



Mild Thermal Modification to Add Value to UK Grown Larch: Monitoring Quality, Physical Properties and Benefits

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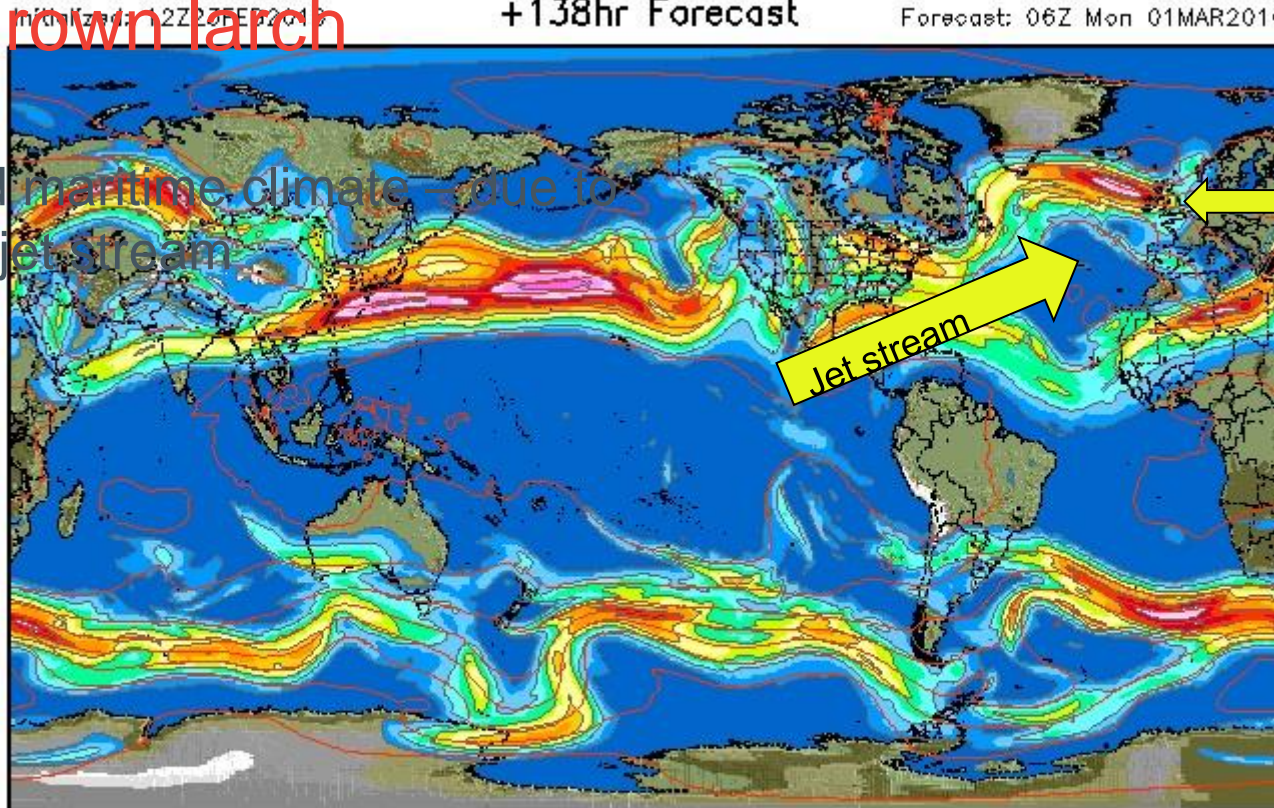
UK grown larch

- Mild maritime climate – due to the jet stream

STORMSURF

+138hr Forecast

Forecast: 06Z Mon 01MAR2016



GFS 250 mb Wind Speed (kts) and Height (m)

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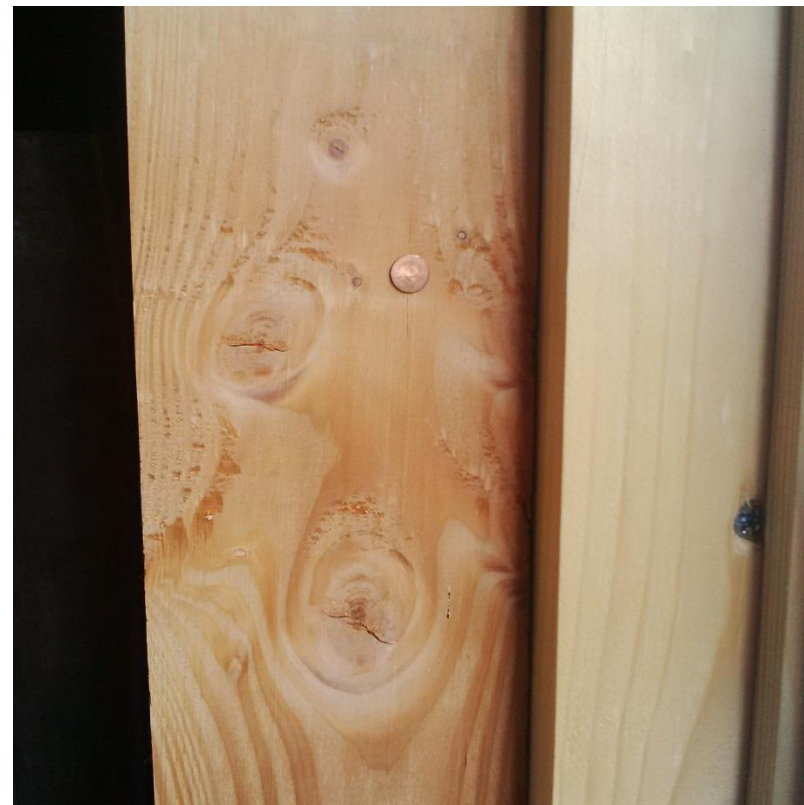
UK grown larch

