overdrying of the grain bottom layers. Overdrying levels from 1 to 2% points were observed for the two experiments for a target moisture content of 15% (Experiments 1 and 5). Our current hypothesis is that the differences in the corn EMC relationship during the moisture desorption and absorption phases may be more significant than previously assumed in the literature. This will be further investigated with laboratory experiments in preparation for the 2004 fall harvest season.

[Note: The research project "Site-specific drying and conditioning of identity-preserved quality food grains" was separated into two phases. The second phase of this project was granted with a second year extension from MAFMA. The research reported in this document is related to the first phase of this project. The first phase and second phase of the project are closely related. The third objective of the second phase of the project (Objective 3) is the continuation of the second objective (Objective 2) of the first phase of the project. The relationship between the first phase of the project and the second phase of the project will be explained under Objective 2 of the report].

## 2. Objective Accomplishments

## Objective # 1

## To evaluate an improved Equilibrium Moisture Content Controlled (EMC$^2$) variable heat in-bin low temperature drying and conditioning prototype system, and to quantify its benefits on quality and purity of IP food corn

During the 2003 drying season, six field experiments were carried out in three Indiana locations: Princeton (Southwestern Indiana), West Lafayette (West-Central Indiana), and Shelbyville (Central Indiana). In Princeton, two bins were set up to dry white corn (21-22%) with the new Self Adapting Variable Heat (SAVH) strategy (experiments 3 and 4) (see Objective 2). In West Lafayette, two bins were filled with 22-23% wet corn (regular yellow dent). One bin was set up with the new SAVH strategy (experiment 1) and the other with the Continuous Natural Air (CNA) strategy (experiment 2). In Shelbyville two bins were filled early in the season with fairly dry corn (16%), and two other bins were filled late in the season with wet waxy corn (23-24%). In the first two bins, little drying work was required. The second two bins were set up with the Variable Heat (VH) strategy (experiment 6) and with the new SAVH strategy (experiment 5). The bins were constructed from corrugated-galvanized steel sections and equipped with a fully perforated drying floor, centrifugal fans, and a low pressure LP gas burner (The GSI Group, Assumption, IL). Tables 1 to 3 summarize the key information for each one of these experiments. Initial samples were collected from each one of the experiments during binning. Afterwards, bins were probed on a weekly basis until the end of the experiment with a standard torpedo probe every three feet (i.e.: 0, 3, 6, 9 ft, etc) below the grain surface, and at two locations: in the center and near the sidewall. At Shelbyville, a pneumatic probe (Port-A-Probe, GVS Ltd., Prairie Village, Kansas) was used to probe bins of experiments 5 and 6. The quality of the grain was quantified in terms of moisture content, grain composition and test weight (TW). The grain moisture content and test weight (lb/bu) were determined with a calibrated GAC-2100 analyzer (Dickey-John, Auburn, IL). Grain composition (protein, starch, oil and density) was determined with a calibrated NIRT machine (Infratec 1229 Grain Analyzer). Ambient temperature and relative humidity data were collected every 15 minutes during the entire period of the drying experiments. Plenum conditions were also recorded (temperature and EMC), as well as operational parameters of the drying system (fan and heater status, error messages, etc). Temperature and relative humidity conditions of the headspace were collected with HOBO data loggers in three bins. This data were used to explore the possibility of using headspace condition to compute EMC of the exhausting air, and relate that to the moisture content of the surface grain layer. This data could be useful to predict the end of drying.

## West Lafayette

Table 1 summarizes the information corresponding to the two drying experiments at West Lafayette. At this site, the new SAVH strategy and the CNA strategy were tested in two identical bins, drying regular yellow dent corn. The CNA drying bin had a 10% higher airflow rate (1.68 vs. 1.84 cfm/bu for the SAVH and the CNA strategies, respectively). The drying experiment started on September 26 and finished on November 7. The initial moisture content was about 20.8% for both experiments. The SAVH strategy used the fan intensively, i.e., 99% of the operating time (operating time is defined as the time during which the system was working, and does not take into account the time during which the system was down due to any kind of failure). During the entire drying period the SAVH strategy was about 10 days out of service. The heater run time was about 54% (Figure 1). The SAVH strategy increased the air temperature in the plenum by 6ºF average above the ambient temperature.

