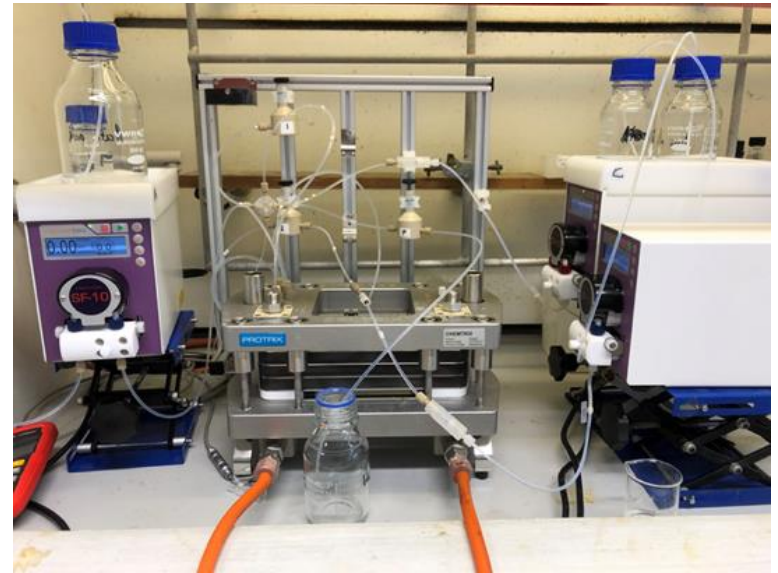
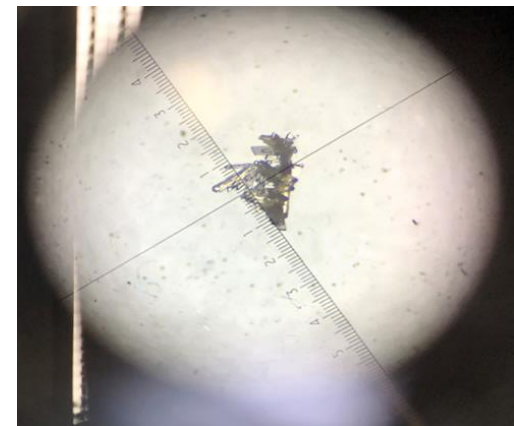


# Challenges for the Explosives Sector – A Regulatory Perspective

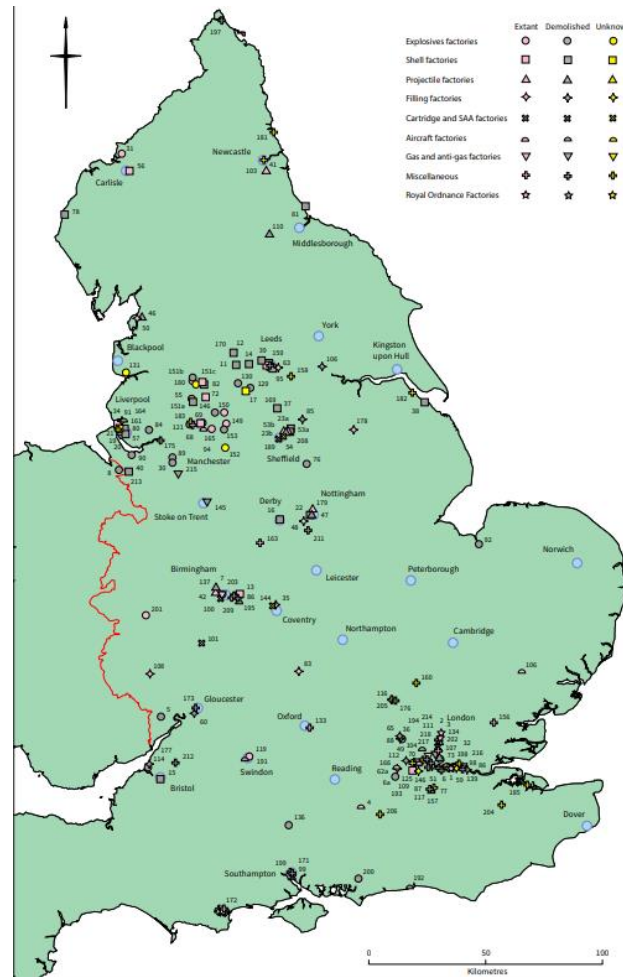


**Dr Nathan Flood**

**Acting HM Principal Specialist  
Inspector of Health and Safety  
(Explosives)**



# WW1 – Ministry of Munitions



[https://historicengland.org.uk/research/results/reports/7543/FirstWorldWarNationalFactories\\_AnArcheologicalArchitecturalandHistoricalreview](https://historicengland.org.uk/research/results/reports/7543/FirstWorldWarNationalFactories_AnArcheologicalArchitecturalandHistoricalreview)

