FINAL REPORT **DURATION: 97-00**

WTFRC Project #_____ Battelle Project # 28836

Project Title: **Evaluation of Ammonia Sensors for CA Storage**

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Cooperators: Matt Wight and Mike Young, Stemilt Growers

Objectives: Identify reliable commercial ammonia sensors for CA storage

Significant findings:

1) Contrary to popular belief, ammonia sensors do not "go to sleep" if they are not exposed to ammonia for an extended time period. In our study, an array of 8 ammonia sensors were shut down for a period of 3 months (August 4 through November 3, 2000) and all sensors showed normal responses when re-exposed to 10-15 ppmV ammonia injections. All three of the Pacific Technologies ammonia sensors (configured as alarm devices) required readjustment of the alarm setpoint.
2) Laboratory evaluations of a selected set of ammonia sensors (David Bishop, MST/ATMI) indicate peak response times ranging between several seconds and 1-2 minutes.
3) One of two MST/ATMI sensors (Model 9602-0200 with Model 9602-6702 ammonia sensor) failed when exposed to ca 2000 ppmV ammonia. Sensor response was restored by baking the sensor units at 40C over a three-day period, however both MST/ATMI units showed significant baseline shifts.
4) Final measurements to establish lower detection limits for the David Bishop and MST/ATMI sensors will be completed in July.

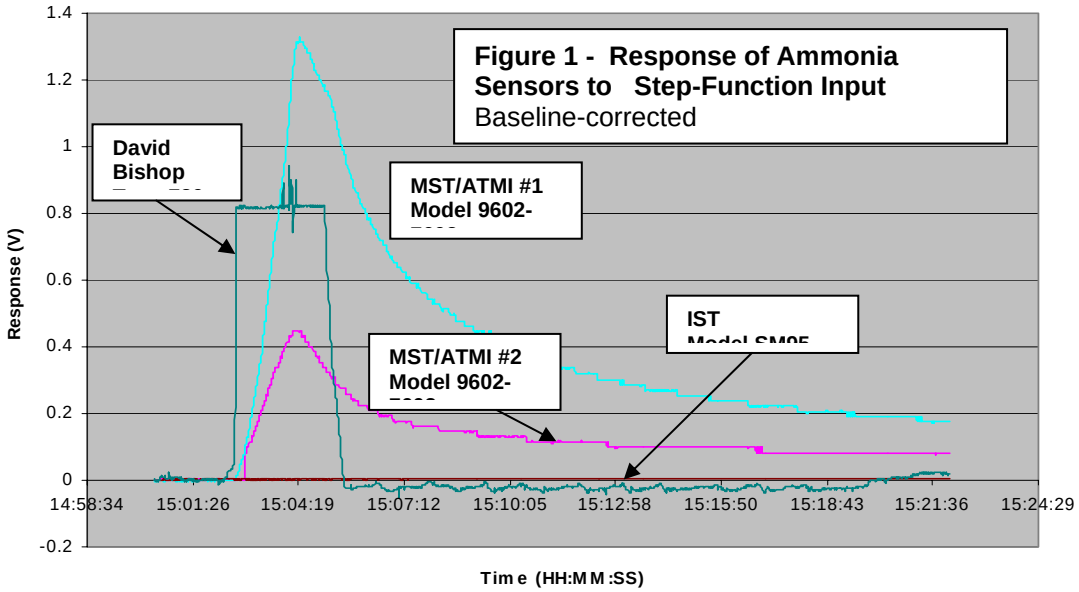
Methods:

At the end of the 2000-01 fruit storage season (August 3, 2000) the ammonia sensor testing system (installed at Stemilt facilities in Wenatchee, WA) was shut down. The sensor suite was comprised of ammonia sensors manufactured by David Bishop, MST/ATMI (two units), Plant Rat, Enmet, Draeger, Industrial Scientific (three units), and Pacific Technologies (three units). All sensors were left in place (at the exhaust of the sampling manifold) and powered down. In early November, when the CA rooms were again full, the sensor system was powered up to determine if any of the ammonia sensors had "gone to sleep". All sensors (except the Pacific Technologies devices) were observed to "wake up" and show normal responses to the hourly ammonia injections. The three prototype sensors provided by Pacific Technologies initially showed no response to the hourly ammonia injections. However, when the alarm threshold for each device was recalibrated, two of the three devices returned to normal operation.

Laboratory evaluations of selected ammonia sensors were performed to: a) determine response times and ammonia concentration detection limits and; b) observe sensor performance features and failure modes not previously observed during the field evaluations at Stemilt facilities in Wenatchee, WA. These evaluations were performed using one David Bishop Type 730 and two MST/ATMI Model 9602-0200 (Model 9602-6702 detector). A third sensor (International Sensor Technology Model

SM95-S1) was included in the laboratory evaluations but was deemed unreliable due to intermittent outputs. Representative data appear in Figure 1.

Results and discussion: This year's laboratory experiments suggest that there are at least two



commercially-available ammonia sensor systems suitable for reliable CA monitoring (David Bishop Type 730 and the MST/ATMI 9602-200). The prototype optical ammonia sensor system under development by Pacific Technologies also appears to be a viable option assuming it becomes commercially available. Note that Industrial Scientific has chosen to *discontinue development* of its (successful) optical ammonia sensor technology for the ammonia refrigeration market.

Budget: The budget summary for this project appears in the table below.

Project duration: 1997-2000 (This project is now complete.)

Current year: Budget for the current year was $35K.

Yearly budget:

Year	Year 1 (1997)	Year 2 (1998)	Year 3 (1999)	Year 4 (2000)
Total	$57.8K	$62K	$58.4K	$25.9K

Budget Breakdown				
	Year 1 (1997)	Year 2 (1998)	Year 3 (1999)	Year 4 (2000)
Battelle labor	$19.7K	$29.4K	$23.8K	$19.3K
Student labor	$6.3K	$12.9K	$15.2K	$2.1K
Equipment and supplies	$29K	$16.7K	$17.1K	$3.6K
Travel	$2.2K	$2.9K	$2.2K	$0.9K