EXTRUSION SAFETY:
THE DANGER OF STEAM AND PRESSURE
REMEMBER

• If the extruder augershaft is turning and the die is severely restricted or plugged, stop the machine and clean it out.

• Do not start the extruder with hard material in the die. Actively plan and execute shutdowns to avoid this.

WARNING

NEVER attempt to push lodged, hard, dry material out of the extruder with the die door in place. This procedure could cause severe personal injury and extensive machine damage.

CAUTION

Never run the extruder with dry, hard material in the extruder spirals or die assembly. This could result in severe machine damage and personal injury.
WHAT CAN HAPPEN?

https://youtu.be/t4_gw5SzYpY
EXAMPLES

• Hinged door swings open violently
• Rapid shear pin failure, resulting in pin fragments
• Die holder studs fail, resulting in release of die assembly
• Core pin failure, resulting in projectile fragments
• Other failure of die assembly components
WHAT CAUSES STEAM TO FORM?

- Heat due to friction
- Excessive friction in the extruder
  - The die flow is completely stopped or significantly restricted
  - The augers are turning
WHAT CAUSES PRESSURE TO BUILD?

- Steam has nowhere to go
- Two primary pathways to vent
- The pathway for steam back through the barrel can close suddenly and unpredictably
PREVENTION (1) - SHUT THE EXTRUDER DOWN WITH SOFT MATERIAL IN DIE

• Planned shutdowns:

✓ Turn the vacuum off, increase the water in the pug tub, and run the machines until the wetter, unconsolidated column exits the die.

✓ Cover the die to minimize drying.

✓ Wet or cover the material in the pug tub.

✓ If the shutdown is going to last more than a couple days, clean out the die and empty the machine of material.
PREVENTION (2) – BRIEF SHUTDOWNS

• Shutdowns with high temper clay in the die & extruder:
  ✓ Turn the vacuum off.
  ✓ Cover the die to minimize drying.
  ✓ If shutdown lasts more than two hours, clean out the die and empty the machine of material.
PREVENTION (3) - BE DILIGENT DURING STARTUP

- **Startup:**
  - Run the machines without vacuum until moisture content is consistent.
  - Make sure the die is in working condition and oiling properly at all locations.
PREVENTION (4) - LAST CHANCE

• If the die is severely restricted or plugged:

  ✓ Never run the extruder for more than 20 seconds.
  ✓ Clean out the die and empty the machine of material.
  ✓ Keep the die area clear.
  ✓ If the machine has run for a longer than 20 seconds, it should be allowed to cool before opening the die.
OTHER CONSIDERATIONS

• Never add water to material in the pug tub or vacuum chamber once hard, dry material is in the die.

• Don’t rely on motor amps or belt squeal to predict a steam event.

• The shear pin is not a safety device, it’s a mechanical drive protection device.

• The hydraulic die changer provides the ability to make die changes quickly and easily, which may affect the mill operator’s decision to clean out the die.

• The hydraulic die changer lets you change the die without having people around the die.
OTHER CONSIDERATIONS

- Steam pressure events can occur with either compression or constant volume augers.

- The temperature of the extruder barrel is **not** representative of what’s going on inside the barrel.

- Pressure can build suddenly and where the pressurized region will occur is unpredictable.

- Die lubricant pressure is not always useful when there is no flow through the die.

- Volatiles in the material can result in an explosive event under the same heat conditions.
RECOMMENDATIONS

• Training, Training, Training

• Establish operating procedures:
  ✓ Planned shutdowns
  ✓ Shutdowns with high temper clay in the die
  ✓ Start-ups
  ✓ Severely restricted or plugged die
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