

# Die maintenance and die change operations

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**P**ellets are formed at the nip point between the die and the rolls. Within this work area, feed is compressed and extruded through the pellet die—the heart of the pelleting operation. Properly maintaining the die is essential to achieve maximum production rates and to prolong die life during the pellet-forming process.

The best way to maximize die performance is to follow established maintenance procedures that begin at die start-up and continue throughout the life of the die. A successful maintenance program consists of:

- Regular inspection and preventive maintenance practices that find minor problems and address them before they become major issues. Clearly, the most cost-effective manner to maintain pellet dies, as well as other equipment, is to inspect and repair equipment on an on-going basis, rather than waiting for a catastrophic failure. An effective preventive maintenance program saves both time and money.
- Personnel should have defined responsibilities for maintaining the die and pellet mill. Limiting the number of personnel assigned to maintain the die helps increase accountability and ownership associated with these important duties. Providing personnel assigned to perform maintenance activities with adequate training and clear responsibility for those functions helps improve the overall maintenance program.

Next we will discuss some areas to consider when putting together a die maintenance program.

## Installing a new die

Installing a new die provides a great opportunity to inspect the die housing (or quill), pellet die and associated wear components. The following is a list of possible checkpoints for maintenance personnel to look at during this process:\

- Inspect the die housing groove where the die mates to the housing. Look for shiny spots, wear and feed build-up. If found, these conditions may be indicators that the die did not properly fit into the die housing, or that the die was not securely fastened. The vast majority of die breakage occurs because of improper die fit or loose dies.
- Inspect the wear ring insert in the die housing. Gauge the inside diameter of the ring to ensure the proper dimension, especially if the wear ring appears worn. Worn wear rings are a leading cause of improper die fit. Replace worn wear rings to avoid breaking dies.
- Inspect the die housing key and the keyway of the old die for wear. A key or keyway that is battered or worn is another indicator that the old die was not securely fastened to the die housing or did not properly fit. Replace any key that shows wear and evaluate why the wear occurred. Apply anti-seize compound to the key before installing to facilitate removing the key later.

- If the die attaches to the die housing with clamps, carefully inspect the die clamps and clamp bolts. Use an appropriate die clamp wear gauge to measure clamp wear during each die change. Also, look for shiny spots on the die and the die housing where the die clamps attach. Such spots can indicate die movement from an improper fit or loose clamps. Replace worn clamps immediately. Use of worn clamps may result in die breakage and can ultimately cause severe wear that requires resurfacing of the die housing.
- Periodically measure the outside diameter of the new die's pilot diameter—the portion of the die that fits into the die housing groove—to ensure the correct dimension. This is especially relevant when purchasing a die from a new supplier. If the die pilot diameter falls outside of the pellet mill manufacturer's tolerances, work with the die supplier to resolve the issue. Using a die that has too small of a pilot diameter can lead to die movement and breakage during use.
- Apply anti-seize compound to the surfaces where the die mates with the die housing and to clamping surfaces if clamps are used. Use of anti-seize compound will help when removing the die and clamps during the next die change.
- Treat the die and die housing with care while removing or installing dies. Never strike the die or die housing with a bare steel hammer or drop the die on a hard surface. The materials used to make dies are very durable for their designed application; however, structural shocks that are severe enough can lead to metal fatigue or weakness and major die failure. If force is necessary to remove or install a die, use a plastic or wooden hammer to soften the blows.
- Closely follow the pellet mill manufacturer's recommendations on bolt grades and torsion specifications. Most pellet mill manufacturers recommend replacing critical bolts, such as die clamp bolts or hold-on bolts, when installing a new die. Correctly tighten all bolts associated with securing the die to the die housing with a torque wrench. Problems can occur from both under-tightening or over-tightening bolts. Always

tighten bolts to the pellet mill manufacturer's recommended torque value.

- Install new rolls with a new die, or carefully inspect used rolls to ensure they are worn evenly and match well with the face of the new die. Used rolls with uneven surfaces can quickly damage the new die.

### **Starting a new die**

Although the holes in pellet dies are precisely machined and polished by the manufacturer, it remains important to start up a new die at a lower than normal production rate. Establish procedures to operate the pellet mill at a reduced setting for a given amount of time to allow the holes of a new die to become polished. This amount of time may differ between different dies and feed types.

If possible, when starting a new die choose a ration that develops low die friction as the first production run to aid the start-up process. Rations that contain a high percentage of corn or a high fat content are examples of low die friction feeds. As an alternative to feed, manually running a mixture of corn, silica sand and approved oil through a new die for several minutes can effectively polish the holes and facilitate a smooth die start-up.

