

Thiokol Propulsion

19mm Twin Screw Extruder Incidents Briefing

Presented by:
Mike Rose

May 1, 2001



Outline

- 19mm TSE incident history
- Incident comparison
- Damage comparison
- Isolation system development
- Summary

19mm TSE Incident History

- Thiokol has had two incidents while extruding energetic materials in the 19mm TSE
 - First incident occurred on March 25, 1997 (M-56)
 - Second incident occurred on March 26, 2001 (M-241)
- Incident similarities
 - Extrusion parameters
 - Throughput ~ 5 lbs/hr for each process
 - Screw design, screw speed, and operating temperature and pressures were similar
 - Raw materials
 - Extrusion feedstock consisted of molding powder comprised of BAMO/AMMO and CL-20
 - Approximately 10 pounds of molding powder present in the feed hopper during each event

Incident Comparisons

- M-56
 - Thermal cook-off of the extrudate occurred and triggered the ignition near the die
 - Flame propagated through the extruder, reached the raw material located in the feed hopper and ignited the bulk material
 - Substantial damage to the facility and equipment resulted from ignition of the raw material
- M-241
 - Cause of ignition has not been determined, however, it has been concluded that ignition occurred near the die
 - Flame propagated through the extruder, but remained isolated from material in the feed hopper
 - The facility and equipment sustained only minor damage due to the incident

Isolation of flame propagation significantly reduced facility and equipment damage

Facility Damage Comparison



M-56 Facility

- Roof and blowout wall completely destroyed
- Significant damage to ducting and utilities



M-241 Facility

- Building structure not damaged
- Minor damage to vacuum line piping



Equipment Damage Comparison



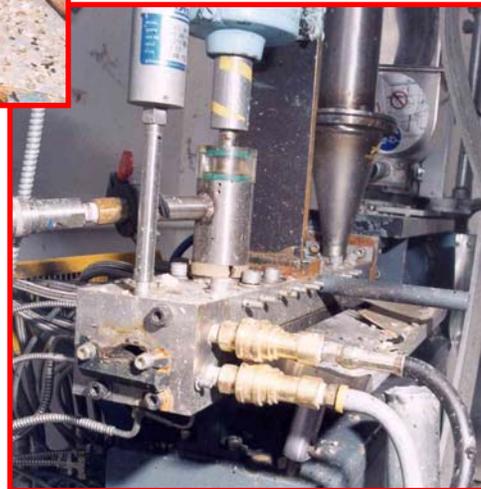
M-56 Equipment

- LIW feeder destroyed
- Screw shafts and elements ruined
- Minor damage to extruder



M-241 Equipment

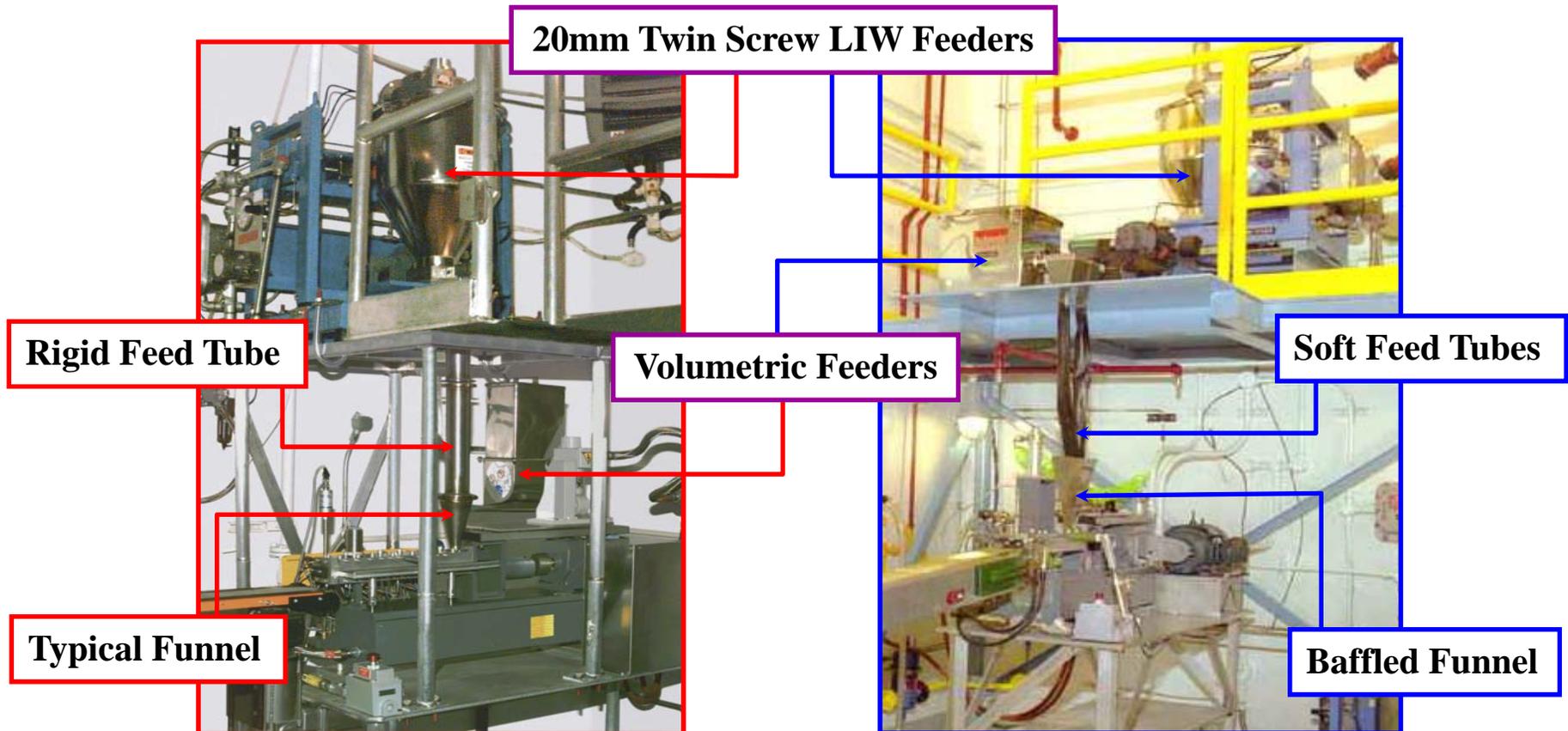
- No damage to LIW feeder
- Screw shafts and elements ruined
- Minor damage to extruder



Isolation System Development

- The M-56 incident revealed gross inadequacies regarding flame propagation
- Installation of isolation system requisite before energetic extrusion could continue
 - Many different systems were examined for effectiveness
 - All of the systems examined required a discrete amount of time for sensing and system activation
 - Propagation happens very rapidly (milliseconds) limiting the usefulness of these types of systems
- Thiokol designed, fabricated, and implemented an isolation system that is not time dependant
- The system involves a baffled feed funnel, pliable conductive feed tubes, and conveyor belts
 - Each device within the system provides additional protection against propagation

19mm TSE Process Modifications



Installation @ M-56

Installation @ M-241

Test Comparison For Funnel Design



Typical Funnel Design

Baffled Funnel Design



Summary

- The energetic extrusion community is on the cutting edge of technology
- Risk management is essential for all members of the energetic community
- Thiokol has had two incidents involving the 19mm TSE while extruding BAMO-AMMO/CL-20 material
- Each incident provided valuable information for extruding energetic material safely
- Isolation systems can be designed to increase protection to the facility and process equipment