Table 1. Information for the in-bin drying experiments implemented at West Lafayette, Indiana during the 2003 drying season.

| Description | Experiments | |
|---|---|---|
| | 1 | 2 |
| Location | W. Lafayette | W. Lafayette |
| Year | 2003 | 2003 |
| Strategy | SAVH | CNA |
| Grain | Regular Corn | Regular Corn |
| EMC set points[1] | 13-15% | - |
| Bin diameter | 18 ft | 18 ft |
| Fan | CF 3 HP | CF 3 HP |
| Burner | 500,000 BTU | - |
| Grain depth | 12 ft | 12 ft |
| Static pressure | 0.9 inches | 1.05 inches |
| Airflow (cfm/bu) | | |
| Wall | 1.92 | 1.99 |
| Middle | 1.80 | 1.93 |
| Center | 1.32 | 1.59 |
| Average | 1.68 | 1.84 |
| Bushels | 2290 bu | 2279 bu |
| Initial drying date | September 26 | September 26 |
| Initial MC (%) | 20.8 | 20.8 |
| MC range (%) | 18.5-21.5 | 18.5-21.5 |
| Final drying date | November 7 | November 7 |

| | | |
|---|---|---|
| Fan run hours (%)[2] | 998 (99) | 1256 (100) |
| Heater run hours (%)[2] | 549 (54) | - |
| Temperature Increase | 6ºF | - |
| Final MC (%)[3] | 13.7 | 14.0 |
| MC range (%) | 12.8-15.5 | 13.7-14.2 |

[1] $EMC_L$ and $EMC_H$ set points.

[2] Percent of operating time.

[3] Final target MC was 15%.

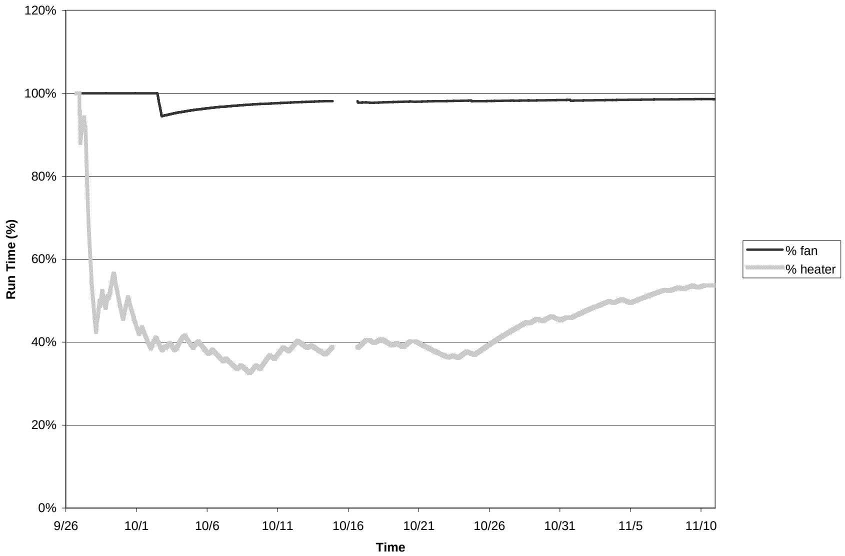

Figure 1. Fan and heater run time (as percentage of the operating time) for the SAVH strategy at West Lafayette.

Figure 2 shows the effect of the selecting/conditioning work of the SAVH strategy based on the EMC of the drying air in the plenum of the bin. The average ambient EMC oscillated between 18 and 20% during the entire drying experiment. It indicates that there were not enough hours with dry air conditions during the day to compensate for the wet air conditions of the night hours. As a consequence, the average EMC in the plenum of the bin had the tendency to exceed the upper EMC limit of 15%. Therefore, to compensate for the excess of wet aeration hours the system used the heater to condition ambient air during the wet hours to the higher EMC limit of 15%. In this case, the system behaved like the traditional VH strategy. The final result shows that the average EMC in the plenum of the bin was 15.2%.