### **Feed distribution**

Correct feed distribution over the face of the die is an important factor in achieving maximum pelleting rates and die life. Ideally, the feed plows or deflectors and wipers in the die chamber should direct an equal amount and an even mat of feed to each roll. Improper feed distribution causes uneven wear of the die face. It also reduces pelleting capacity since feed is not equally distributed to the entire working area of the die.

To check feed distribution, thoroughly clean the face of the die and closely observe the wear of the individual holes. Look for areas of the die that show greater wear than others. The depth of surface wear is the perpendicular distance of the die face

from the horizontal plane where the original die face started. Measure the die face wear by inserting a micrometer or small rod from the outside diameter of the die until it appears on the inside die face. Mark the rod or check the measurement of the micrometer to determine the remaining die thickness. Subtract this measurement from the original die thickness to determine the depth of wear. To ensure consistency when using this method, take measurements from the same row of holes in several areas of the die during each inspection. If high wear areas are found, that means these areas are receiving more feed and doing more work than the remainder of the die.

Checking for uniform feed distribution is especially important when starting a new die. If pelleting is a significant part of the feed mill operation, check the face of a new die daily to ensure even wear. It is essential to establish a good wear pattern in a new die in order to maximize production and die life.

Various types of feeds may distribute differently within the pelleting chamber. Since it is not practical to change feed deflector positions for each type of feed, the overall goal is to adjust the feed deflectors to an average position for good feed distribution over the life of the die. Adjust the feed deflectors accordingly to distribute feed away from high wear areas. Regularly inspect feed plows and wipers and replace worn parts.

### **Tramp metal**

Tramp metal reduces die life and pelleting rates. This is because tramp metal reduces the working area of the die and causes uneven die wear. Feed does not flow through a die hole filled with tramp metal. In extreme situations, the uneven die wear caused by tramp metal may make it impossible to properly adjust the rolls.

Inspect the pellet die at least weekly for tramp metal. Use an appropriate pin punch to remove any metal found by starting from the outside of the die and punching the metal back out into the die chamber.

Magnets, scalpers and other cleaning devices play an important role in extending die life. Clean and maintain this equipment on a regular basis to ensure it is properly and effectively working. Clean magnets positioned at the discharge of conditioners or within feed chutes at the end of each shift.

### **Die flushing and storage**

Flush the die with an oily mixture at the end of each production day or if the die is taken out of service. Flushing will protect the die by preventing corrosion caused by moisture or corrosive feed ingredients. It also allows the die to easily start when put back into production.

If the die is placed in extended storage, in addition to flushing, store the die in a dry, protected area. Using a proper storage area will minimize the potential corrosion that can reduce die life.

### **Other die conditions**

**Honeycombing:** Moderate honeycombing of the die—the condition where the diameter of the die holes enlarges and the ligament thickness of the metal between the holes thins through wear—is a normal condition and generally indicates good die performance. However, severe honeycombing can cause die breakage due to the structural weakening of the die. If severe honeycombing is experienced, decreasing the open area of the die by changing die specifications or changing die material may help reduce the problem.

**Corrosion:** Die corrosion is caused by the combination of heat, moisture and feed in the die. Corrosion may cause pitting and rough surface areas within the holes of the die. Pitting slows down production rates and can cause frequent plug-ups because of increased friction while the feed moves through the die hole. To check for pitting, thoroughly remove all feed from the die hole and shine a light from the inside diameter of the die so that the internal surface of the hole can be seen. Look down the hole from the outside of the die to evaluate the condition of the surface. Mild pitting

looks like pin pricks on the sides of the hole wall. Severe pitting appears as large abrasions. To avoid pitting problems, properly flush and store dies. Also, work with pellet die manufacturers to select the proper die material for the types of products being pelleted.

**Scoring:** Scoring of the die holes can occur when pelleting abrasive materials. Scoring appears as longitudinal lines down the hole wall. Often, scoring will occur due to earlier pitting of the die hole surface. To inspect for scoring, follow the same procedure used to evaluate die holes for pitting. If scoring is a problem, take steps to minimize die corrosion and work with pellet die manufacturers to select appropriate die materials.

**Rollover:** Die rollover is a condition that occurs when the inlet area of the holes in the die face begin to be peened shut. Rollover is caused when the force exerted on the face of the die is greater than the strength of the die material. Typically, rollover results from improperly setting die rolls, but it also may occur when pelleting certain types of feed. Regardless of the cause, rollover can greatly reduce the pelleting capacity of the die and adversely affect pellet quality.

