



## **DRYER OPTIMIZATION: Be Smarter Than Your Dryer**

**Wesley L. Peterson, Regional Sales Manager, Mathews Company, Crystal Lake, Illinois, U.S.A.**

### **Operations**

A simple statement, which may at first seem out of context when discussing the operations of your grain dryer, let's discuss what it takes to be smarter than your dryer.

It is important that any operator of a grain dryer should understand not only the mechanical functions of the equipment but the principles of drying grain as well. While keeping a mechanical and electrical device in safe and working order can be a learned behavior, some better than others, knowing how to adjust and regulate for the desired outcome is equally as important.

### **Always be prepared with a plan to act promptly.**

A plan for the routine, a plan for the unexpected, and a plan for the emergency. Routine operational guidelines include understanding the manual and the important information it offers. Sometimes it starts with just knowing where the manual is located. Have all documentation organized and on file. Duplicate everything to ensure that you have a copy at the drying station as well as one on file in the office. Highlight or reproduce the periodic maintenance schedules as outlined in the manuals. Most manuals, some better than others, will have the lubrication schedule outlined. It is important to have all electrical prints duplicated and available at the drying station. I understand that not all of your dryer operators will be as familiar with the details of electrical blueprints, but having them available for any technical support that can extract information from them can save time and money. Discipline yourself and/or your staff to follow it correctly.



Also produce a checklist of scheduled inspections and maintenance which is devised by your own supervisory staff for consistency with the discipline set for your entire facility. This should be prepared and routinely reviewed by your most experienced operators of type and make of drying machines currently at the facility.

### **Value the experienced operators.**

Provide regular training for all operators of the drying equipment. A high temperature, high output drying machine is not something you leave at the hands of a night staff rookie. There is too much at stake for mistakes. It is suggested that you provide advanced technical training as well. Your dryer manufacturer and/or dealer support system may be able to assist in this training.

It is always an excellent practice to pre-start your dryer well ahead of the first rush of the drying season. This should first be done in conjunction with regular preseason maintenance. During this inspection, practice dryer start-up and shut down with all of your operators. This is an excellent opportunity to train several back-up operators. The basic general operation of the mechanics of the dryer is invaluable to the rookie operator who is asked to fill in during the rush of the season.

### **Know how to troubleshoot.**

Detailed troubleshooting should be schooled each year for the advanced operators and/or supervisor. Understand the difference between the safety circuit and the control circuit of the panel. This simple differentiation can save timeless hours of downtime resulting from often clear-cut problems. Simply defined, the control circuit is that electrical flow which will result in the function of devices such as motors, burners and solenoids, conveyors, etc. The safety circuit is electrical flow which is necessary to activate a control circuit. It is not the purpose of this paper to offer details, but a simple understanding of these circuits will help to focus on the troubleshooting of any drying equipment. [Continued on next page >](#)



Example: If you can activate your general controls, but one of the motors will not start, the focus of the troubleshooting should be for the controls and circuit of that particular motor. The fact that you can activate the control circuit assures you that the safety circuit is intact. A more classic example would be the inability to activate the general controls at all would not indicate that you have a bad motor but that the safety devices that protect a motor would be suspect. Applying logic first to all troubleshooting will most often result in quicker resolve times. Always rehearse in your mind the sequence of operations that would or should normally occur when and focus on those devices that are next in sequence but appear to not be functioning.

### **Know who your go-to support people are**

When all else fails in your attempt to troubleshoot your equipment on your own, always know who your go-to support personnel are. You should be familiar with your local support personnel. This might be your local electrician or dealer. When you call on them it is important to have your electrical and mechanical documentation accessible. Often local electrical support may not be as familiar with your drying equipment as you, but they can apply that technical understanding of manufacturer prints to assist in your troubleshooting. Also, always know your dealer and/or manufacturer technical support personnel and their hours of operation. Having the same documentation available can assist in their ability to first troubleshoot over the phone. Always logically review the sequence of the failure and perform a few simple tests before you call for technical support. The more information you have available when speaking with support can often determine the success of resolving the problem via phone. A very high percentage of problems can be resolved with phone support but are often not due to lack of initial information and or impatience of the operators.

Mechanical know how, although an essential attribute in proper operations of a grain dryer, is only part of the abilities of a well trained proficient operator. A general understanding of the physiology of grain drying is essential in the proper operation and performance of a well tuned dryer.

