The Development And Operation Of The BNFL Magnox Encapsulation Plant

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NJ Bowmer, IH Godfrey, EJ Butcher
Introduction

• Overview of Presentation

• Waste Feeds to MEP.
• Approach to Product Development
• Specific Development Challenge
  • Magnox Corrosion
  • Pyrophoric Waste feeds
• The MEP Process
• Conclusions
Waste Feeds to MEP

- Magnox Swarf

Picture of magnox fuel elements
Waste Feeds to MEP

- Decanning
Waste Feeds to MEP

- Example of Magnox Swarf
Waste Feeds to MEP

- Other Minor Streams
  - Rotary Skip Wash Arisings
  - Uranium Re-cans
  - In-Cave Scrap
  - Decanner Sump Arisings
Approach To Product Development

• Product Evaluation Programme

Standard Format used across Sellafield site to develop techniques for encapsulating ILW.

• Phase 1 - Characterisation
• Phase 2 - Initial Investigations
• Phase 3 - Small and full scale trials of preferred waste form
• Phase 4 - Development of the plant envelope

• MEP Operational Database
Specific Development Challenge

- **Magnox Corrosion**

- Largest threat to product longevity
- Increased corrosion at higher product water content
- Increased corrosion at higher product voidage
- Reduced rate of corrosion at higher pH
Specific Development Challenge

- **Magnox Corrosion**

  Competing Factors Affecting Processing:

  - Low water content wasteform to reduce corrosion
  - High fluidity (water content) grout to reduce voidage
Specific Development Challenge

- **Magnox Corrosion**

Controlled by using a specific optimum OPC/BFS grout

Super-plasticisers were not available as an option at this time due to concerns on possible enhanced solubility of long lived radionuclides in the repository - UK Nirex requirement.

Required grout fluidity achieved by using vibration during in-filling.
Specific Development Challenge

• **Pyrophoric Wasteform**

Uranium Hydride present in waste feed to MEP of variable concentration and particle size.

Possible Control Methods:
• Remove pyrophoric material
• Limited air exposure time ‘safe window’
• Minimum air exposure time

Nuclear expertise intelligently applied
Specific Development Challenge

- Methods of Encapsulation

- Required grout fluidity achieved by using vibration during infilling

Methods of Encapsulation to Control Pyrophoric Hazard assessed:

- Rapid in-filling
- Grouting under water
- Grouting under inert gas atmosphere
Specific Development Challenge

- Methods of Encapsulation

- Rapid in-filling
  - Top + Bottom Filling
  - Lowering basket of swarf

- Grouting under inert gas atmosphere
  - Remove cover water & Top fill
The MEP Process
The MEP Process

- Final Product
Conclusions

• Magnox waste is a complex material presenting significant technical challenges

These were addressed through:

• Understanding of the waste chemistry and waste - encapsulant interactions
  – short term processing issues
  – Long term product quality

• Developing specific grouts suitable to produce the required product quality

• Engineered solutions to allow the process to operate effectively
Conclusions

• How do we judge if this was a success?

• MEP has been operating to the PEP defined encapsulation envelopes since 1990.

• Over 15,000 encapsulated products manufactured that meet the criteria specified by UK Nirex Ltd. for disposal

• Characterisation of full-scale historic inactive cement-based intermediate level nuclear wasteforms

• Do you have any questions?