Proper roll adjustment is critical to avoid die rollover and to achieve maximum pelleting production rates. Adjusting the rolls too loosely reduces capacity and causes plugs. Adjusting the rolls too tightly causes excessive roll wear and rolled-over dies. Because pelleting causes the die face to wear away, regularly inspect and adjust the rolls to ensure they are in the proper position. The required inspection frequency depends on the pelleting operation.

Follow these procedures to correctly adjust the die rolls:

- Never adjust rolls while the die is turning. Follow established lock-out, tag-out procedures to de-energize all energy sources to the pellet mill before making any adjustments or repairs.
- Wear appropriate personal protective equipment, such as gloves and eye protection.

- Thoroughly clean off the die face and rolls.
- Loosen the locking screw away from the roll-adjusting gear.
- Adjust the tightening screw on the roll-adjusting gear so that the rolls barely touch the die face. Spinning the rolls by hand provides a good indication of roll clearance.
- If the end of the adjusting gear adjustment is reached, completely back off the tightening screw, remove the adjusting gear and re-install the gear as close as possible to the tightening screw.
- After adjusting the rolls, lock the adjusting gear in place by tightening the locking screw against the gear.
- To check the roll adjustment, re-energize and start the pellet mill, bring the die up to full speed and then turn the mill off. Properly adjusted rolls will spin when the die is rotating at full speed, but will quit turning as the die coasts to a stop. Tighten rolls that fail to spin when the die is at full speed. Loosen rolls that continue to spin until the die completely stops.

### Die maintenance records

Keep accurate and complete records on all die specifications and tonnage to help evaluate die performance. In addition, recording hours that a die runs provides a means to evaluate the overall production rate of the die. Maintain all die records for a period of time long enough to establish historic trends.

### Die change operations: Removing worn dies

The cost of a die is a major operating expense associated with the pelleting process. Although running more feed tonnes through a die that still runs results in lower costs per tonne, other conditions may make it cost-effective to install a new die. In other situations, such as catastrophic die failure, it becomes immediately necessary to make a die change.

The following list shows some of the common reasons for replacing a die:

- The die is worn so deeply that the rolls can no longer be adjusted out far enough to contact the die.
- The pellet quality produced by the die does not meet customer expectations.
- The die creates too many fines that take too much time and energy to recycle and reprocess.
- The die is damaged due to breakage, excessive tramp metal, pitting, scoring and/or uneven wear.
- The die is worn below the wear groove cut in the die face, which exerts a higher load on the roll shells and accelerates roll wear. Monitoring this condition is especially important when running hardface rolls intended for use with more than one die.

### **Die removal**

Removal of the pellet die may be necessary to perform pellet mill maintenance; produce a different pellet size or type of product; and install a new die. Some pellet mills are designed for die changes by manually unbolting the old die and bolting the new die in its place. Other pellet mills are designed for a more rapid die changeover that is accomplished by removing the entire die and die housing cartridge assembly and replacing it with a different die and cartridge assembly. With either system, at some point the die must be physically attached to the die housing.

Manually removing and installing dies is a potentially dangerous process. Dies can easily weigh hundreds of kilograms, and may be awkward to handle. Each operation should carefully develop appropriate procedures for manual die removal and adequately train personnel involved in this operation.

The following are some guidelines to consider when developing procedures for manually removing and changing dies:

- Follow established lock-out, tag-out procedures to de-energize all energy sources to the pellet mill before removing the die or making any adjustments or repairs.
- Use all appropriate personal protective equipment during the die removal operations. Examples of some of the protective equipment that may be necessary are leather gloves and eye protection.
- Carefully inspect all equipment involved in lifting and transporting dies before each use. Develop a safety checklist for use by personnel.
- Flush the die with an oily mixture if it will be returned to use.
- Back-off all cutting knives from the die.
- Open the pellet mill door and remove the feed cone.
- Loosen and adjust the roll-adjusting bolts to completely back the rolls away from the die.
- Adequately support the die with a die stand or hoist system designed for die removal.
- Remove the die clamps or die bolts from the die and remove from the die housing.
- Store the die in a dry protected area if it will be returned to use.

Pellet dies are the heart of the pelleting process — typically the most expensive operation in terms of capital investment and energy cost within the feed mill. Die maintenance deserves and requires close attention due to its impact on the overall mill operation. Properly maintaining the die is essential to achieve maximum production rates and to prolong die life.

Take the time to establish a thorough die maintenance program and adequate procedures for die change operations. Look at the time spent as an investment in improving the mill's bottom line.

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