

# EXTRUSION SAFETY: THE DANGER OF STEAM AND PRESSURE

The Global Leader in Stiff Extrusion



# 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?



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[https://youtu.be/t4\\_gw5SzYpY](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









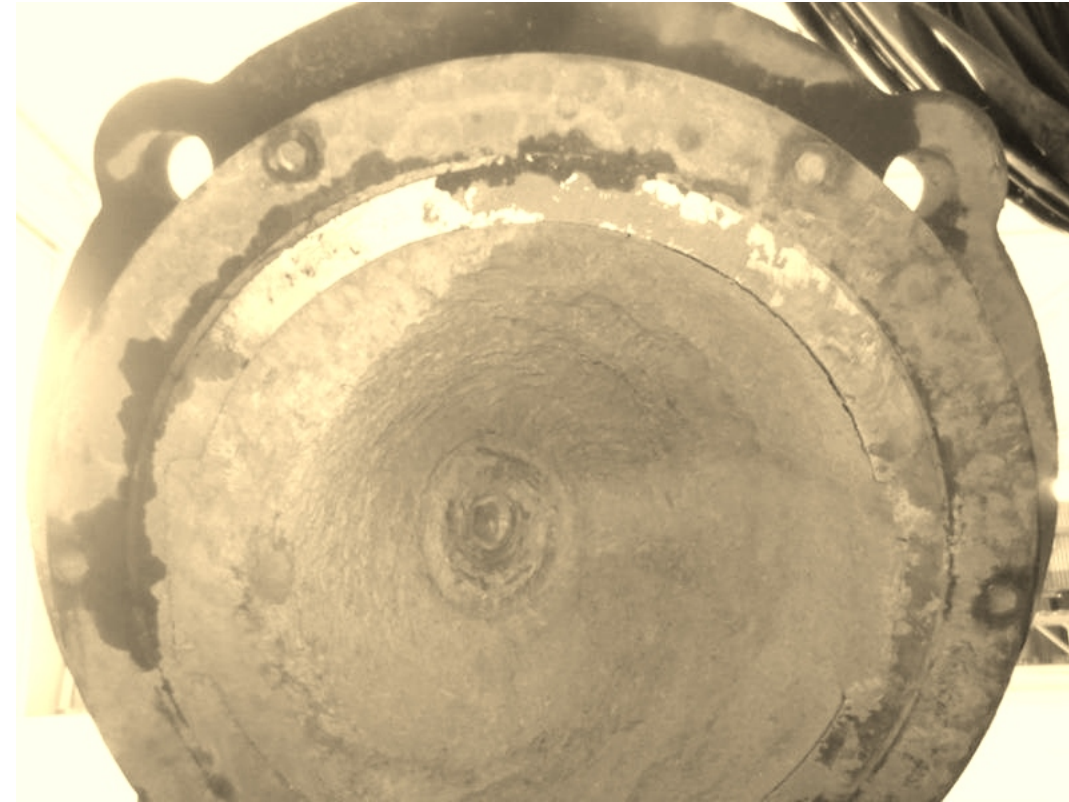
# WHAT CAUSES STEAM TO FORM?

- 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.







<https://youtu.be/rGz29D5Gn3s>



# 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



# The Steele Group



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