Research Facility: focusing on developing leading edge capability to deliver total shaping of material solutions from concept to validation

Partnership between: University of Strathclyde, UK Government & Engineering Industries

Collaborating with Industry: commercialising applied research and development to advance industry’s manufacturing processes and materials

Collaborating with Academia: working with key academics in relevant research fields to advance manufacturing process and material understanding development

AFRC’s key funding bodies:
High Value Manufacturing Catapult (HVMC)

- Achieve a step change in activity and impact of manufacturing R&D in the UK
- A network of 7 centres collaborating across many key technology areas
- AFRC is the only centre in Scotland with access to support from Scottish Enterprise as well as the UK Government
- AFRC key focus is in the areas of metals forging and forming, and materials understanding
- AFRC works collaboratively with partner centres, for example joint road-mapping activities
Addressing Technology Readiness Levels 4-6

**Product Challenges**
- New materials
- Novel geometry
- Tighter specifications
- Safety & environmental needs

**Business Challenges**
- Lower Operational & material costs
- Improved process capability
- Reducing PI Lead times
- Delivery adherence

**Technology Readiness Levels - TRL**

1. Develop new capability and de-risk new technologies

**TRL 4-6**
- Provider world class industrial scale equipment
- The best relevant research
- Support from engineers, scientists
- An environment of collaboration and open innovation

**Drive Industry Growth**
- Create commercial impact
- Help companies of all sizes
- Strengthen supply chains

**Faster Time to Market**

**Product Differentiation**

**Capable processes**

**Enhanced Product Quality**

**Reduced Lifecycle Costs**
AFRC Technology and Capability

- Hot Sheet Forming (Superplastic Forming)
- Process modelling
- Hot Bulk Forging
- Incremental Deformation
- Heating Technologies and modelling
- Die Management (Die life/monitoring, rapid make of dies)
- Low temperature sheet forming
- Material Characterisation
- Residual Stress
- Metrology
Core Research Programme

Directed by AFRC Tier 1 Members
An end-to-end capability

- Test the material
- Model the behaviour
- Simulate the process
- Compare prediction and process
- Physically try out the process
- Measure the trial outputs
- Test the material
- Model the behaviour
- Simulate the process

Time-hardening:
\[ \varepsilon = A \sigma^n \tau^m \]

Strain-hardening:
\[ \varepsilon = \frac{\Delta H}{k} \left[ \sinh \left( \frac{\Delta H}{k} \right) \right] \]

Hyperbolic Sine:
\[ \varepsilon = A \left( \sinh \left( \frac{\Delta H}{k} \right) \right) \exp \left( \frac{\Delta H}{k(1 + \Delta H)} \right) \]

Modified Time-hardening:
\[ \varepsilon = A \sigma^n \tau^m - C \exp \left( \frac{\varepsilon}{D} \right) \sigma^n \]
AFRC Strategic Opportunities

• UK Metals Strategy Forum
  • Developing R&D strategy for a UK Metals Strategy
• CBM membership. Trade association - represents majority of UK forgers / formers
• Recent tie-in with NPL (NPL Scotland)
• The Scottish Institute of Remanufacture
  • a pan-Scottish hub to focus on realising the vast value in the materials and components within the products we recycle.
• Oil and Gas
  • working with Scottish Oil and Gas Innovation Centre
• Technology and Innovation Centre
  • Multi-million Innovation Hub at University of Strathclyde:
    • low carbon power and energy systems
    • advanced sensors and ICT
    • high-value manufacturing and engineering
    • Nanoscience
    • plasma physics
    • continuous pharmaceutical manufacturing
Workshop 1 of 2

Production scale forming and forging
Workshop 2 of 2

Near net-shape forming
ICSAM 2015

• 3 papers submitted and accepted:
  
  • Bylya, Vasin & Blackwell – The mechanics of SPF; how to incorporate and model SP & SP-like conditions (Invited talk)
  • N. Zuelli et al - Innovative Methods for Investigating Key Process Variables in the Manufacture of Superplastically Formed Aero-Engine Components (cycle time reduction, temperature measurement, factors affecting tool life)
  • P. Anderson - Finite Element Analysis and Validation of the Superplastic Forming of Multi-sheet Structures