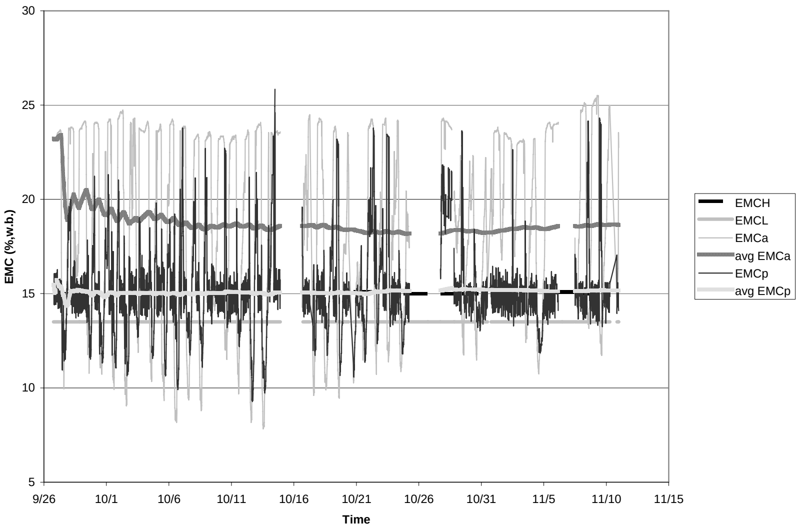

Figure 2. Hourly EMC values and cumulative average of ambient and drying air in the plenum of the SAVH strategy bin at West Lafayette (Experiment 1).

The change in moisture content for the SAVH and CNA drying experiments are presented in Figures 3 and 4, respectively. The SAVH strategy caused some overdrying of the grain. For this experiment the grain moisture content seemed to stabilize at about 13%, 2 percentage points below the target final moisture content, even though the average EMC in the plenum was close to 15%. Some level of overdrying of the grain bottom layers was also observed in other experiments.

CNA drying showed good performance, drying corn to a final average moisture content of 14% and with low variability. This observation is in agreement with what has been observed during previous years, i.e., CNA drying with a relatively high airflow rate (1.84 cfm/bu average) could be a suitable strategy for West Central Indiana.

Different drying rates were observed for the grain volume located in the center vs. side of the SAVH and CNA strategies bins. The main reason was the uneven airflow rate in the bins due to the non-uniform distribution of the fine material in the grain mass. The fine material concentration was 3.55% and 1.32% for the center and side volumes of the SAVH strategy bin, respectively, and 2.23% and 0.93% for the center and side volumes of the CNA strategy bin, respectively. The higher concentration of fine material in the center of the bin caused a decrease in the airflow rate through that volume and an increase of the airflow rate in the grain mass close to the bin wall (45 and 25% increase for experiments 1 and 2, respectively). The higher airflow rate caused a faster movement of the drying front in the grain mass close to the bin wall than in the grain mass at the center of the bin, which finished drying earlier. As a consequence, once the grain close to the bin wall was dried, the system had to continue removing moisture from the center of the bin, while most of the drying air was flowing through the side volume, making the drying system overall less efficient. The non-uniform airflow rate resulted in an extension of 28 days in the drying period for the grain mass in the center of the bin in comparison to the drying period of the grain mass close to the bin wall for the SAVH strategy (October 24 and November 21 for the side and center grain volumes, respectively). Similarly, the drying period for the grain mass close to the bin wall was 14 days shorter than for the grain mass in the center of the bin for the CNA strategy (October 24 and November 7 for the side and center grain volumes, respectively). For future experiments, some preventive steps will be taken to reduce the effect of broken corn and foreign material (BCFM) on the uniformity of the airflow rate. The preferred options to deal with BCFM are: 1) remove FM by cleaning the grain before filling, 2) filling the bin with a grain distributor to scatter BCFM, and 3) coring the bin after filling without using a grain distributor.

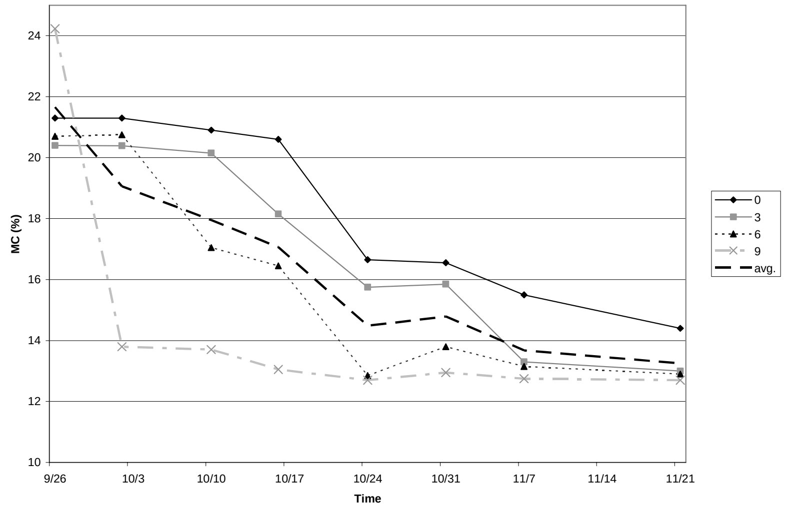

Figure 3. Change in corn moisture content at the grain surface and 3, 6 and 9 ft below the surface during drying with the SAVH strategy at West Lafayette (Experiment 1).