All operators should have a good understanding of the limits of the fill and unload rates of their dryer. Too much or too little grain flow through conveyors and spouting can contribute to grain damage and shrinkage of put through for your facility. In system design and installation, try to keep the flow to and from the grain dryer as simple as possible. Keep the discharge path simple but adequate. Transferring downstream from a drying tank at full capacities of your handling equipment in lieu of marginal flow from the dryer can greatly manage damage and shrink. Wet grain charging the dryer should also have simple high capacity flows to not restrict the automatics of the dryer and/or risk high energy loss of heated air. It is also suggested here that segregating moisture feeding into a high speed dryer will enhance performance and simplify the operations of the dryer. If moisture variation of incoming grain can be minimized the opportunity for manual or automatic control of the dryer output is greatly enhanced.

### **Operations**

Let's discuss the physiology of grain. A basic understanding of the principles of heat, air, and time helps the operator to control and anticipate results from the drying process. With all current technology regarding controls as well as mechanical improvements in the drying process it is still undisputed that the general mechanics of removing water from grain is a function of the level of heat (BTU's), the volume of air (total CFM), and the time to pass through the dryer (holding capacity). At a given drying temperature with a given volume of drying air a put through rate can be anticipated based on the retention time in the drying section of the dryer. It is important that the operator know this holding capacity as it reflects to length of time to affect a change in the output moisture from the dryer. Example: If it is known that heat holding of a dryer is 2,500 bushels and the dryer is discharging at 2,500 bushels per hour, the operator cannot expect to see the results of the initial or any additional adjustments in the operation of the dryer for at least one hour. Too often operators tend to rush their management decisions of the dryer resulting in longer than desired time to achieve target output.

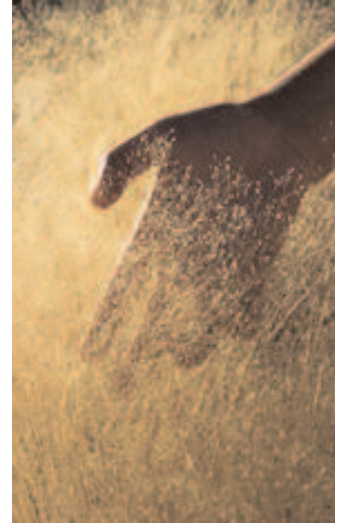
As the operator is making changes to any of the dryer inputs it is important to reference the relationship between drying temperature and kernel temperature. In most cases it is the kernel temperature that you are ultimately trying to manage but very seldom do you have the ability to monitor this temperature throughout the drying process. The higher the kernel temperature the more susceptible the grain is to physiological damage. High kernel temperature results in faster migration of moisture to the atmosphere (higher capacity put through) but it will most likely result in a higher percentage of stress cracking and additional breakage of final product from mechanical handling through the facility. [Continued on next page >](#)



Reducing the temperature of a high temperature dryer to result in the most acceptable capacity rates for the facility will net more dry matter (drying shrink) and less total breakage to the final product (total shrink). Let it be noted that most United States grain facilities today consider shrink management as a total separate profit center in the overall operations of their business.

### **Humidity**

One additional factor affecting the drying process is the outside relative humidity. Let it suffice to say that this variable is very difficult to manage. First of all, there is no way to control or predict what humidity levels will be at any given time. It is known that the higher the humidity of the outside air the less ability a given cubic foot of drying air has to carry water. Therefore if you are expecting a given CFM of air at a given temperature to remove a given amount of water in a set amount of time, you can expect that as the outside humidity increases so will the amount of time needed to dry. This can be offset by an increase in drying temperature which in turn taxes kernel temperature. This may sound like a chase your tail phenomenon but it should be noted that this effect normally is not a serious issue unless the humidity is 85 to 90 percent or higher. The operator should then be aware of the results and manage the discharge rates accordingly.



Drying temperatures and efficiencies are also an elusive subject. In fact, the higher the drying air temperature the greater ability the air has to remove water. Therefore, a reduction in drying air temperature to reduce fuel usage may not, in fact, use less fuel if the grain needs to remain in the dryer longer. Operator management should again focus on the optimum temperature to achieve the desired grain quality (managing kernel temperature) as well as an acceptable drying rate for the facility. Keep in mind here the mistake is often made to let dryer capacity be the leading factor in temperature choice. With today's energy costs it is difficult to not let efficiencies become the next driving force. Align the operations of your dryer with the expected outcome of your facility and make your adjustments accordingly.

Expected outcomes of the facility will be determined by type of grain being dried and any specialty crops requiring extraordinary kernel temperature management. This can be varied with the initial moisture content of the incoming grain. Managing the uniformity of kernel temperature can be a positive tool as well. Some grain dryers are equipped with devices to turn or alter the flow of the grain to more uniformly maintain kernel temperature. As a result, the negative effects of cooling the grain with colder outside temperature can be diminished.

