



# Tooling Block The Green Alternative



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# Tooling Block The Green Alternative

## Agenda.

- History
- Current Practices
- Trends & Initiatives
- Materials
- Potential savings
- Questions



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# Tooling Block The Green Alternative History.

- Patterns & moulds have been for many years, Wood, metal Syntactic, PU, wax, etc
- To consistently replicate parts to a design.
- Production methods include machining, casting and hand shaping
- Majority of everyday items are produced from moulds



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## Current Practices

Specification of the product.

- Component to be made
- Process
- Temperature range
- Cure Cycle
- Surface finish



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## Current Practices

- Tooling materials are bought in sheet form
- Sheets or blocks are bonded together using compatible adhesives
- Machined
- Sealed



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## Trends & Initiatives

- We are all being asked to reduce, reuse and recycle.
- European Unions end-of-life for Vehicles – (95% by 2015)
- Governing bodies are suggesting limited modifications to aerodynamic packages.
- Manufacturers looking for cost savings.
- Manufacturers looking to become green – natural fibers
- Majority of patterns sent to landfill.



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# Tooling Block The Green Alternative Materials

- Polyurethane
- Epoxy Syntactic
- Hydro Carbons
- Thermoplastics



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# Tooling Block The Green Alternative

## Polyurethanes

### Advantages

- Wide range of products available from 0.18 to 2.0 density
- Wide application options, styling, modeling, checking jigs
- Relatively cost effective compare to others
- Generally faster production techniques and shorter conditioning time.



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## Polyurethanes

### Disadvantages

- Lower temperature range than other materials
- Low chemical resistance
- Lower mechanical properties on the same density blocks of other materials
- High CTE values.



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## Epoxy Syntactic Advantages

- Better mechanical strength than PU boards
- Better chemical resistance than PU boards
- High temperature resistance than PU boards
- Low coefficient of thermal expansion
- Good surface finish



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## Epoxy Syntactic Disadvantages

- Limited density range of product
- Longer process and conditioning time than PU boards
- Relatively more expensive than PU boards



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## Epoxy Syntactic Properties



Board Reference	TB320PS	TB560PS	TB620PS	TB650PS	TB1750PS
Application	Lightweight Pattern Core	Hand Carve Modelling	Machine Modelling	Fine Surface Modelling	Hammer Forming
Colour	Blue	Orange	Blue	Green	Tan
Density Kg/m <sup>3</sup>	320	560	620	650	1750
Shore Hardness ° D		55	69	69	95
Compressive Strength MPa	8.0	14.0	38.0	45.5	92.8
HDT °C	72	58	110	111	86
CTE X10 <sup>-6</sup> °C	40.0	73.0	39.0	38.0	46.0
Filler	Glass	Talc	Glass	Glass	Chalk

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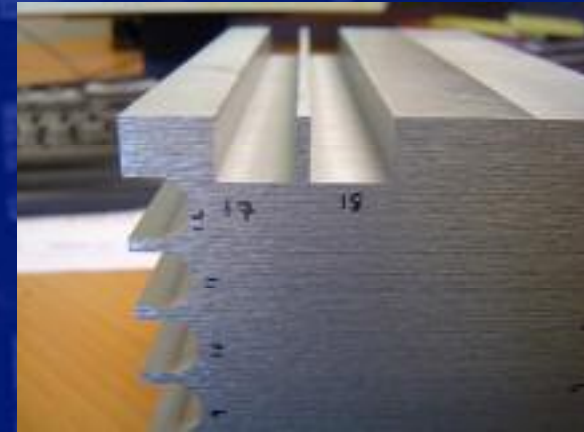
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## Hydro Carbons Advantages

- Ease of machinability
- Good surface finish
- Good swarf morphology (bark chip consistency)
- Can be used at elevated Temperatures
- Good CTE value



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## Hydro Carbons Disadvantages

- Market perception
- Base matrix pricing dependant on oil price & demand
- Availability
- Manufacturing temperature
- Limited fill options



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## Hydro Carbons Properties



Sample	PB162-085A	PB162-089A
Tested by		
Vf of Al (%)	52%	52%
Density (Kg/m)	1906	1922
Tensile Strength (MPa)	35.2	39.5
Tensile Modulus (MPa)	11259	11022
Flexural Strength (MPa)	53.1	56.5
Flexural Modulus (MPa)	9542	9342
Uniaxial Compressive Strength (MPa)	92.4	97.2
Uniaxial Compressive Modulus (MPa)	3800	3739
HDT (°C)	125	141
Tg (°C)	129.1	146.38
CTE (mm/mm °C)	41.56	42.22
Shore D Hardness (°D)	91	93
Specific Heat Capacity (J/g°C)	0.75	0.75
Izod un-notched (kJ/m2)	7.01	7.91
Izod notched (kJ/m2)	1.89	1.98

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## Thermoplastics

### Advantages

- High Service Temperature
- Excellent Machinability / surface finish
- No Dust or Odour
- Minimal residual Stress Larger block sizes
- Excellent chemical resistance
- Recyclability



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# Tooling Block The Green Alternative

## Thermoplastics

### Disadvantages

- Currently cost
- Availability
- Market perception
- Difficult to bond / repair



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## Thermoplastics.



