

Opportunities for Textiles in Composites

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REMEMBER

Where there is a problem,
there is a business opportunity

WHAT ARE COMPOSITES?

A mixture of two or more materials to give a product in which, hopefully, the best qualities of both are combined to give an even better product.

The Market for Textile Composites

What types are there?

- Short fibre reinforced composites
- Long fibre reinforced composites
- **Fabric reinforced composites**
- Ceramic matrix composites
- Metal matrix composites

Uses of Textile Composites

Automotive

Problems

- Reduce Weight
- Reduce number of parts
- Lower tooling costs for composites





Automotive

- Body Shell parts
- Drive Shafts
- Transmission components
- Crashworthiness improvement components
- Large trucks body parts
- Odds and ends

Composites in Automotive

- Ideal for shorter production runs
- Racing Cars - many 'one offs'

Aircraft Problems

- Weight
- Weight
- Weight







Aircraft

- Access panels
- Skin panels
- Ducting
- Nose cones
- Control Rods
- Propellers
- Spinners

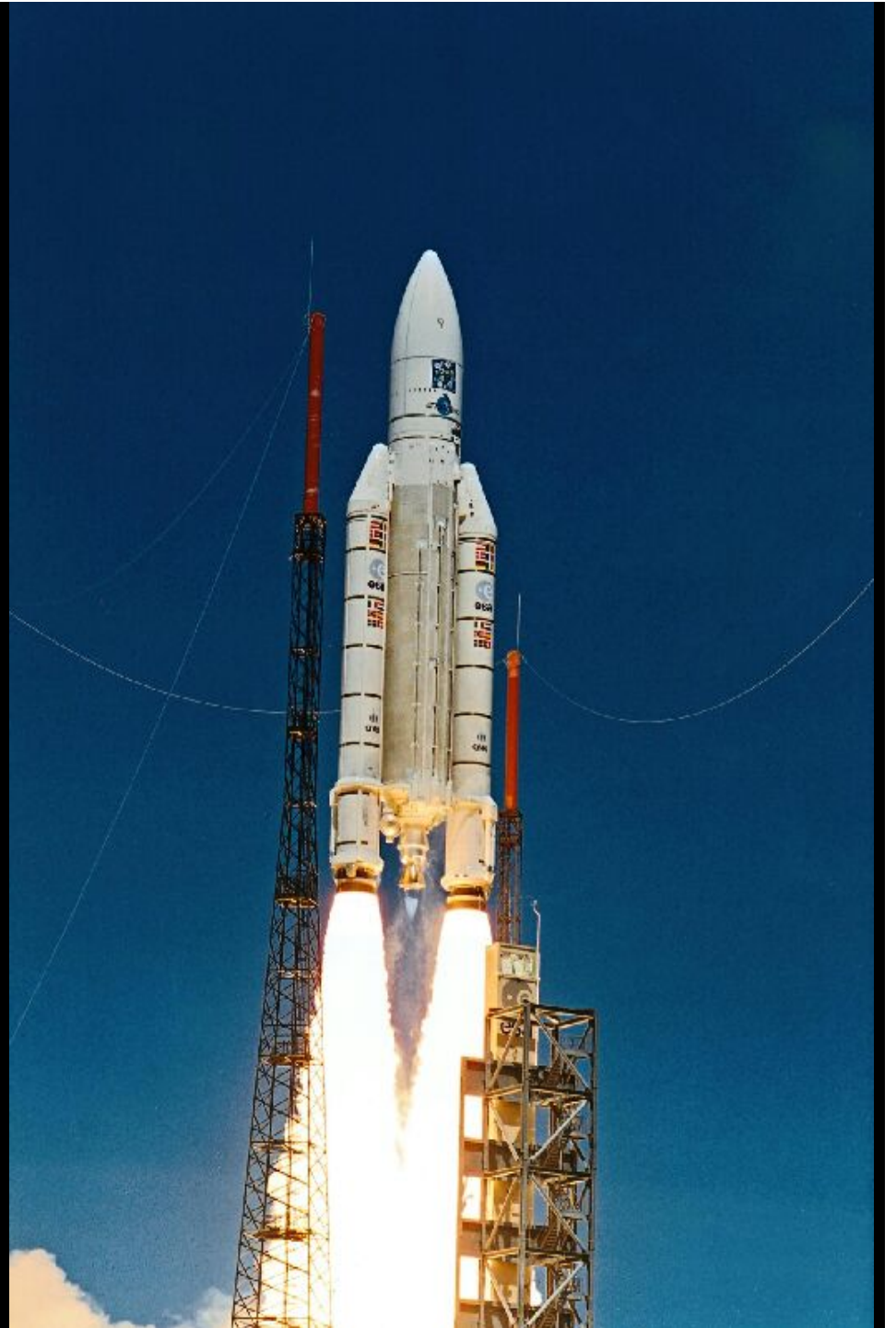
Aircraft Engines

- Fan blades
- Engine liners



Space

- Weight saving crucial
- Many high specification items
- Temperature considerations significant



Defence

- Tanks
- Armoured Cars
- Stealth materials
- Ships
 - Mine sweepers
 - Large ships
 - Fast ships



Medical

- X-ray tables
- MRI magnet holders

Wind Turbines

- Blades
- Universal joints



Others

- Helmets
- Protective equipment
- Missile launch tubes
- Lifeboats
- Yachts



THE TEXTILE COMPONENT

Fibres

- Glass
- Aramid (Kevlar and Twaron)
- Carbon
- Polyethylene
- Polypropylene
- Polyester
- PBO (Zylon)
- Vectran
- Others