One final note to offer the operators as a tool to manage the effects of kernel temperature in today's dryers is the effect of tempering the grain. It is argued that tempering grain is a function of hours in the drying process, not minutes in the drying column. When tempered properly, however, the results are very positive. The pro's of tempering grain can result in less stress cracking, higher utilization of energy, reduction in dryer shrink, and increased capacities through the dryer. However, the major setback for this tool is that it requires downstream cooling of the grain as well as additional transfer between the drying process and long term storage. Today's modern grain facilities often lack the design to manage the flow of grain in this fashion. With the rising costs of energy and the potential on the rise for higher standards of grain, further design research is warranted in this area.

### **Maintenance or Subsistence**

The value of maintenance of any piece of equipment has been argued successfully for all industries. The value of true maintenance versus just fixing to get by is often circumvented during the rush of the season or the time left in the day. Prioritizing levels of maintenance along with good record keeping can assist in achieving a true maintenance regime.

Inspections of the grain dryer should be based on four values. Cleanliness, Functionality, Integrity and Safety. It is recommended to prioritize these values consistent with the management and facility guidelines. If you apply these values to each aspect of the dryer from electrical, fuel, mechanical, and structure you will have a solid true maintenance program. Example: Cleanliness. Is the equipment or component clean? Functionality. Is the equipment or component functional? Integrity. Is the equipment or component in good working order? Safety. Is the equipment or component safe? Although these questions may seem academic, by requiring a simple yes or no response on a checklist forces the operator to take a black or white position and not compromise his response. Supervisors can then require action based on a yes or no answer consistent with the facility guidelines. [Continued on next page >](#)



### ***Now the supervisor or manager can apply set priorities.***

Example: Can equipment be safe but not clean? Can equipment lack integrity but be functional? Can equipment be functional, yet not safe? Some of the answers to these questions can be obvious, yet others force the supervisor to a call for action. We all want to require safety to be our number one priority and most cases advocate it in our daily routines. However, if an inspection report shows a device as functional but not safe, and the dryer is allowed to continue to operate, we have managed to fix it to get by and have made a conscious and knowledgeable decision based on facts. Lack of facts or knowledge of a problem is often the first excuse for an incident. If your true maintenance plan is intact you will avoid accidents, downtime, and more costly repairs.

Lubrication records should be noted on the inspection report as well. As mentioned earlier, always know where your manuals are located. The inspection report keeps all this information in one place for easy review and follow-up.

Make the fuel train a separate inspection report. Apply the above values to each component. Some component failures of the fuel train can be disastrous. Example: A fuel valve forced open with a pipe wrench can still be functional and is still in tact (integrity), but certainly not safe. If safety is top priority, an immediate action is called for and the dryer is maintained.

Here it is to be mentioned again the importance of knowing your primary go-to service providers. Without quick and easy access to this information and knowledge of their hours of support and locations, you will have more difficulty maintaining you priority discipline and make quick and often ill-advised repairs with escalating risk. You should maintain an updated list of your secondary support personnel as well. This may include field technicians or factory support. Verify these access numbers and contacts as a pre-season check as well. Current updated information can be invaluable for time and cost management.

### ***Create a detailed checklist***

Create a detailed checklist showing and identifying component areas with an overall view of each dryer in the facility. This checklist will serve as an extension of the pre-season inspection and any repairs. As repairs are done in season, note them on this form. If a dryer sheet repair is done, show location of repair and extent of repair. Remember, some dryers have an exterior cladding which does not allow clear view or access of dryer skins. Therefore, these records may later prove to be your only reminder of off-season repairs to be completed. The detail of these notes can be personal preference but retention of basic information which will call for later action is invaluable.

The BUCK stops here. Facility managers should require a copy of these logs weekly or daily in season. The safe and profitable operations of any facility is ultimately the responsibility of the facility manager. He or she may or may not be a trained operator of the dryer or even knowledgeable of the many mechanical functions along with the dryer. However, a true maintenance checklist with a clear defined priority of maintenance values can assure proper information to this level for sound knowledgeable decisions. IS MAINTENANCE DISCIPLINE TAUGHT? or INSTILLED?

### ***FIRE!!!***

Fire in a grain dryer can and frequently does result in costly losses, downtime, lost revenue and/or personal injury and occurs most often as a result of a wrong action or lack of action at the time of the incident. This subject remains one of the most elusive subject matters in the grain industry. Most input on the subject comes from those who have experienced a fire. This information is often in the form of what could have been done differently. Such lack of information and preparedness still exists today in the majority of our grain facilities.

