

Developments in Processing of IM Gun Propellants in the UK

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Due to the increasing requirement to introduce IM propellant formulations into gun propelling charges, in the direct fire and indirect fire systems, BAESYSTEMS has re-established R & D gun propellant processing in the UK at their Land systems Glascoed plant in Wales.

Presentation Overview

- Introduction
- Facility Overview
 - Incorporation
 - Extrusion
 - Cord handling & Cutting
 - Stoving & Blending
 - Control system
 - Testing
- Propellant Processing
- Future technology
- Conclusions

Introduction

- The new propellant processing facility at Glascoed is a remote controlled processing facility. Conventional propellant processing technology equipment has been instrumented and controlled by sophisticated computer technology.
- The facility will be used for all gun propellant Research and Development programmes. Propellant formulations for direct and indirect fire applications will be processed and tested.

Facility Overview

- Incorporation
- Extrusion
- Cord handling & Cutting
- Stoving & Blending
- Control system
 - Interface with interlocks
 - Software restrictions
 - Data collection
- Testing

Incorporation

- Weigh scales & Metal Detector
- Incorporators
 - 3 incorporators available
 - Capacity of 2kg to 20kg batches
- Rheometer
 - Each batch is monitored for viscosity



Extrusion

- 3" Press
 - 1kg capacity
- 8" Press
 - 20kg capacity
- Cord handling system
- Granule Cutter



Cord handling & Cutting



Propellant is draped and cut

Stoving & Blending

- Stoving
 - Propellant is dried on trays in a controlled room
 - Max temp is 45°C
- Blending
 - Stick propellant is manually blended
 - Granules are blended or coated in a drum blender

Remote control process



Control system – Initial access screen

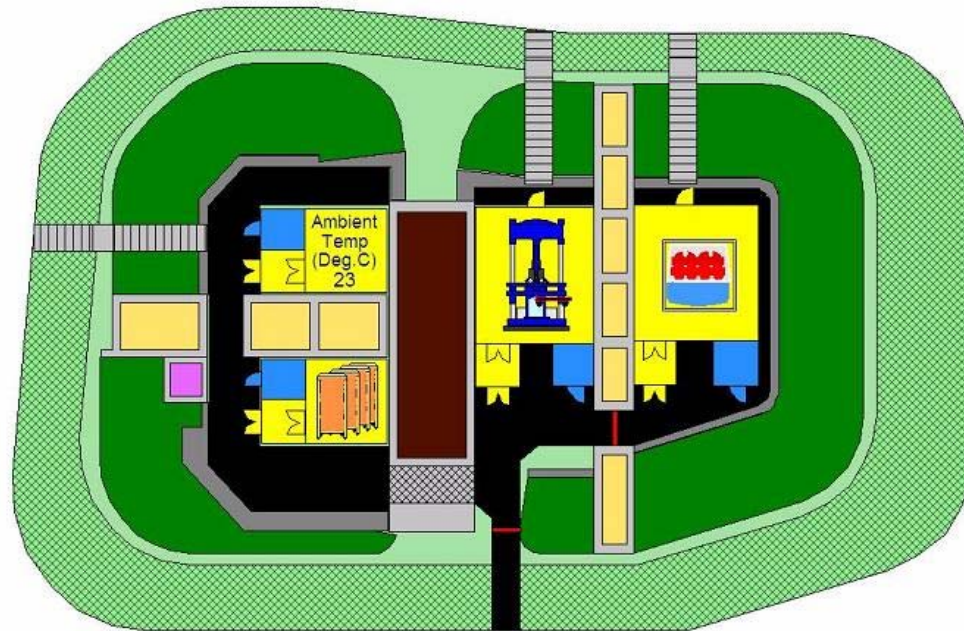
Propellant R & D Facility

BAE SYSTEMS

12:04:30 15/06/2006

Log Off
8 Inch Press
10 Kg Incorporator
Stoving
Historical Data
Alarm History
Close Stoving
Maintenance
Engineering