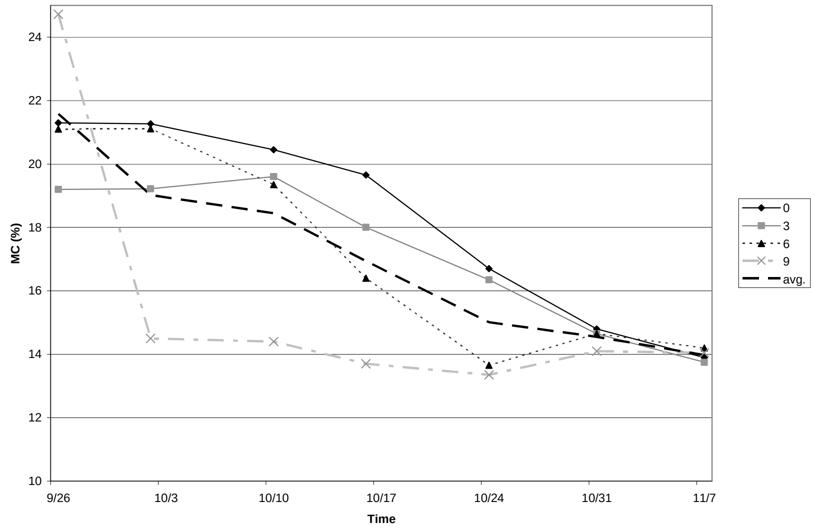

Figure 4. Change in corn moisture content at the grain surface and 3, 6 and 9 ft below the surface during drying with the CNA strategy at West Lafayette (Experiment 2).

Table 2 summarizes the energy consumption and drying efficiency for Experiments 1 and 2. Since the total fan run time for the CNA experiment was about 25% higher than for the SAVH experiment, the electricity consumption was also 25% higher for the CNA experiment (5,797 kWh vs. 4,602 kWh). The SAVH strategy also consumed 192 gal of propane (equivalent to 5,175 kWh). Thus, the total energy consumption for Experiment 1 was 9,777 kWh. The total water removed for this experiment was 4,710 kg, which yielded a drying efficiency of 2.07 kWh per kg of water removed. In contrast, the drying efficiency for the CNA experiment was higher. A total of 4,505 kg of water were removed with a total energy consumption of 5,797 kWh. This yielded a drying efficiency of 1.29 kWh per kg of water removed (38% less energy was required to remove 1 kg of water with the CNA strategy than with the SAVH strategy). For this location, it was also cheaper to operate the CNA strategy than the SAVH strategy. The cost of drying corn with the SAVH strategy was 20 cents/bu, while the CNA strategy was 20% cheaper (16 cents/bu). Previous simulation work (Bartosik and Maier, 2004a) also reported that for some years the CNA strategy could be a cheaper option than the VH or the continuous heat (CH) strategy. However, simulation results also showed that when many years are considered, the average cost of the VH and CH strategy are lower than the average cost of the CNA strategy.

Table 2. Energy consumption and drying efficiency for Experiments 1 and 2 at West Lafayette, Indiana during the 2003 drying season.

| Description | Experiment 1 | Experiment 2 |
|---|---|---|
| Electricity consumption (kWh) | 4602 | 5797 |
| Gas consumption (kWh) | 5175  (192 gal) | - |
| Total energy consumption (kWh) | 9777 | 5797 |
| Efficiency | | |
| Total water removed (kg) | 4710 | 4505 |
| Drying efficiency (kWh/kg of water) | 2.07 | 1.29 |
| Cost | | |
| Electricity (0.063 $/kWh) | $298.9 | $365.2 |
| Propane (0.85 $/gallon) | $163.2 | - |
| Total | $453.1 | $365.2 |
| Bushels of corn | 2290 bu | 2279 bu |
| Cost per bushel | 0.20 $/bu | 0.16 $/bu |
| Cost per bushel per point of moisture | 2.78 c/bu/pt | 2.36 c/bu/pt |

