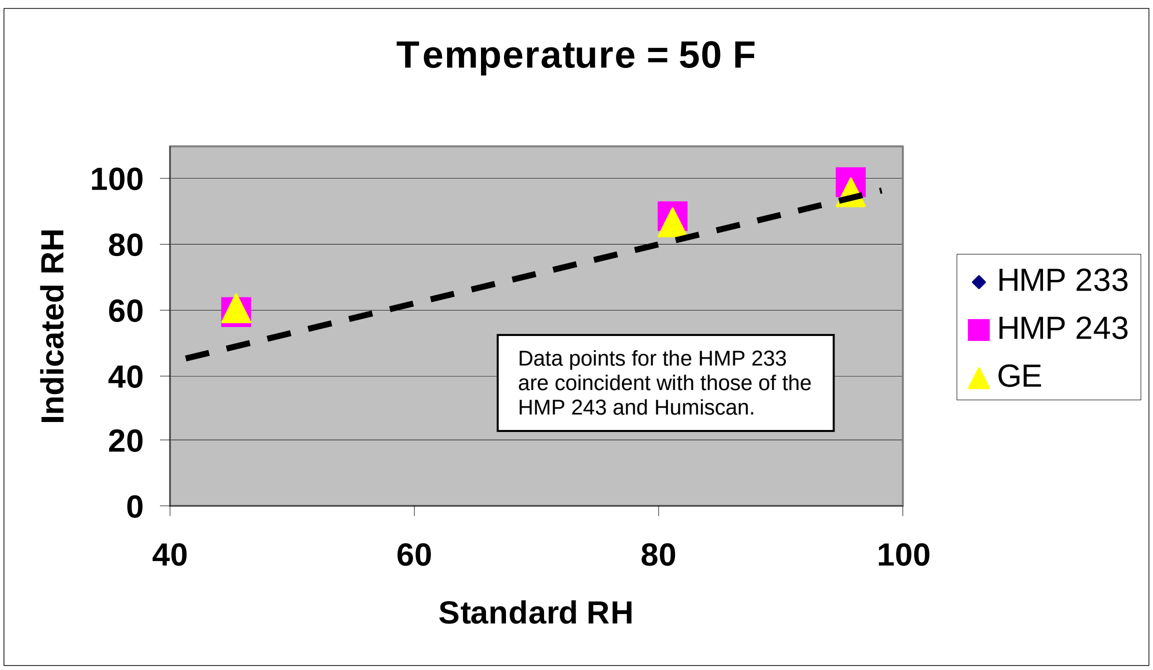
Objectives: Identify reliable commercial relative humidity sensors for CA/RA storage

Significant findings:

1) Both optical dewpoint hygrometers predicted humidities that varied significantly from the RH standards generated with the saturated salt solutions. This poor performance coupled with the fact that this type of sensor requires frequent cleaning (of the mirror) and re-calibration disqualifies its use in the CA/RA environment.
2) The capacitive type RH sensors showed similar responses but significant deviations from the calibration RH's generated using the saturated salt solutions. Plots of selected experimental data appear below. These three plots compare the indicated RH of the sensors (Vaisala HMP 233 and HMP 243, General Eastern Humiscan) with the RH of the standard saturated salt solutions. If the sensors demonstrated perfect agreement with the calibration standard their respective data values would lie on the dotted line.







These data indicate that the heated Vaisala RH sensor (HMP243) performs much better than the unheated Vaisala sensor (HMP 233) in the low temperature regime (30-35 F). Performance of the General Eastern Humiscan was comparable to the Vaisala HMP 243.

Methods: Commercial relative humidity sensors from Vaisala (HMP 233 and HMP 243), General Eastern (Humiscan), and EdgeTech (Model 200) were evaluated using saturated salt solutions in a temperature-controlled chamber. Two types of devices were evaluated: 1) optical dewpoint hygrometers which measure the temperature of condensate formation (i.e., the dewpoint) on a chilled mirror and; 2) capacitive sensors whose dielectric constant changes as a function of absorbed moisture. Both optical dewpoint sensors produced spurious outputs early in the tests and were eliminated from further study. Saturated salt solutions were used to generate standard humidities for all tests. For a given salt solution, RH was adjusted by varying the ambient temperature in the measurement chamber. A table of RH values above the saturated salt solutions appears below.

Relative Humidity of Saturated Salt Solutions					
Temperature (F)	**20**	**30**	**35**	**45**	**50**
Potassium sulfate	**97.6**	**97.0**	**96.7**	**96.1**	**95.8**
Potassium chloride	**85.1**	**83.6**	**82.9**	**81.7**	**81.2**
Magnesium nitrate	**54.4**	**51.4**	**49.9**	**46.9**	**45.4**

Results and discussion: Assuming the RH values generated using the saturated salt solutions are valid (see "Humidity Fixed Points of Binary Saturated Aqueous Solutions" by Lewis Greenspan, J. Res. Natl. Bur. Stds., 81A:89,1977). none of the commercial RH sensors evaluated in this study gave satisfying results. Of the five sensors evaluated, the Vaisala HMP 243 and the General Eastern Humiscan gave the closest agreement with the calibration RH values. The fruit storage measurement regime (95% RH at 32-40 F) presents a significant challenge to available RH sensors, most likely due to the formation of condensate on the sensor element. On this assumption, a heated sensor element (Vaisala HMP 243) seems imperative. Clearly there is an opportunity here to explore alternative sensing methods for the unique conditions of the CA/RA environment.

Budget: $25K (2000-01)

Project duration: This was a one-year project and is now complete.

Current year breakdown:
Battelle labor: $7K
Student labor: $ 3K
Equipment and supplies: $15K