There are, however, some very outstanding plans in place. Most of them self instilled as a result of a facility fire but nonetheless have been well thought out. [Continued on next page >](#)





I, too, will fall short of a detailed plan of action in the event of a fire because it has not yet been fully researched as to the do's and don'ts of any given structure fire. I do highly recommend that this advance as a subject for future discovery on behalf of GEAPS or others in order to provide more absolute details for the industry.

I can however report on some findings and discussions had with various industry personnel and provide a list of suggestions to follow for better preparedness.

### **KNOW WHAT TO DO!**

*Example: What To Do In Case of A Dryer Fire*

- When you first detect or suspect a fire, the entire drying operation should be shut down, including grain flow into and out of the dryer. The emergency controls may have previously completed this step.
- Shut off the electrical and fuel supply to the dryer.
- Do not try to cool a fire by running the dryer's fan(s). This will only add oxygen to the fire and intensify the fire.
- Never run grain from the dryer into the elevator or other storage if a fire is known or suspected.
- Locate the area of the fire.
- If the fire is in the interior of the dryer, but not in the grain column, extinguish it with a fire extinguisher or water hose as quickly as possible. Poor housekeeping inside the dryer likely caused this type of fire. After extinguishing the fire, check for damage to the dryer, and then thoroughly clean the dryer before attempting to restart it.
- If the fire is within the grain column, emergency discharge slide gates at the bottom of each column should be opened to permit fast dumping of the burning grain from the affected grain columns. It is not necessary to dump the entire dryer, only those columns where burning grain is detected. After the fire is extinguished, check the dryer for damage.
- A fire extinguisher should always be located at or near the dryer. If a fire seems to be spreading out of control or if there is any question at all about the location of the fire or even if a fire exists, call the fire department.



*Note: Dryer fires often occur after the dryer is shut down for the night. Always inspect the interior of a dryer after it has been shut down for the day for possible hot spots or smoldering grain or trash.*

### **Additional suggestions:**

If the decision is to purge the suspected column of grain, do not do so until the fire department has been summoned and is in place to react. Often when the grain is exposed to the air during this process, the highest risk of open flame and damage occurs.

- Volumes of water on the suspected area is usually the best advice. Often the suspected fire is well above ground in most commercial grain dryers which presents difficulty for some fire departments.
- Always keep safety in mind for both facility personnel as well as firefighters. What appears to be smoke can be a rush of flame when free air is introduced.
- Never enter a dryer with a suspected fire without proper protection and training. Danger of flash and entrapment is possible.

We can continue to list many good suggestions and some observations. I am sure you can list several of your own. However, the most important message to take from this information is for you to know what YOU are going to do, to know WHO you are going to contact, and to know WHO is in charge! [Continued on next page >](#)



### ***Develop a plan.***

Review with your operators the importance of observation. They are the personnel that are familiar with the dryer. They can be the first to note a different sound, a different look, and a different odor. This early detection can be invaluable. Most grain dryer fires are a result of a trash fire. Therefore, all trash fires are avoidable. All operators should be aware of this peril which follows poor housekeeping. Some fires however are a result of mechanical failures. These are often quite serious and most damaging because they can be so fully involved.

### ***Know who to contact.***

Have a reporting procedure in place. Keep supervisory personnel numbers posted as well as fire and ambulance numbers. Most facilities do a good job of having an emergency plan in place but often fall short of having a specific plan for a Grain Dryer Fire.

### ***Know who is in charge.***

It must be made totally clear that once the fire department is summoned to the fire, the fire chief or acting chief for this run is **TOTALLY** by law in charge. Even though you may have valued input into any action, the chief has full jurisdiction over your facility. This may at first seem a little hard to accept but it is beneficial to know now not later. Therefore, develop your plan **WITH** your local fire support. Have them make a run to your facility. Show them the general layout of the grain flow, electrical, and fuel. Discuss with them your request to purge any columns and the method to do so. Yes, advise them of what you have learned concerning the behavior of the fire and cautions for safety. Make this an annual meeting prior to harvest. Cooperation is essential before and during an incident.

### ***Make Total Preparedness a Goal***

Some examples of total preparedness include water retention ponds on site of the facility, rehearsed use of hydrants, annual practice, mock drills, and response training. Some facilities provide an annual picnic for all local fire, police, and emergency response personnel in appreciation for their preparedness.

Each year we hear of industry grain dryer fires and the damage that occurs and unfortunately personal injuries as a result. Quality prevention and total preparedness are your greatest tools to protect your facility and personnel. ■