Glass Fibre

- Cheap
- Strong
- Dense
- Inextensible
- Several types
- Extensively used

Aramid Fibre

- Strong
- Fairly expensive
- Most usually yellow
- Not abrasion resistant
- Retains moisture, therefore not for aircraft skins
- Poor UV resistance

Carbon Fibre

- Generally coming down in price
- Stiff
- Difficult to dispose of

Polyethylene and Polypropylene

- Cheap
- Thermoplastic
- Degrade in UV
- Creep

Polyester

- Relatively cheap
- Flexible
- Easy to process
- Low moisture content
- Often used as a holding product

Glass Reinforced Thermoplastics

- Market growing rapidly
- Twintex (thermoplastic coated glass)
- Twintex supplies a growing part of the composites market.

High Strength Polyethylene

- Dyneema (Europe and parts of Asia including India)
- Spectra fibre (US)

Increasingly used in bullet resistant and stab resistant garments

Silicon carbide

- Very expensive
- Very rigid
- Very high temperature resistant
- Can be used to reinforce metals such as titanium
- Black or dark grey

Metal

- Steel
- Copper
- Titanium (ribbon)
- Shape memory alloys
- Superelastic alloys
- Gold

Natural Fibres

- Straw
- Flax
- Hemp
- Jute

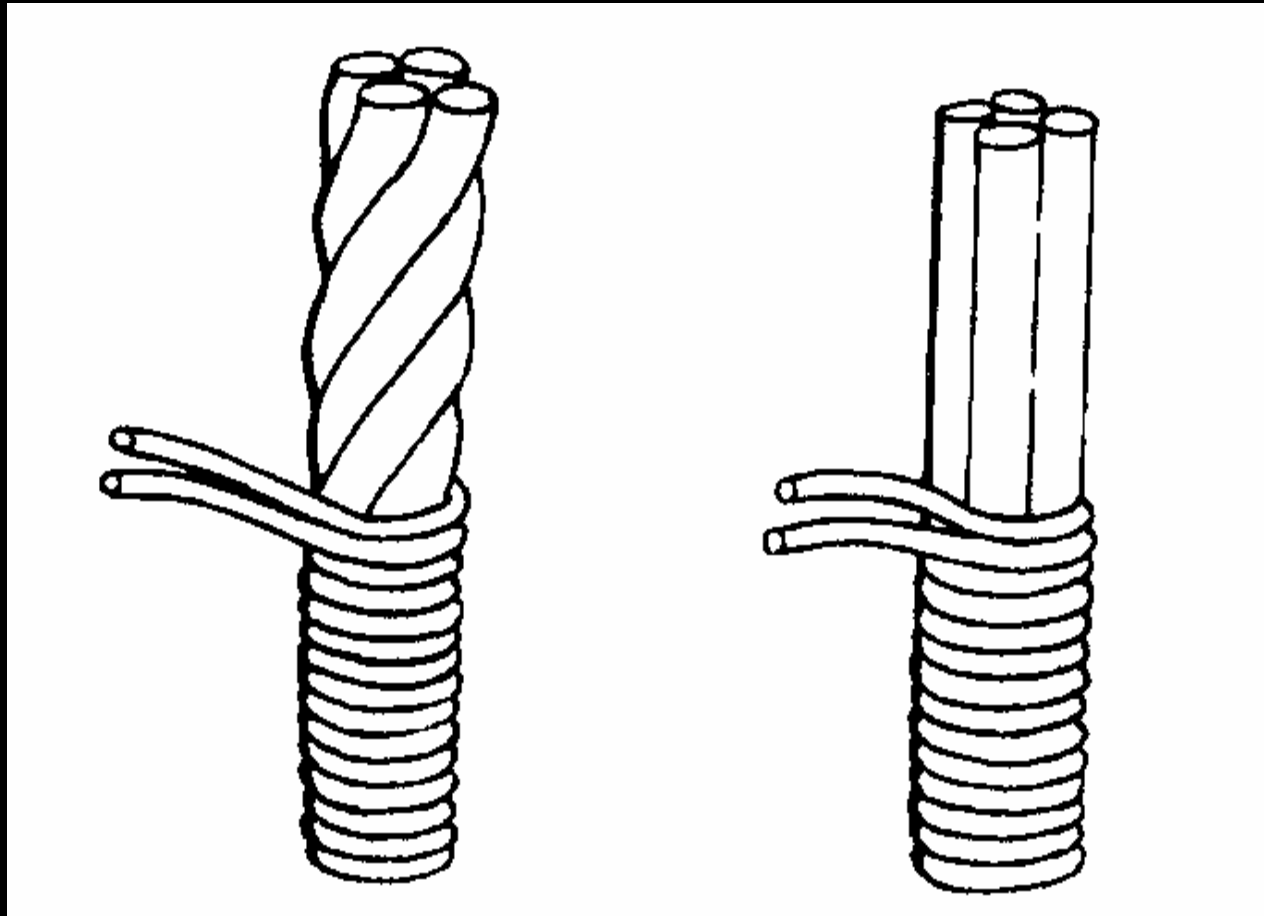
Other Fibres

- Alginate
- PBO (Zylon)
- Vectran

Yarn Types

- Monofilament
- Continuous Filament
- Spun
- Twist
- Gimp
- Others
- YARN ENGINEERING!

