

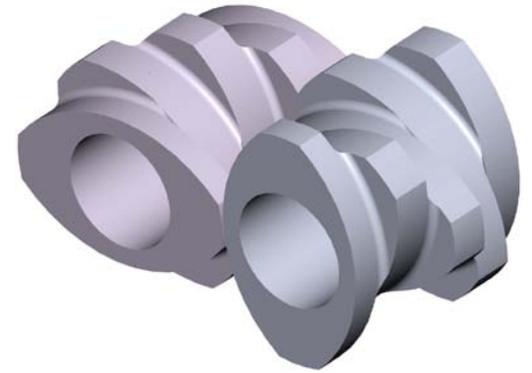


# Roger M. Smith Continuous Processing Scale-Up Facility Status

14th Continuous Mixer and Extruder  
User's Group Meeting  
11-12 October 2006

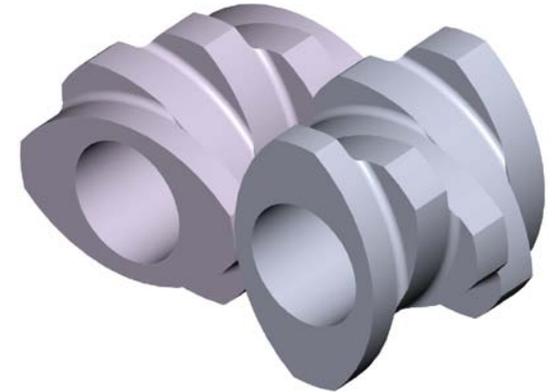
Wayne Thomas

- Objectives
- Facility Status
- Technical Challenges



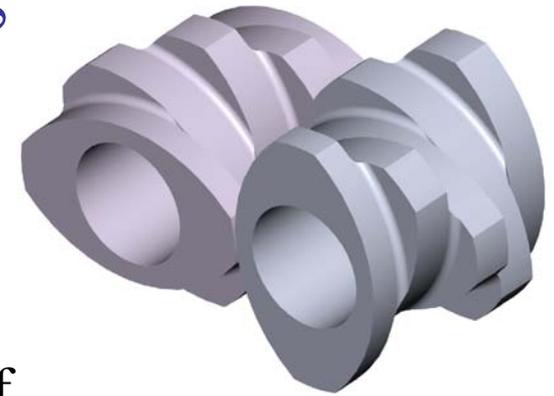
# Objectives

- Obtain Process Review Board and Command approval for live operations.
- Process energetic material in the facility.
  - Using Eurenco Bofors produced precipitated powder.
- Produce MK 99 gun propellant.



# Status

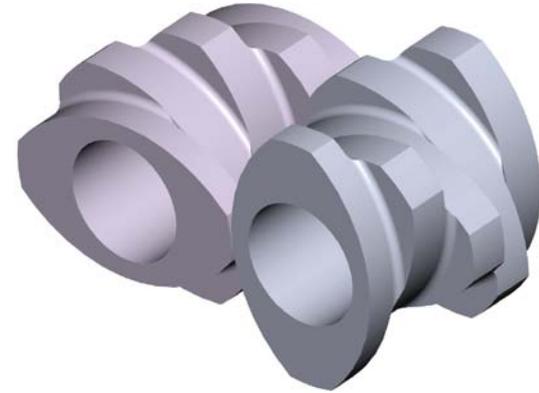
## Inert Processing



- Processed several hundred pounds of inert material through a series of process trials
- Successfully demonstrated the operation of all process equipment:
  - Clextral Evolum 88 millimeter extruder
  - K-Tron T-60 feeder with MATCON discharge station.
  - American Crane and Equipment Company automated crane.

# Status

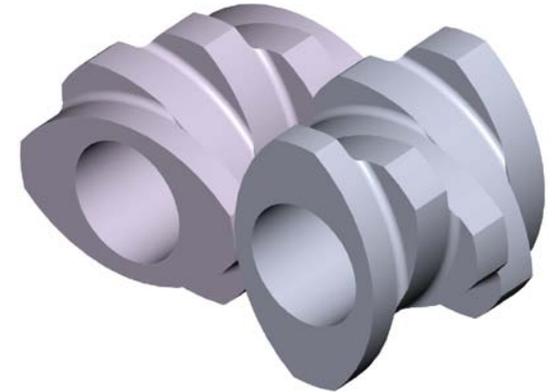
## Inert Processing



- Liquid feed systems.
  - This includes Pro Flow pressurized/jacketed feed systems with Micro Motion mass flow controllers.
- Romeo Engineering take away system.
- Highly Filled Materials Institute designed die for MK 99 propellant.
  - This was designed using Eurenco Bofors precipitated powder.
    - This is a pre-formulated dry granulated powder.