Castell [P][I][S][D]
Extraction [P][I][S]
UPS Healthy



Ack	Description	Value	Time In	Area	Tagname	Status
✓	8 inch press system pressure		1 09:23:51.982	ALL	TP_SYSTEM_PRESSURE	LOLO

Control system – 8” press and Cord handling

Propellant R & D Facility BAE SYSTEMS
13:48:35 15/06/2006

Log Off | 8 Inch Press | 10 Kg Incorporator | Stoving | Historical Data | Alarm History | Close Stoving | Maintenance | Engineering

Castell [P][I][S][D] Extraction [P][I][S] UPS Healthy

Manual | Press | Retract | Automatic | Create Cycle | Stop Pump | Abort Auto Cycle | Pause Cycle | Snapshot | Close

8" PRESS

CYCLE STATUS
 1: FAST APPROACH
 2: SLOW APPROACH
 3: MATERIAL DETECT

Controls
 On Off
 On Off
 On Off
 On Off

Drives
 Enabled
 Interlock
 Enabled

Power
 Enabled

- Cord Handling System -
 Stick Granules
 Save Stick Save Granules

Drape Ring Stroke: Decrease 748 Increase
 Drape Ring Dwell Time: Decrease 658 Increase
 Crossfeed Stroke: Decrease 314 Increase
 Crossfeed Zero: Decrease 49 Increase

Extrusion Rate mm/min: -- 0 + ++
 Conveyor Speed: -- 392 + ++

Crossfeed Dwell Time: -- 135 + ++
 Display UTAC Chart

Ack	Description	Value	Time In	Area	Tag
	8 inch press auto cycle run	AUTO CYCLE	13:47:28.685	ALL	TP_AUTO_CYCLE_F
	8 inch press pump status	RUNNING	13:46:30.602	ALL	TP_PUMP_STATUS
	8 inch press auto mode selected	AUTO SEL	13:45:03.206	ALL	TP_AUTO_SELECTE
	8 inch press selection status	Selected	13:44:55.090	ALL	TP_SELECTED

Safety Considerations

- Captive Key system
 - No one allowed in the facility while the press is running
 - No one allowed in the facility before dough-up
- Maximum pressures, torque and temperatures set.
 - First warnings and software regulated actions
- “Emergency stop” buttons throughout the facility and on the panel

Control system - data collection

- Software system monitors the process continuously and data points for all equipment are recorded.
- Incorporator cycles are saved
 - Cycles can be replayed to ensure batch to batch consistency
- Press cycles are recorded
- Processing is monitored by CCTV

Testing

- Rheology
 - Capillary rheometer
 - Viscosity measured for each batch
- Dimensional analysis
- Closed Vessel
 - Recorded for each lot of propellant
- Chemical & physical analysis
 - Density recorded for each batch
- Hazard data
- Ballistic testing
- IM testing