Gimp Yarns



In yarn engineering there lies an
opportunity for innovation in
composites

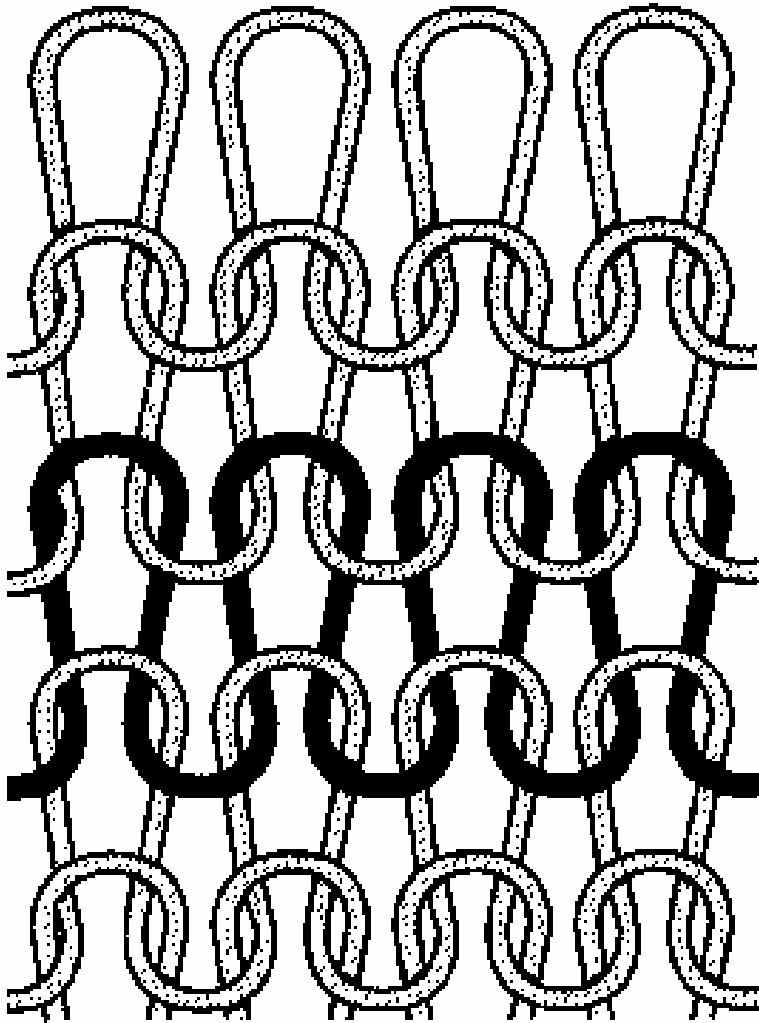
If you understand yarns, think
deeply!

Why fabric reinforcement?

- More structurally efficient than short fibre composites
- More expensive than short fibre composites

FABRICS

Weft Knitting

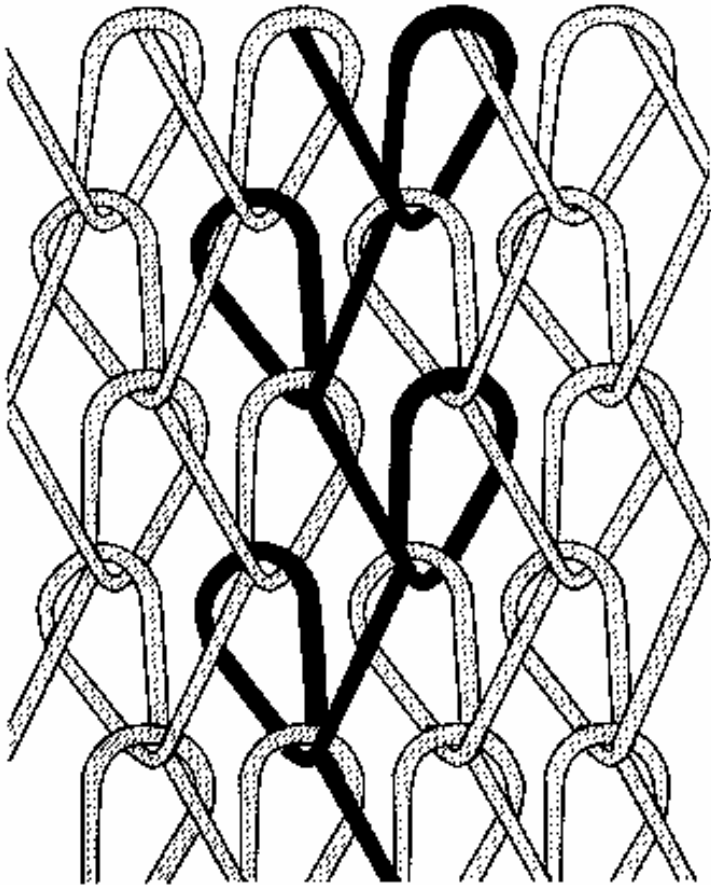


PROBLEM

Stretchy

Use a laid in yarn!