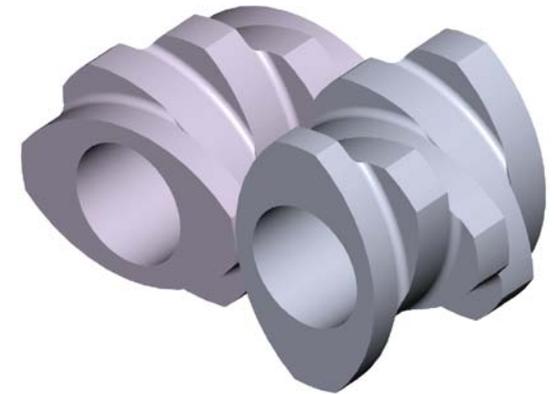
# Facility Status

- The equipment in the facility is ready to run energetics.
  - There have been a number of technical challenges involved in bringing the facility on line.
- The current focus is to complete the Process Review Board.
  - The PRB is a meticulous review process of ensuring that all the technical questions have been answered before our Captain releases the facility to run energetics.



# Technical Challenges Equipment

- The 88 millimeter extruder has been a challenge to bring on line.
  - We have had several metallurgical issues.
    - The 88 millimeter has 10 segmented barrel liners. The liners are stainless steel (not nitrided). Originally we had nitrided liners that were brittle.
    - The screw elements are a Clextral proprietary brass compound. Originally we had stainless steel elements.

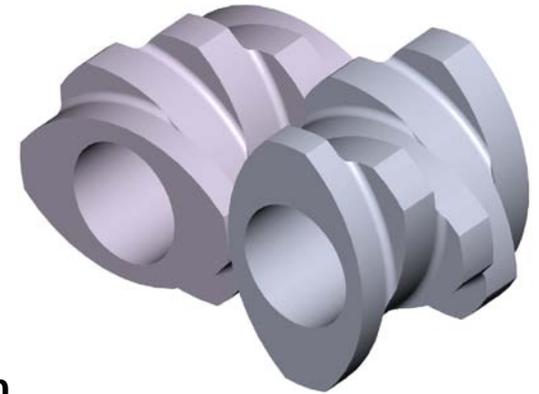


# Facility Status

## Barrel Liner History

- First iteration
  - Stainless steel liners with stainless steel screws.
    - HRC difference of 5 points
- Second iteration
  - Nitrided liners/stainless steel screws coated with Stellite® 12
    - nitriding was too hard
- Final choice
  - Stainless barrel liners and brass screw elements

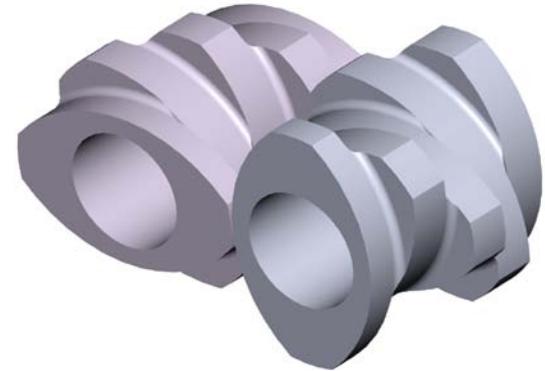
# Technical Challenges Equipment



- Product take-away has presented numerous technical hurdles to overcome.
  - Strand rate is high and we have not been able to exercise the equipment with the inert material.
    - At 350 lbs/hour feed rate the eight strand die is running at approximated 25 inches per minute per die.
    - Previous work in other extruders gives us the confidence to move on to the Eurenco Bofors precipitated powder.

# Technical Challenges

## Electro Static Discharge Hazard



- The last major technical hurdle is the mitigation of the ESD issues associated with the Eurenco BOFORS powder.
- We are modifying our MATCON bins.
  - This will reduce the bulk discharge potential.
    - We will further mitigate the charge by controlling the flow rate of the material into the bin.
- Testing with Chilworth Technology is tentatively scheduled to close this issue.