A Tier One View on the Future of Materials in Aerospace Manufacturing

Abby Lilly
VP Supply Chain
GKN Aerospace North America

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Agenda

Introduction
Composite or metallic?
Material trends
Metallic technology development
Composites
Summary
GKN Group Introduction

GKN: leadership in four specialist, global sectors

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GKN plc: Global positioning

c 50,000 employees in over 35 countries
GKN Aerospace

$3.5 billion International Aerospace enterprise
35 sites, 12,000 people
3rd Largest Global Aerostructures Supplier
2nd Largest Global Engine Products Supplier

Aerostructures
Engine Products
Special Products

- Aerospace North America
- Aerospace Europe & Special Products Group
- Aerospace Engine Systems (Volvo Aero)
GKN Aerospace – Markets and customers

Market

Business Mix

Sector

Customer Base
GKN Technology – Targeted Innovation

Future product differentiation

Future wing technologies
Advanced fuselage
Nacelle, pylon and exhaust
Engine structures
Engine rotatives
Transparencies and coatings
Ice protection systems

Next generation composite processes

Advanced metallic processes

Advanced process development

GKN Aerospace
Composite or Metallic?

- Reality is both!
  - Recent years with both the Boeing 787 and A350XWB there has been a step increase in the level of composites used.
  - In aeroengines composites are also making a larger contribution

- So are metals being replaced?

- Every aircraft designed today and tomorrow will be a mixture of both
  - Even so-called composite aircraft are around 50% composite meaning the other 50% is still metallic.
  - It should be about putting the right material in the right place

Materials used in 787 body
- Fiberglass
- Carbon laminate composite
- Carbon sandwich composite
- Aluminum/steel/titanium

By comparison, the 777 uses 12 percent composites and 50 percent aluminum.
Material Trends

However the material mix is changing in both engines and alloys

Today the range of different materials utilised is huge and is continuing to grow

The mix varies on mission profile of the product

Debate is often over-simplified - it is not just simply a weight issue, or engineering performance - always commercial and market factors

GKN Aerospace has extensive capability in both composites and metallics to ensure it can design and develop the products of the future in the right material
Metallic Trends

> Only so much value in a structure or engine and suppliers are fighting for their share

> The increase in CFRP use has driven the metallics industry to develop new competitive products – e.g. new 3rd generation Al-Li alloys

> A shift in metallics is also taking place
  > Increase in range of alloys used
  > Growth in use of Titanium

> But more advanced alloys and materials can equate to higher cost and processing challenges

![Use of Ti in Aircraft](image)
Metal Processing

- Processing is driven both by cost down and performance increase
- The industry has always used a range of different processing techniques
  - Forming, casting, welding, machining
- Manufacturing is dominated by subtractive processing techniques, especially for structural elements
  - Composite manufacture is predominately additive
- Machining continues to evolve with more thin walled monolithic structures being achievable
- However it is a wasteful process
  - Current throw away rate (or recycled) is typically up to 90%+
  - Need to move to net shape
- New challenges:
  - Harder materials
  - Higher cost
  - Larger more complex structures
  - Environmental considerations
Advanced Metallic Processes & Materials

- High performance machining
  - Hybrid, Cryogenic, Thermally Assisted
- Laser welding and EB welding
- Linear friction welding
- Friction stir welding
- Advanced hole drilling & assembly
- New materials developments
- Net shape HIPing
- Additive Manufacturing

Requires materials developed for process

Increase in use of powder metallurgy
The range and mix of materials deployed is changing
Use of metals will certainly continue in aircraft
New alloys and products tailored to specific application
New processing techniques can help “unlock materials science”
But big challenges required to benefit fully from the opportunities now available (certification challenges)
Thank you for your attention