Warp Knitted



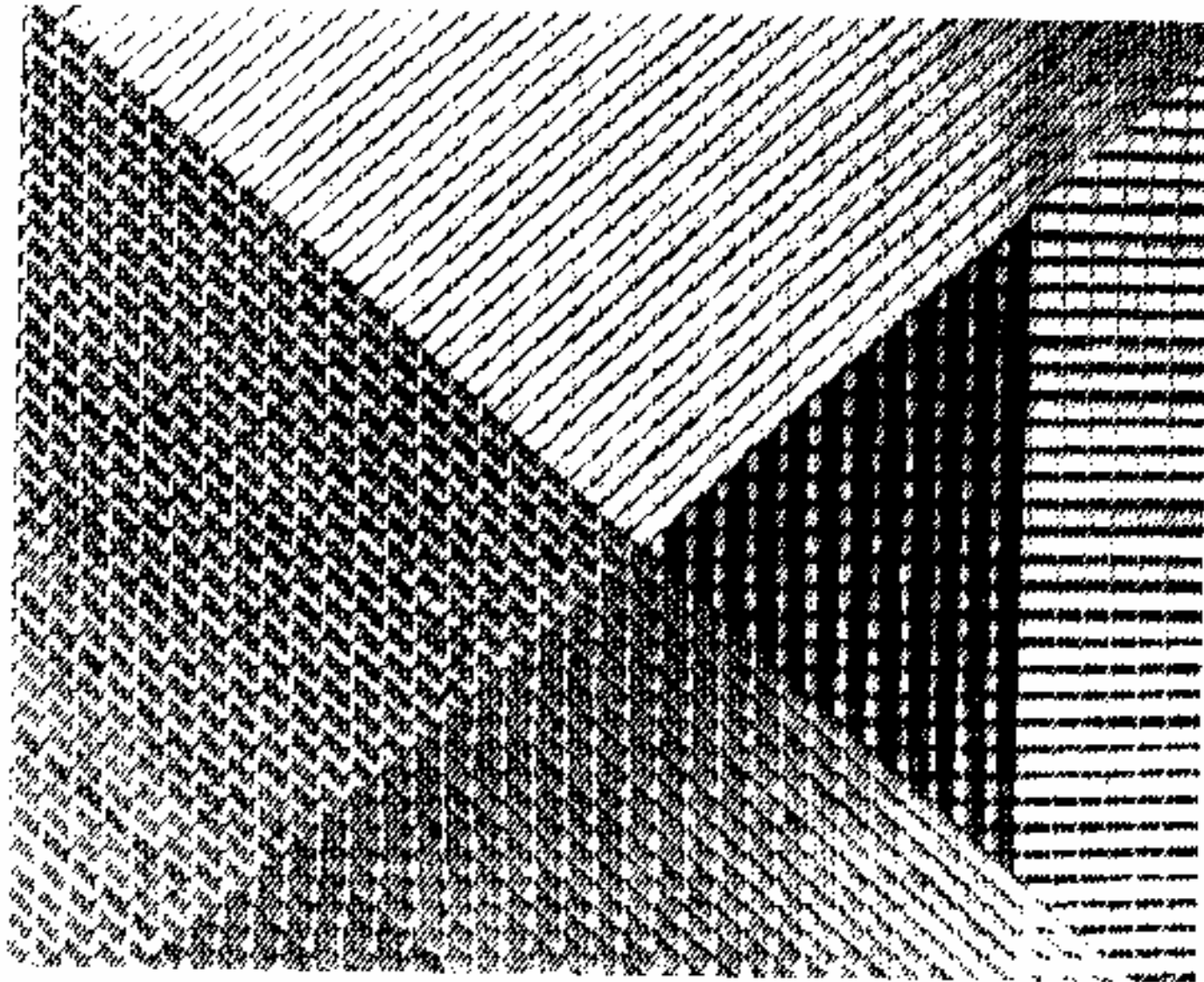
PROBLEM

Stretchy

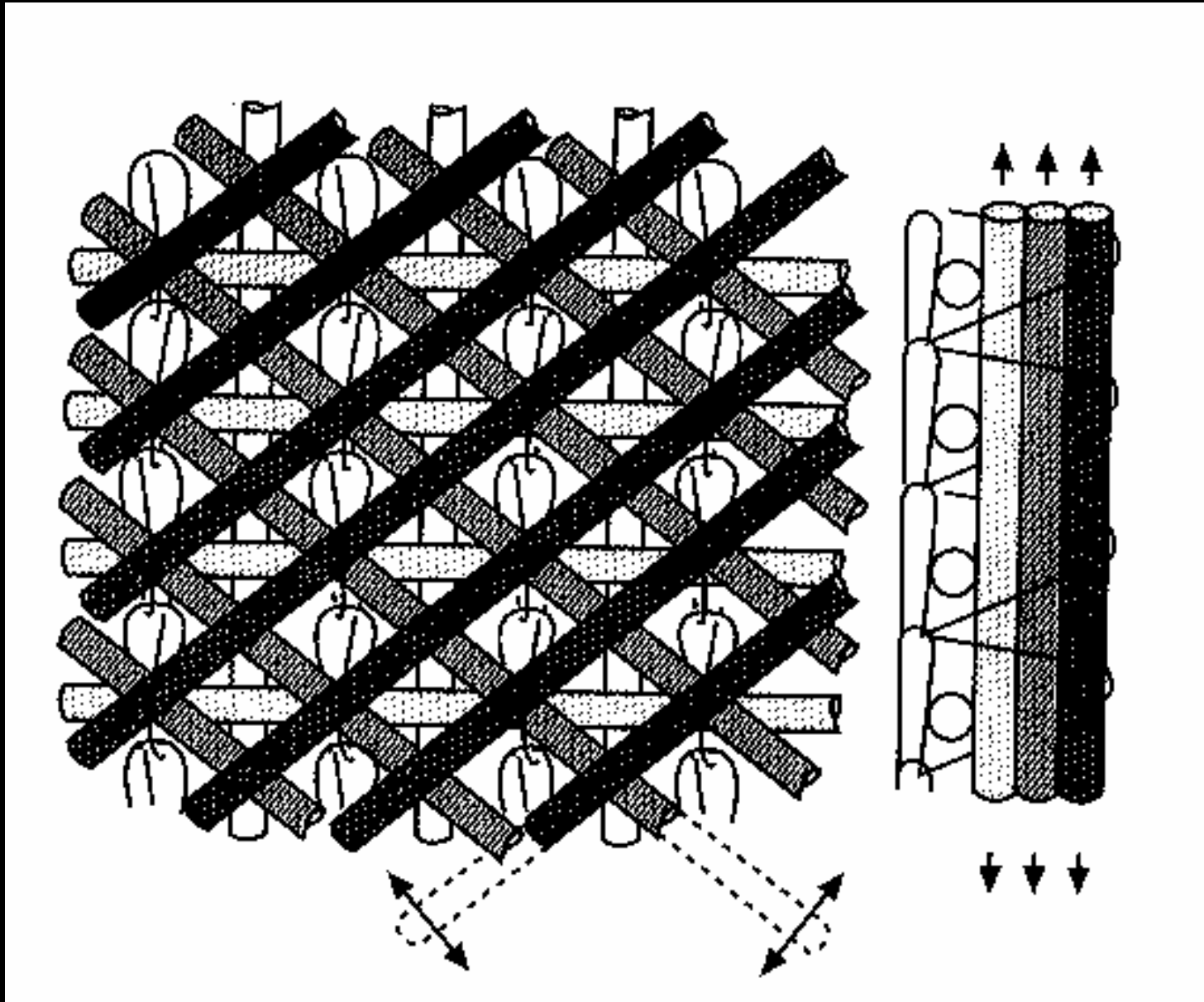
Use laid in yarns

Also: use multilayer
fabrics

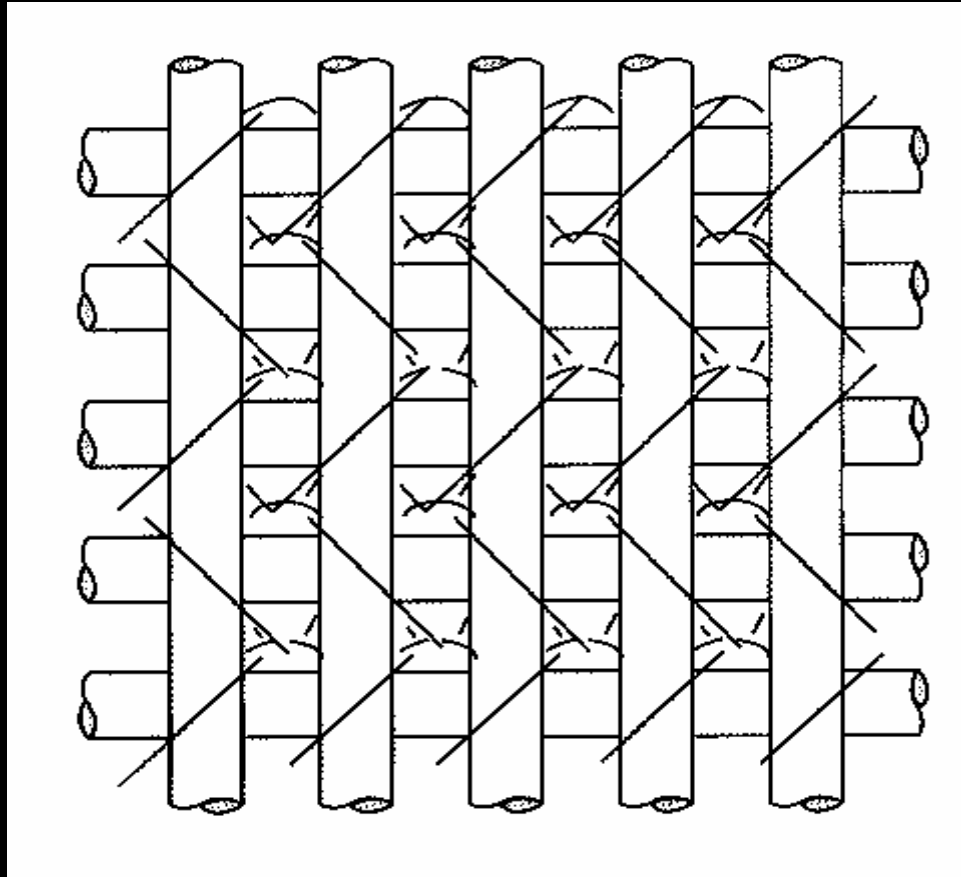
Four Layer Multi-Ply Fabric



Multiaxial Warp Knitted Fabric

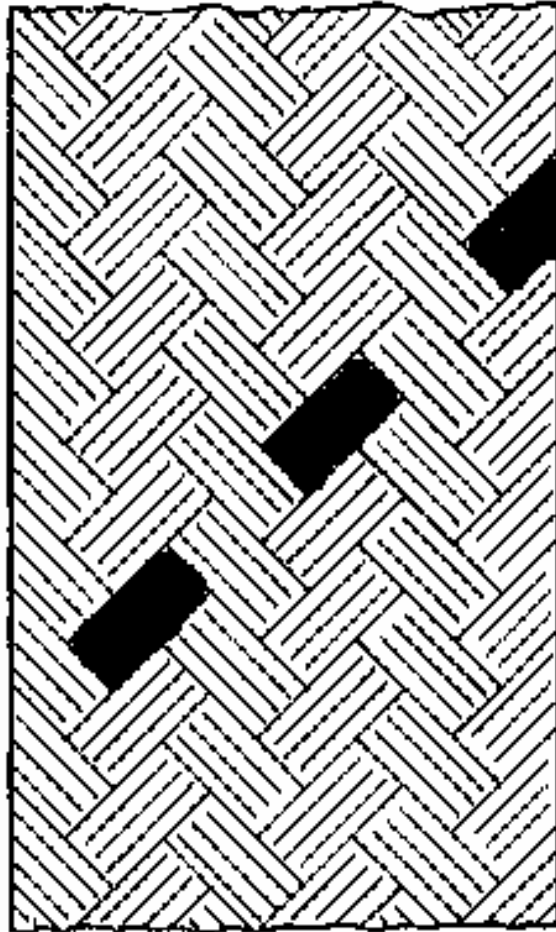


