Evolution of Hot Forming and Superplastic Forming Presses in the Aerospace Industry
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Group presentation

ARIES

100%

Cyril Bath
USA

100%

ACB
FRANCE

100%

ACB
TEST

ACB
PRESSES Pte Ltd

ACB
PRESSES UK Ltd
Elastoforming

- For special stamping or fluid cell parts
Cold Stretch Forming

- For fuselage skin panels
- For Airframe structures
Hot Stretch Forming

➢ Titanium Airframe Components
Friction Welding

➢ For jet engine components and Airframe structures
Milling

- For fuselage skin panels
Hot/Superplastic Forming

For titanium fan blades, engine pylons & nacelles, skin panels...
Hot Forming

- HF
  - Temperature: 700°C for Ti-6Al-4V
  - Punch/die system
  - Complex tool design
  - Short forming cycle
  - Medium formability: simple part shape
  - Low thickness dispersion
Hot Forming
Superplastic Forming

- SPF
  - High temperature: 900°C for Ti-6Al-4V
  - Forming using gas pressure
  - High formability: superplastic properties of the material
  - Long cycle time
  - High thickness dispersion
Superplastic Forming
Presses evolution

- Part quality
- Productivity
- Material saving
- Energy efficiency
- Cost reduction
- New materials
Platen technology

Ceramic
- Low density & thermal expansion
- Low cost
- Low installed power
- Brittle
- Max. temperature: 1000°C

Metallic
- High thermal conductivity
- High heat inertia
- High installed power
- Low creep resistance
- High cost
- Max temperature 1000°C
Platen technology

Refractory concrete platen (2010)

- High temperature (1100°C)
- No creep deformation
- Intermediate cost
- Less brittle
- High installed power
Temperature regulation

- Temperature homogeneity is a key criteria for SPF / HF part quality
- The ability of the press to recover quickly its platen homogeneity after part unloading/loading influences its productivity
- Since 20 years ACB has developed new technologies
  - Heat-shields
  - Heater failure detection (2009)
  - Direct tool temperature regulation (2012)
Gas Management

- Regulation system for SPF developed by ACB
  - Standard pressure 6 Mpa
  - Accuracy up to 0.001 Mpa
  - Permanent parameter control and recording
  - High pressure gas line up to 15 MPa

Inconel 718 – free bulge test
IRT Jules Verne Dual Press

- HF / SPF dual press (2014)
  - Platen size: 2480 x 1500 mm
  - Max. daylight: 1500 mm
  - Hot Forming/Sizing: 500 T
  - SPF: 1000 T
  - Max. temperature: 1100°C
  - 3 gas lines
    - 2 conventional lines: 6 MPa
    - 1 high pressure line: 15 MPa
  - Heating shields
  - Second effect (cushion)
Case study

- Ti-6Al-4V SPF part – 2000 x 400 x 100 mm
- Double curvature
- High thickness dispersion (3 to 1.8 mm)
- Between 90 and 120 min cycle time
- 4000 parts per year

How to save cost?

Material saving = Blank thickness
Cycle time
Combined HF/SPF cycle

Processes comparison

- SPF process
  - High elongation
  - High thickness dispersion
  - Long cycle time

- HF process
  - Low deformation
  - Small thickness dispersion
  - Short cycle time

Combination

- Same temperature
- Intermediate cycle time
- Improved thickness homogeneity
- Complex part shape
Combined HF/SPF cycle

*hybrid* part after forming cycle, tool open (left); *hybrid* part after unloading (right top and bottom)

Blank thickness reduction from 3 to 2.2 mm

Cycle time reduction 90 min to 60 min
Part Loading

- Part quality often depends on their handling and cooling conditions.
- Tool life-time is also significantly reduced in case of incorrect cooling and heating.
- Operator safety.
Hot Die Loading

ACB also designs complete plants for SPF & SPF-DB purpose with field-proven solutions for:

- Pre-heating ovens
- Tool handling in hot conditions
- Tool cooling systems
Conclusion
Thank you for your attention