Similar results and observations were made for the experiments at the other two locations (Princeton and Shelbyville) and are summarized in the papers that have been published based on this research (Bartosik and Maier, 2004, 2005)

## Low Temperature In-Bin Drying Effect on Grain Quality

During the entire drying season grain samples at different locations and depths of the grain mass were taken. These samples were analyzed for composition, test weight, and moisture content. Tables 5 to 7 present average composition data and their corresponding standard deviation for the beginning and the end of each one of the low temperature drying experiments. The average initial composition value for all the treatments were 5.11, 8.75 and 71.0% for oil, protein and starch, respectively, and the corresponding ranges of variation were 5.02%-5.27%, 8.60%-8.97%, and 70.4%-72.0% (Tables 5 to 7). The data corresponding to the end of the experiments show that oil content was greatly affected by drying, decreasing 19% in average, with a final range from 3.44 to 4.57%. Protein content decreased less (6%), with a final range from 7.79 to 8.52%. In contrast, starch content increased by 3% points, ranging from 71.8 to 75.0%. Density of the corn, measured also with the NIR equipment in g/cm$^3$, remained unchanged or had a slight decrease of 2% points. The test weight (TW) of the grain was also determined. There was an increase in the test weight by 4% points on average, from 56.3 to 58.6 lb/bu. This increase of the TW followed the decrease of moisture content during the drying experiment.

FritoLay, one of our food industry partners in this phase of the project, maintains a database with information about the effect of drying method on the final quality of the grain. The grain quality data obtained during the 2003 fall season from our six natural air/low temperature drying experiments was to be compared with the quality data to be provided by FritoLay in order to quantify the benefits of the VH and SAVH strategies when compared to other commonly used grain drying strategies. This was delayed until the second year of the project.

Table 5. Average and standard deviation (s.d.) values for corn composition at the beginning and at the end of drying experiments 1 and 2 at West Lafayette.

| **SAVH Experiment 1** | | | | | | |
|---|---|---|---|---|---|---|
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.07 | 8.71 | 70.37 | 20.22 | 1.25 | 53.70 |
| s.d. | 0.37 | 0.49 | 1.54 | 1.52 | 0.0105 | 1.87 |
| **Final Samples** | | | | | | |
| Average | 3.91 | 7.79 | 73.76 | 14.28 | 1.23 | 55.30 |
| s.d. | 0.23 | 0.26 | 0.74 | 1.34 | 0.0110 | 0.83 |
| **CNA Experiment 2** | | | | | | |
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.02 | 8.70 | 70.63 | 20.22 | 1.25 | 53.40 |
| s.d. | 0.29 | 0.19 | 0.94 | 1.18 | 0.0103 | 1.87 |
| **Final Samples** | | | | | | |
| Average | 4.16 | 7.98 | 73.40 | 14.78 | 1.22 | 55.50 |
| s.d. | 0.17 | 0.21 | 0.58 | 0.10 | 0.0100 | 0.91 |

Table 6. Average and standard deviation (s.d) values for corn composition at the beginning and at the end of drying experiments 3 and 4 at Princeton.

| **SAVH Experiment 3** | | | | | | |
|---|---|---|---|---|---|---|
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.27 | 8.60 | 70.78 | 18.64 | 1.29 | 58.20 |
| s.d. | 0.19 | 0.24 | 0.22 | 0.69 | 0.0100 | 0.69 |
| **Final Samples** | | | | | | |
| Average | 4.57 | 8.52 | 71.93 | 14.15 | 1.29 | 60.47 |
| s.d. | 0.12 | 0.08 | 0.36 | 0.46 | 0.0080 | 0.51 |
| **SAVH Experiment 4** | | | | | | |
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.15 | 8.74 | 70.89 | 18.62 | 1.29 | 58.04 |
| s.d. | 0.25 | 0.43 | 0.53 | 0.66 | 0.0077 | 0.96 |
| **Final Samples** | | | | | | |
| Average | 4.50 | 8.52 | 71.76 | 13.68 | 1.28 | 59.84 |
| s.d. | 0.17 | 0.32 | 0.38 | 0.40 | 0.0043 | 0.36 |