Biaxial Warp Knitted Fabric



A really good solution: very straight fibres

Braided



Braided

- Automated
- Seamless Preforms
- High torsional strength and stiffness
- Good damage tolerance

BUT

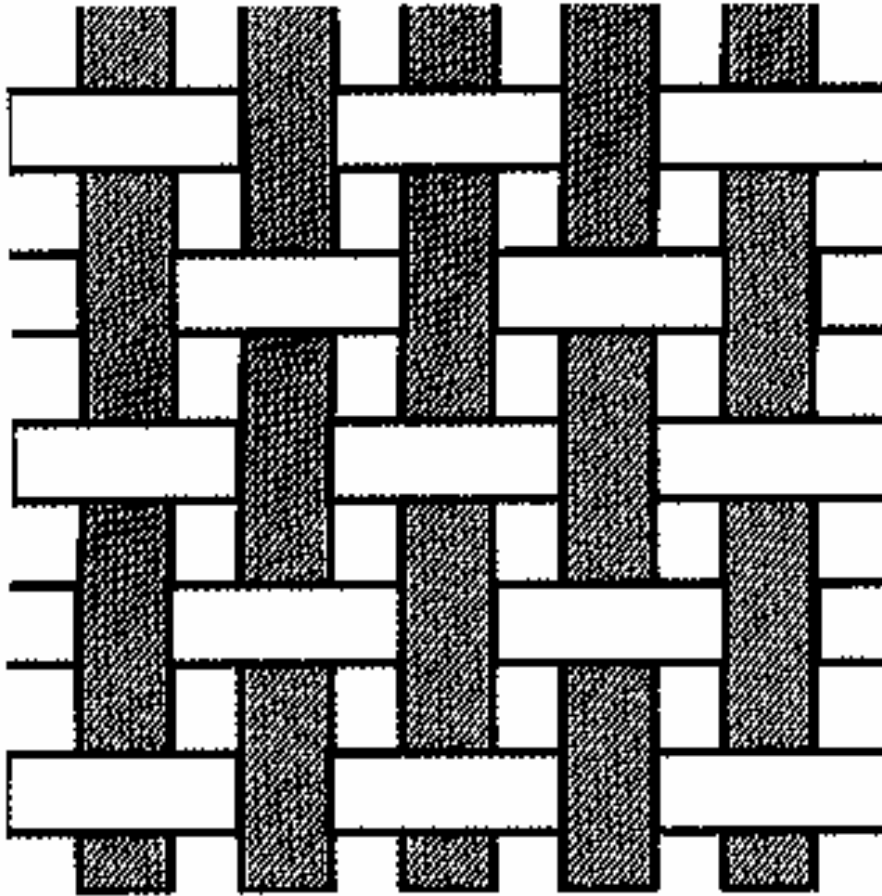
- Limited shapes
- Fibre angle limitations