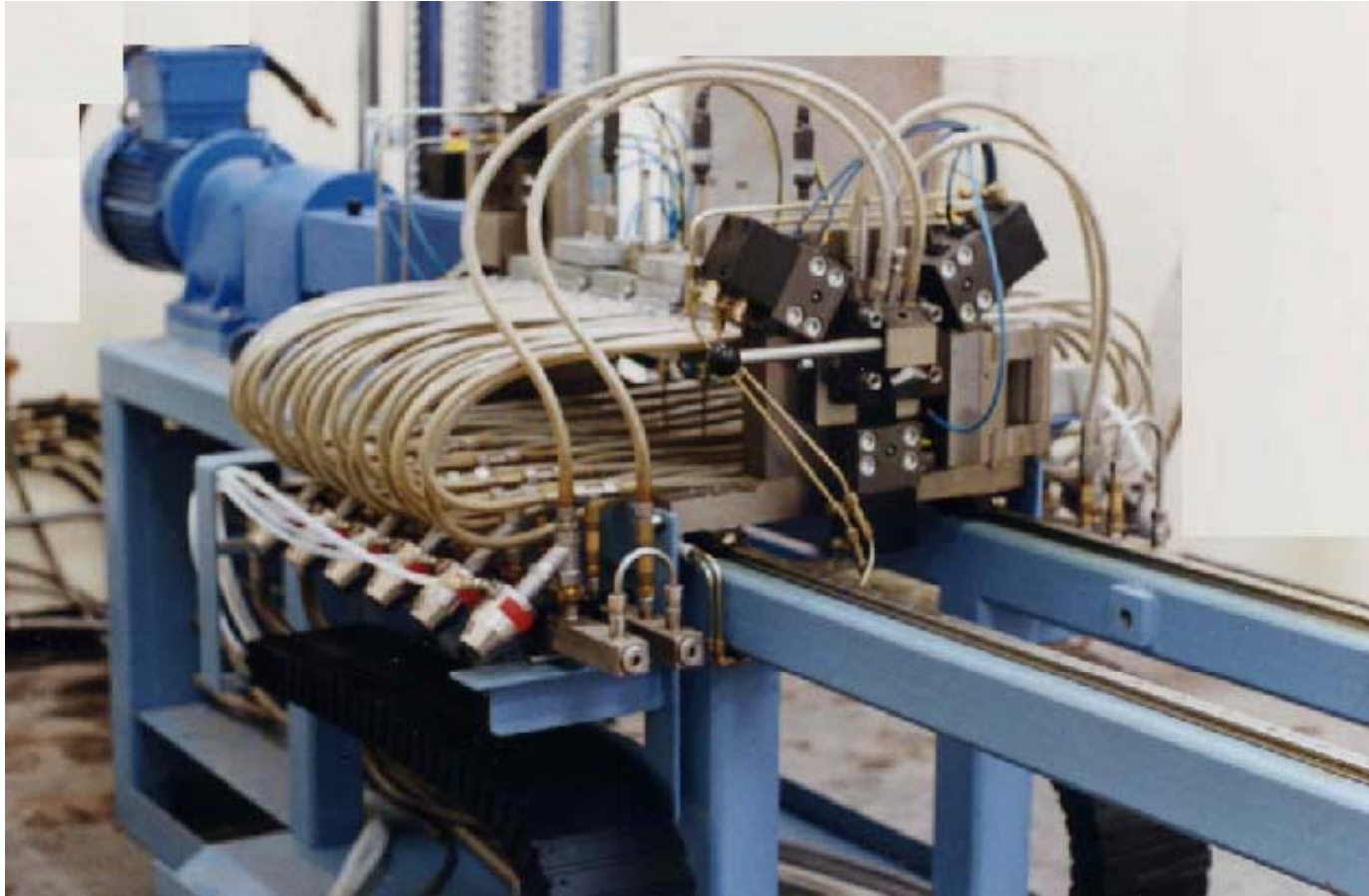
Propellant processing

- Propellant types being processed are multi-based TPE propellants for direct and indirect fire applications including research with novel ingredients
- Currently supporting MoD project for developing IM propellants.
- Collaborating with production suppliers to develop the scale up process for these propellants

Future technology

- Continuous extrusion process based on co rotating, fully intermeshing, self wiping, twin screw extruder
- Benefits well known:
 - Safety
 - Remote processing
 - Lower amounts of energetic material being processed
 - Reduction in wastage
 - Highly controlled and instrumented process
 - Quality
 - Aeration decreased
 - Continuous process
 - Performance benefits
 - Enhances propellant physical properties
 - Enhances ballistic properties
 - Highly flexible process

Future technology



30 mm twin screw extruder to be installed in 2008

Conclusions

- BAE Systems Glascoed re-established an R&D capability within the company.
- The new process route is safer and gives an enhanced reliability within the process.
- TPE LOVA propellant has been processed successfully.
- Facility will continue to develop with Twin Screw Extruder programme.

Questions?