Property	Alu-powder	Unit	Standard
Density	2.01	g/cm <sup>3</sup>	ASTM C128
Hardness	87	Shore D	ISO 868
Tensile Strength	39	MPa	ASTM D638
Tensile Modulus	9.2	GPa	ASTM D638
% Elongation	1	%	ASTM D638
Compression Strength	110	MPa	ASTM D695
CTE (23°C to 80°C)	67	10 <sup>-6</sup> /K	ASTM E831
HDT (1.8 MPa)	214	°C	ASTM D648

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## Thermoplastics.



Property	60vol% Dolomite	Unit	Standard
Density	2.25	g/cm <sup>3</sup>	ASTM C128
Hardness	88	Shore D	ISO 868
Tensile Strength	20	MPa	ASTM D638
Tensile Modulus	17.6	GPa	ASTM D638
% Elongation	0.5	%	ASTM D638
Compression Strength	82	MPa	ASTM D695
CTE (23°C to 80°C)	37	10 <sup>-6</sup> /K	ASTM E831
HDT (1.8 MPa)	218	°C	ASTM D648

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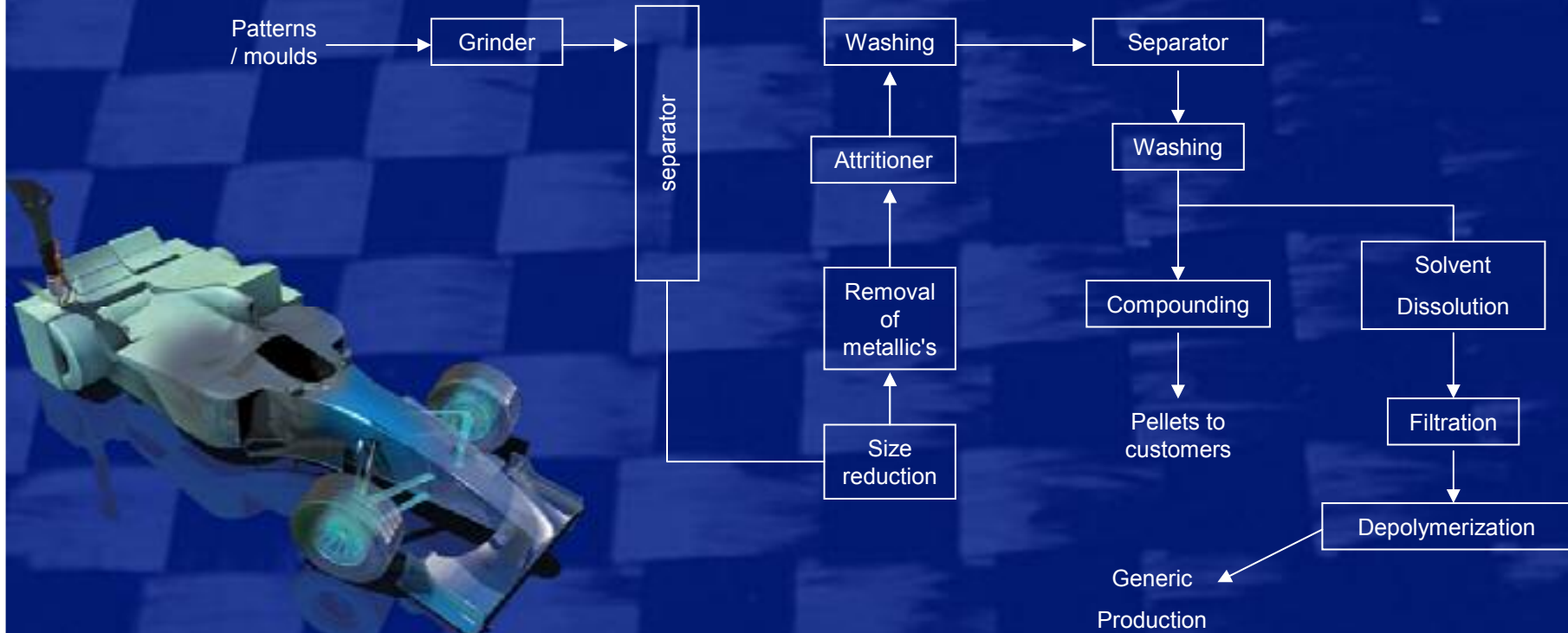
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## Thermoplastic Recyclability

Back to generic



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Recyclability  
Thermoplastics.

- Back to generic
- SMC, BMC, DMC
- Granulate to injection mould



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## Recyclability

### The main issues

- Preservation of the environment
- Stop developing materials that last for an infinite time
- Carbon, Glass, Aramid, fiber reinforce plastics - difficult to recycle
- The Energy consumed for production of materials



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## Recyclability

### The main issues

- Automotive industry driving green composites
- Investigation to natural reinforcements
- Thermoplastic base matrices
- Polypropylene, polyolefin, polyamide etc being used in the packaging industry

ITS TIME TO LOOK FOR ALTERNATIVES

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## Potential Savings

- Machine time
- Cost of component part
- Energy
- Weight of vehicles or components
- Increase in component strength v's cost
- Healthier environment – less CO2



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## Questions



Thank you!

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