- Usually limited to smaller parts
- Fairly slow

Braided

'A' pillar for Aston Martin Vanquish



Woven



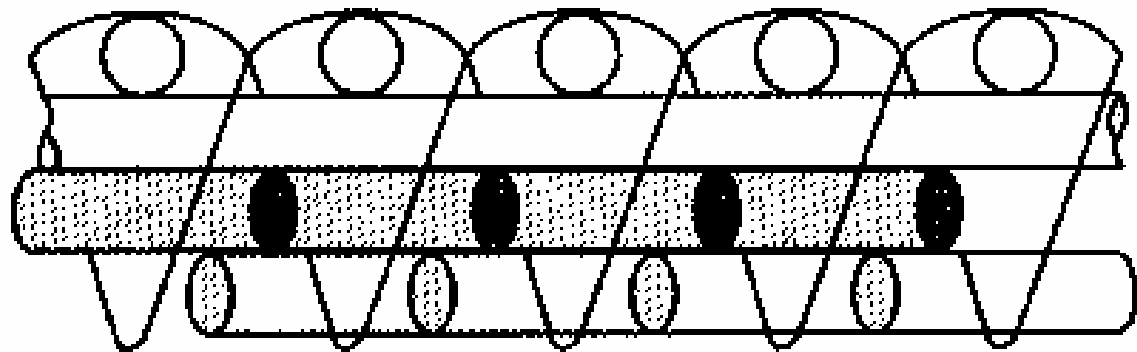
- Poor Shape Potential
- Many weavers do not know what the possibilities are
- Fairly good load transfer (reduced by fibre crimp)