Table 7. Average and standard deviation (s.d) values for corn composition at the beginning and at the end of drying experiments 5 and 6 at Shelbyville.

| **SAVH Experiment 5** | | | | | | |
|---|---|---|---|---|---|---|
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.08 | 8.76 | 71.99 | 19.12 | 1.30 | 57.56 |
| s.d. | 0.16 | 0.19 | 0.50 | 0.56 | 0.0036 | 1.14 |
| **Final Samples** | | | | | | |
| Average | 4.40 | 8.47 | 73.18 | 16.59 | 1.27 | 59.76 |
| s.d. | 0.81 | 0.40 | 1.51 | 2.25 | 0.0274 | 1.52 |
| **VH Experiment 6** | | | | | | |
| | Oil | Prot | Starch | MC | Density | TW |
| **Initial Samples** | | | | | | |
| Average | 5.04 | 8.97 | 71.56 | 21.63 | 1.28 | 56.63 |
| s.d. | 0.15 | 0.16 | 0.36 | 0.48 | 0.0088 | 1.28 |
| **Final Samples** | | | | | | |
| Average | 3.44 | 8.03 | 74.97 | 14.40 | 1.24 | 60.54 |
| s.d. | 0.24 | 0.23 | 0.54 | 0.52 | 0.0033 | 0.34 |

## Objective # 2

## To develop and optimize a self-adapting mode for the EMC$^2$ variable heat in-bin low temperature drying and conditioning strategy

Bartosik and Maier (2004b) tested the variable heat (VH) and the continuous natural air (CNA) strategies in field experiments drying corn during the 2001 and 2002 fall seasons. They observed that, for the fall of 2001, the CNA strategy finished drying corn earlier than the VH strategy. They hypothesized that the CNA strategy took full advantage of the outstanding drying conditions of that fall. On the other hand, the VH strategy selected and conditioned the ambient air, but discarded some of the good drying hours. This resulted in an extension of the drying period.

Bartosik and Maier (2004a) simulated the performance of three in-bin drying strategies, VH, continuous heat (CH) and CNA, in four Midwestern Corn Belt locations: Indianapolis (IN), Des Moines (IA), Lansing (MI), and Minneapolis (MN). They found that, based on the average drying cost of the 30 years series analyzed, the VH strategy was the best choice for each location investigated. The second best strategy was CH, which was from 4% to 91% more expensive than the VH strategy. The CNA strategy was from 86% to 205% more expensive than the VH strategy. Drying costs ranged from 4.3 $/ton to 4.9 $/ton for the VH strategy, from 8 $/ton to 13.4 $/ton for the CNA strategy, and from 4.7 $/ton to 9.4 $/ton for the CH strategy. Additionally, the year to year average cost variability was always smaller for the VH strategy compared to the CNA and CH strategies (1.84 $/ton, 10.3 $/ton, and 8.5 $/ton, respectively). However, for most location and harvest date combinations, the minimum absolute drying cost was almost always observed for the CNA and CH strategies. This indicates that even though over the long term the VH strategy performed consistently better than the CNA and CH strategies, for a specific year the best performance could be observed at times with CNA and CH strategies.

A more detailed analysis of these results showed that for those years in which the CNA strategy performed the best, the cumulative EMC average during the entire drying period in the plenum of the CNA bin was below 15% (Figure 18). An average EMC of 15% in the plenum of the CNA bin indicated that the weather conditions during the drying season were just fine for continuous natural air drying. In this situation, the wetter aeration hours during the night were compensated with the dryer aeration hours during the day. In contrast, for those years in which the CNA strategy performed the worst, the running EMC average in the plenum of the bin during the entire drying period was far above 15%, indicating that the fall was too wet for continuous natural air drying. In this case, the aeration hours during the day were not enough to compensate the wetter aeration hours during the night. As a result of that, the drying strategy that used heat (either the VH or CH strategies) performed the best (Figure 19).

Based on this observation, it seemed that the cumulative EMC average in the plenum of the VH bin from the beginning of the drying experiment could be used as an indicator of the goodness of the drying conditions. Then, whenever the average EMC in the plenum was close to 15%, it would indicate that the distribution of wet and dry hours during the drying season was just fine, and no extra heat would be needed. On the other hand, whenever the average EMC in the plenum was above 15%, it would indicate that the distribution of wet and dry aeration hours during the drying period was not well balanced, and therefore some extra heat would be needed to successfully complete drying the grain. The combination of this idea with the existing VH strategy gave rise to the self adapting variable heat (SAVH) strategy.