# WW2 – ROF Filling Factories

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- ROF Chorley (Filling Factory No. 1)
- ROF Bridgend (Filling Factory No. 2)
- ROF Glascoed (Filling Factory No. 3)
- ROF Rotherwas (Filling Factory No. 4)
- ROF Swynnerton (Filling Factory No. 5)
- ROF Risleigh (Filling Factory No. 6)
- ROF Kirkby (Filling Factory No. 7)
- ROF Aycliffe (Filling Factory No. 8)
- ROF Thorp Arch (Filling Factory No. 9)
- ROF Queniborough (Filling Factory No. 10)
- ROF Brackla (Filling Factory No. 11)
- ROF Swindon (Wootton Bassett) (Factory No. 12)
- ROF Macclesfield (Factory No. 13)
- ROF Ruddington (Filling Factory No. 14)
- ROF Walsall (Filling Factory No. 15)
- ROF Elstow (Filling Factory No. 16)
- ROF Featherstone (Filling Factory No. 17)
- ROF Burghfield (Filling Factory No. 18)
- ROF Tutbury (Factory No. 19)
- ROF Northampton (Factory No. 20)

# Current Status of Explosives Manufacture



## Explosives

- TNT
- RDX
- HMX
- NC
- NG
- AP
- Lead Azide
- Lead Styphnate
- ~~Tetryl~~
- Black Powder
- AN

## Manufacturing Methods

- Melt Cast
- Planetary
- Z-Blade
- Jelly Mould/Turbula
- Extrusion (Twin and Single)
- Pressing
- Sieving
- Nitration – Primary explosives (production scale)

# Everything Changed



Ukraine: Russia has launched 'full-scale invasion' (1) - BBC News - 24th February 2022

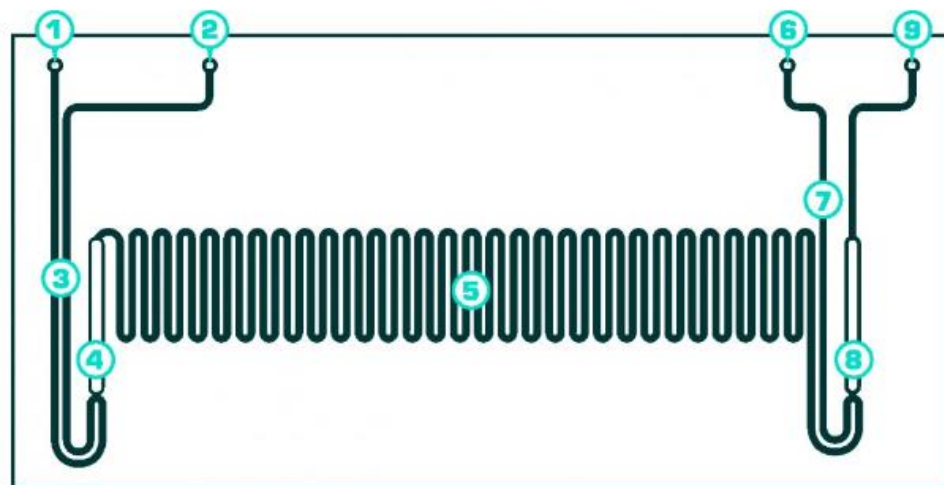
# Moving in to the Future

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- New Explosive Substances
- New Explosive Articles
- New Explosive Manufacturing Methods
- New Explosive Manufacturing Sites
- New Explosive Storage Sites
  
- HSE is essentially regulating a sector that is preparing for conflict

# New Synthetic Methods

- Pros
  - Continuous
  - Smaller scale
  - Quicker scale-up from R&D
  - Less waste
  - UK capability
  
- Cons
  - New!!
  - Requires acid!!
  - Additional kit required e.g. Crystalliser
  - Lack of synthetic production experience



- |                            |                      |                           |
|----------------------------|----------------------|---------------------------|
| ① Reactant A input         | ④ SOR mixer, A&B mix | ⑦ Quench pre-heating      |
| ② Reactant B input         | ⑤ Residence time     | ⑧ SOR mixer, quench mixes |
| ③ Reactant A&B pre-heating | ⑥ Quench input       | ⑨ Product output          |

[Flow Chemistry | Chemtrix](#)