Pocketed Woven Fabric



Multi-ply Woven Fabrics

Multi-ply structure



Cut and Sew

- Versatile
- Complex parts easy
- Held by stitching, glueing, quilting

BUT

- labour intensive
- Stitching may degrade properties if not done correctly

Other Problems

- Laying up fabric into a mould is slow and therefore expensive
- Slow speed holds up the mould
- Therefore need more moulds

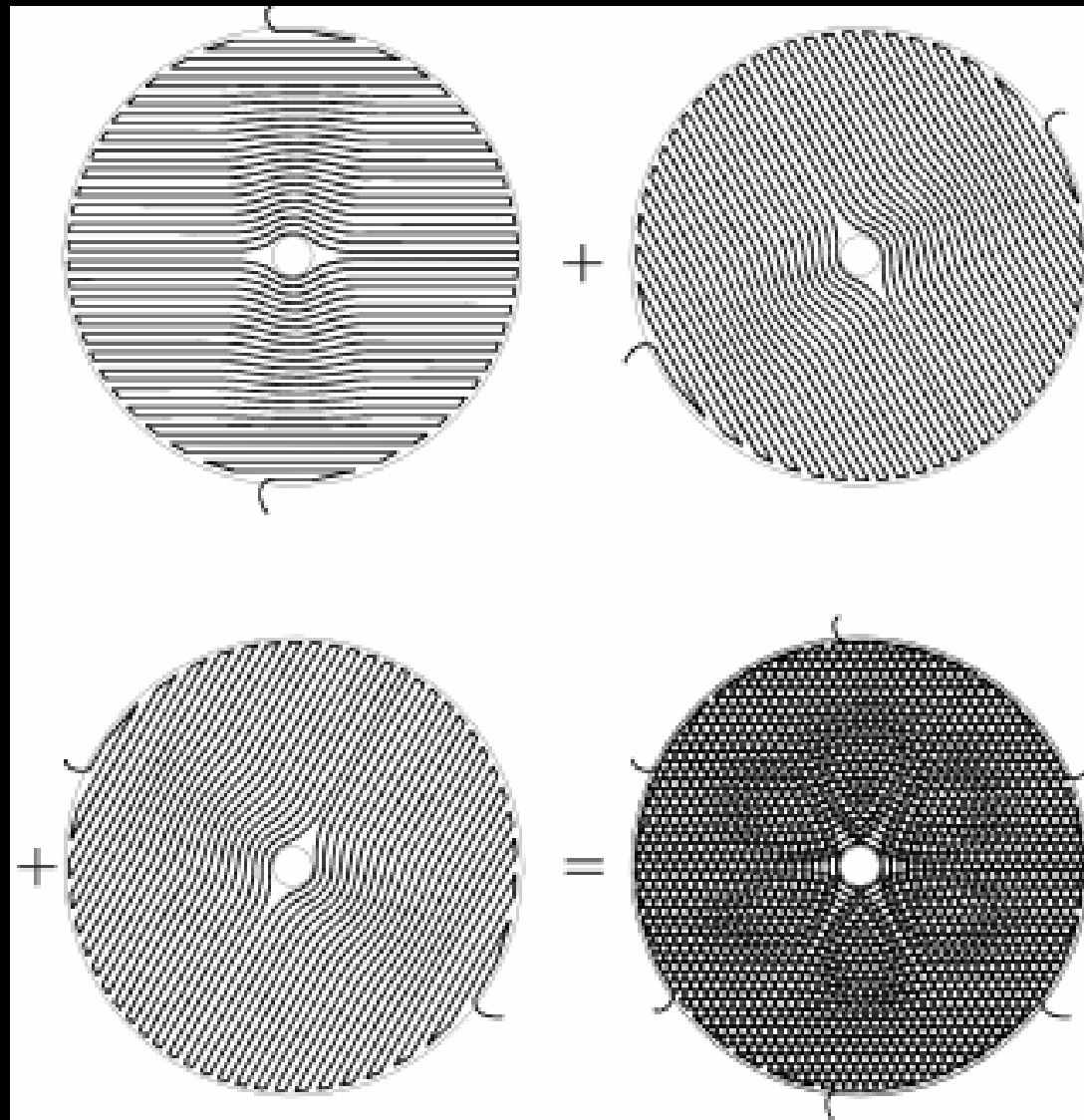
Some solutions

- Spray short fibre and resin into mould
- Choose a fast way to fill the mould
- Select easy to inject resins
- Select fast cure resins