The initial version of the SAVH strategy was first incorporated into the PHAST-FDM simulation model, and preliminary tests were performed. The simulation results showed that the proposed SAVH strategy did not perform as expected, and additional refinements in the SAVH strategy were required.

The SAVH strategy had to be significantly modified by incorporating the Thompson Equilibrium drying model into the strategy. The key components of the Thompson Equilibrium drying model are reliable equilibrium moisture content (EMC) relationships. One of the findings of this research was that the EMC relationship for corn available in the ASAE Standard (ASAE D245.5) was not reliable. As a result, it was required to implement a set of EMC experiments to obtain more reliable adsorption and desorption EMC relationships. The results obtained from this research suggested that we should consider reformulating our research objectives. As a result, the second phase of the project was developed. This second phase of the project was proposed to MAFMA as an extension of the original proposal. Thus, Objective 2 of this research was addressed under Objective 3 of the second phase of the project [Note: The results corresponding to the second phase of the project are reported in a separate report].

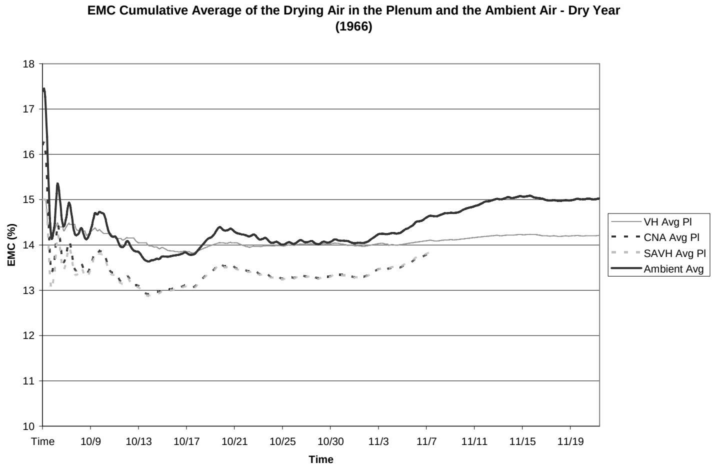

Figure 18. Ambient air cumulative average EMC and plenum cumulative average EMC for the CNA, VH and SAVH strategies for the best year (1966) for CNA drying of the 29 years series analyzed.