# Flow Chemistry





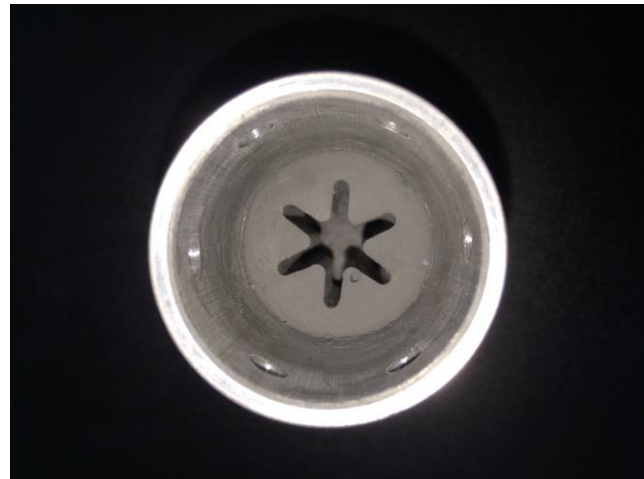
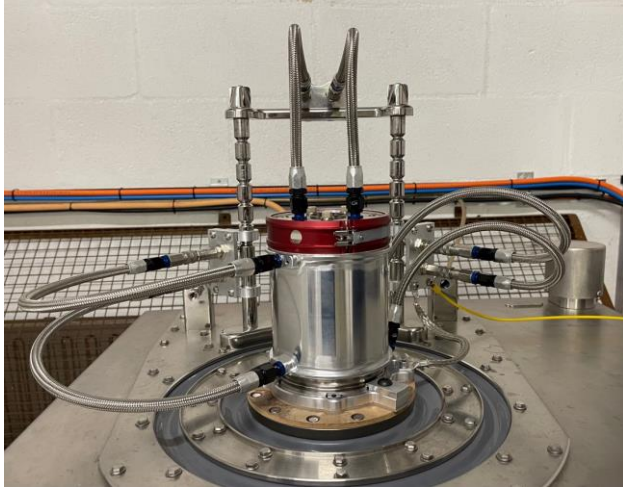
# New Mixing Methods



[RAM 5 H - Resodyn Acoustic Mixers \(resodynmixers.com\)](http://resodynmixers.com)

- Pros
  - Can be continuous
  - Mix in case
  - Quicker scale-up from R&D
  - Less waste
  - Can mix explosives, binders and additives that could not previously be mixed
- Cons
  - New!!
  - Mixing process not understood
  - Requires new processes!!
  - Small pool of experience

# RAM Mixing



# Novel Formulation's and Article's



# Summary

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- This is an exciting time for our sector!!
- The increased funding and new manufacturing methods mean change is coming at pace!!
- Please engage with us about any future plans for your sites as soon as you are able to.

# Further Information

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- Come and speak to us during the conference!!

- Explosive Enquires

[explosive.enquiries@hse.gov.uk](mailto:explosive.enquiries@hse.gov.uk)

- Web Site

<https://www.hse.gov.uk/explosives/index.htm>

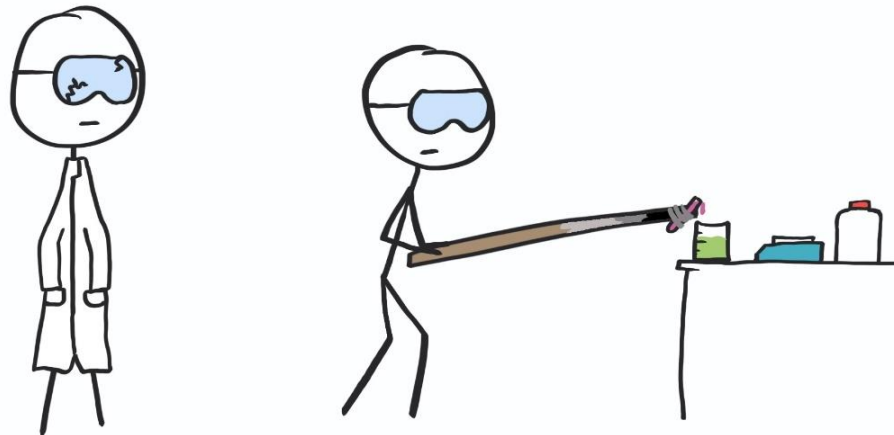
# Acknowledgments

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- The Falcon Project
  - for providing images used in this presentation
- HSE Science and Research Centre (Buxton) and Radnor Range
  - for the testing that has been shown in this presentation

# Questions?

A GOOD DAY IN THE LAB  
IS ANY DAY  
NOTHING EXPLODES



\*UNLESS YOU WORK IN AN EXPLODING THINGS LAB, IN  
WHICH CASE PLEASE BLOW UP THIS INACCURATE CARTOON