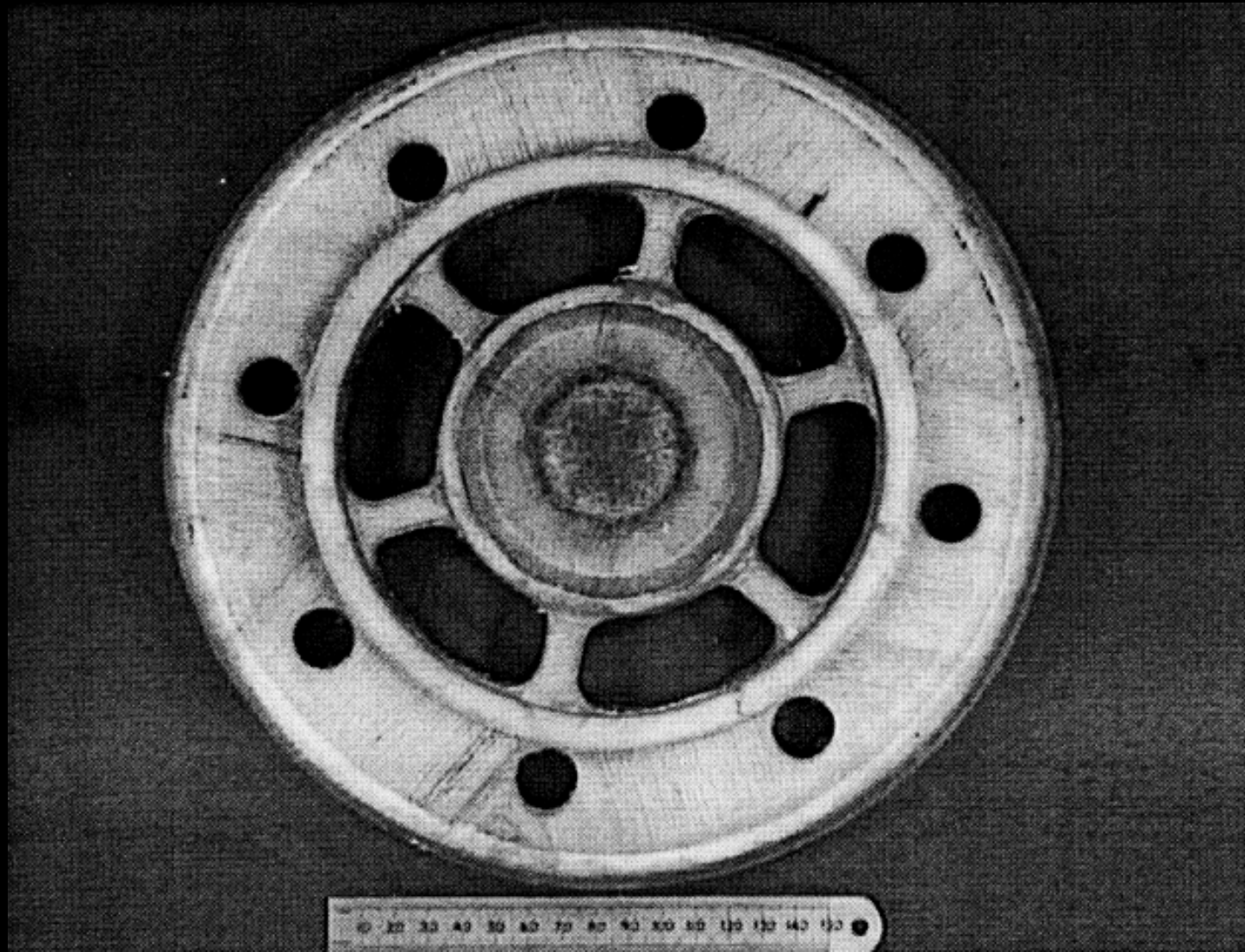
A textile solution

- Net shaped parts
 - KNIT
 - Fibres not straight
 - WEAVE
 - Fibres crimped
 - BRAID
 - Ideal for special shapes
 - EMBROIDER
 - Efficient fibre architecture

Embroidered



Complex Component made from Embroidered Preforms



Problems in Introducing Composites

- Lack of understanding of composites
- End of Life Directive
 - Thermoplastics
- Metallurgists fighting back
 - High strength steel
 - Aluminium
 - Magnesium
- Repairing

THE MARKET WANTS

- a quick and simple process for the production of well-engineered textile preforms
- minimal handling to provide a fast lay-up in the mould
- Fast turnaround for parts

Design Processes

- Seat of the pants
- FE analysis
- Slow
- Expensive

Textile Information

- Composites designers need to know more about textiles
- Who are the best people to tell them?
- Who are designers most likely to turn to first?

Some problems the industry faces

- Isotropic design methods taught
- Poor composite design skills
- Few composite designers
- Poor understanding of textiles
- Perceived cost
- Lowest price quotations wanted
- Lifetime cost reduction not understood

How the problems might be overcome

- Set up your own business in textile composites
- Develop a vertical operation

Strategies for developing new products for the composites industry

- Talk to end users to find out what they want
- Talk to composite manufacturers to find out what they really need (not what they think they need)
- Keep up to date on machinery
- Collect information about relevant fibres (and prices) and keep it to hand for quick responses

Sustainable fibres for composites

- Keep considering green options
- Keep well informed on relevant issues
- Read the research literature
- Consider your own research

There are lots of opportunities out there!

- Everybody is looking for huge volumes – but niche products can be highly profitable, and good for small companies
- Niche products can only be found by being proactive
- Try to retain flexibility
- Work hard at knowing more about the subject than anybody else
- Join groups to develop contacts.

Finally....

Getting composites accepted is
slow, but it is a significant
growth area

Good Luck!

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