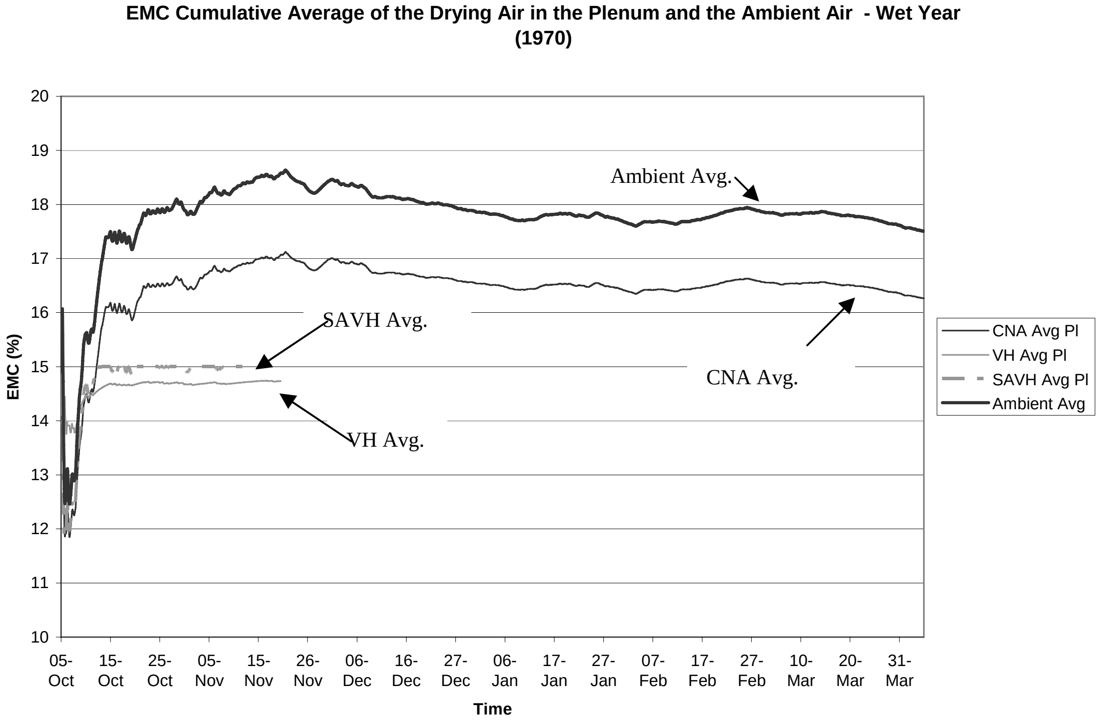

Figure 19. Ambient air cumulative average EMC and plenum cumulative average EMC for the CNA, VH and SAVH strategies for the worst year (1970) for CNA drying of the 29 years series analyzed.

## References

- Bartosik, R.E. and Maier, D.E. 2005. Field testing of a new variable heat low temperature in-bin drying control strategy. Applied Engineering in Agriculture. 21(3):445-453. Purdue ARP No. 17359.
- Bartosik, R.E. and Maier, D.E. 2004. Evaluation of three NA/LT in-bin drying strategies in five Corn Belt locations. ASAE Transactions. 47(4):1195-1206. Purdue ARP No. 17161.

## 3. Unexpected findings, if any

We determined that the hysterisis effect (i.e., the difference in the corn EMC relationship during the moisture desorption and absorption phases) appears to have a much more significant impact on the performance of Natural Air/Low Temperature in-bin drying systems than previously assumed.

Also, it was observed that the drying front of several NA/LT in-bin drying experiments, using fully perforated floor bins, moved faster at the side than at the center of the bin location. The significantly lower airflow rate measured at the center of the bin was caused by a higher concentration of fine material at this location.

## 4. Practical impacts of research efforts.

### a. Short Term Impacts

Major results towards the accomplishment of the goal of the project were made. However, the results from this research suggested that more research and development was required to obtain a successful fan and burner control strategy for the in-bin drying and conditioning of identity preserved quality food grains. The collaboration among Purdue University, The GSI Group and Frito-Lay showed to be highly beneficial for this project.

### b. Long Term Impacts

It is expected that, as a result of this work, a greater number of farmers will be interested in implementing NA/LT in-bin drying systems in their facilities, with the resulting benefit of better grain quality for the U.S. grain processing industry.

5. If you are also making reports to other funding agencies in the course of this research work, please include a copy of that report.

## 6. Publications.

Bartosik, R. and D. Maier. 2005. Field testing of a new variable heat low temperature in-bin drying control strategy. *Applied Engineering in Agriculture* 21(3):445-453.

Bartosik, R. and D. Maier. 2004. Evaluation of three NA/LT in-bin drying strategies in four Corn Belt locations. *Transaction of the ASAE* 47(4):1195-1206.

7. Budget summary of actual expenditures
(See attached form) Include actual matching funds received and/or in-kind.  Remember no more than 50% can be in-kind.

# Final Summary of Expenditures

| Cost Category | Requested from MAFMA | Overall Industry Matching Funds* | |
|---|---|---|---|
| **A) Personnel** | | **Cash** | **In-Kind** |
| Principal Investigator | $0 | $0 | $0 |
| Co-Pi | 0 | 0 | 0 |
| Co-Pi | 0 | 0 | 0 |
| Other Faculty | 0 | 0 | 0 |
| Support Personnel | 0 | 0 | 0 |
| ( 1 ) Graduate Students | $16,500 | 0 | 0 |
| **Fringe Benefits** | $965 | 0 | 0 |
| ( ) Undergraduate Students | 0 | 0 | 0 |
| **Personnel + Benefits Subtotal** | $ 0.00 | $ 0.00 | $ 0.00 |
| **B) Operating Expenses** | $0 | $7,000 | $0 |
| **C) Supplies and Materials** | 0 | $5,000 | 0 |
| **D) Travel** | 0 | $2,000 | 0 |
| **E) Miscellaneous** | 0 | $1,000 | $2,500 |
| **TOTAL PROJECT COSTS (A-E)** | **$ 17,465.00** | **$ 15,000.00** | **$ 2,500.00** |