- Mild maritime climate
- Species selected for fast growth rate
- High annual increment means low rings per inch
- Large difference in density between earlywood and latewood





Typical problems





UK grown larch

Advantages:

- Strong and stiff
- Moderately durable heartwood
- Suited to rough sawn applications e.g. fences
- High availability due to *Phytopthera*

Disadvantages:

- Fast growth rate
- Proportion of sapwood
- Poor machining quality
- Market saturated due to *Phytopthera*

How to add value?





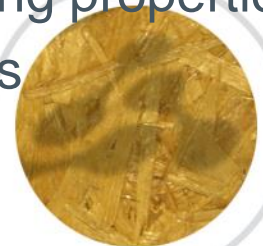
Thermal modification

Traditional thermal modifications:

- Typical treatment of 190 or 220°C
- May use an inert atmosphere (nitrogen or steam) to prevent degradation
- Enhances dimensional stability
- May increase durability
- Colour becomes (very) dark

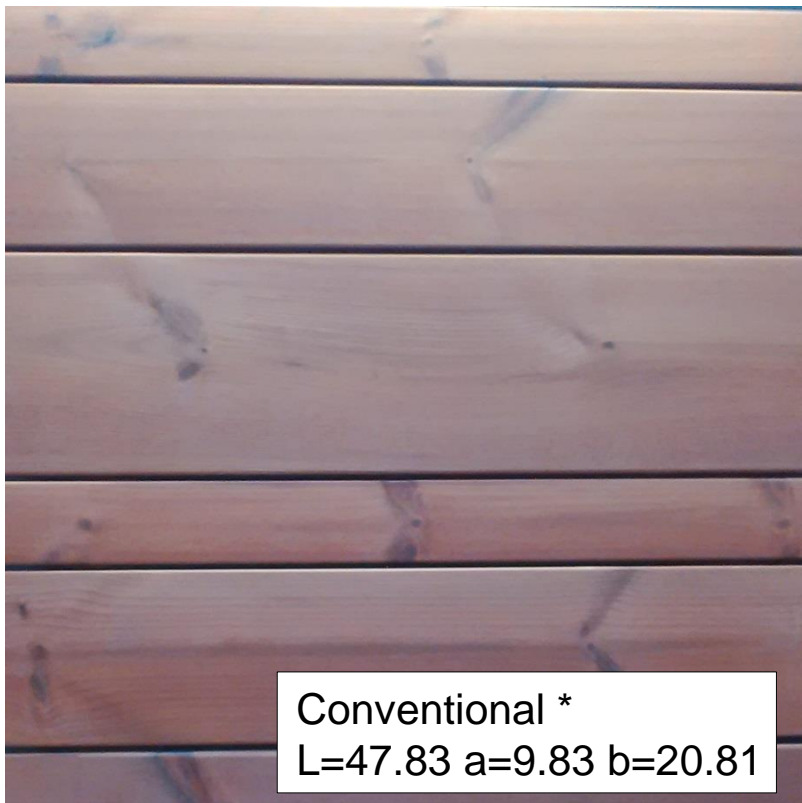
Mild thermal modification:

- Typical treatment of 150 to 190°C
- Use of steam to minimise degradation
- May enhance dimensional stability
- Improves machining properties
- Colour altered less





Thermal modification – the products



*Data from Barcik et al (2015) Cell. Chem. Tech. 49(9-10):789



Mild thermal modification process

- Japanese larch planks of different cross sections used in trials
- Pilot scale kiln 90cm lengths
- Full scale kiln 3m lengths
- Timber restrained during kiln process to minimise twist, spring, cup, bow etc.
- High humidity throughout the process



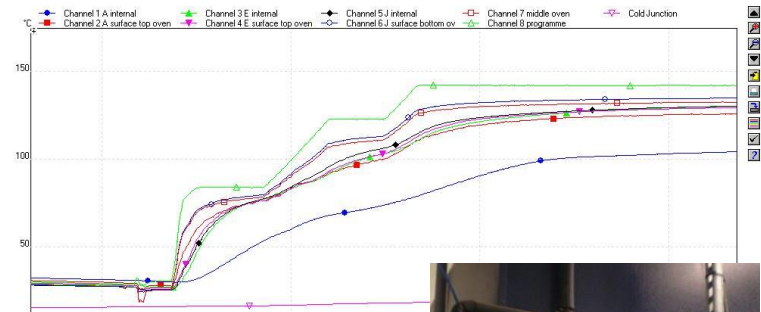


Mild thermal modification

Logged temperature in kiln and at locations within stack

Different heating rates observed:

- with oven,
- with timber dimensions,
- with timber moisture content,
- with volume of stack,
- with location within the stack,
- with steam input and air flow rate





Properties evaluation

Properties relating to level of treatment:

- Moisture content before and after
- Weight change in the planks
- Bulk density
- Colour change

Properties relating to timber use:

- Mechanical properties
- Dimensional stability
- Surface quality after machining
- Suitability for gluing
- Lamination quality
- Weathering

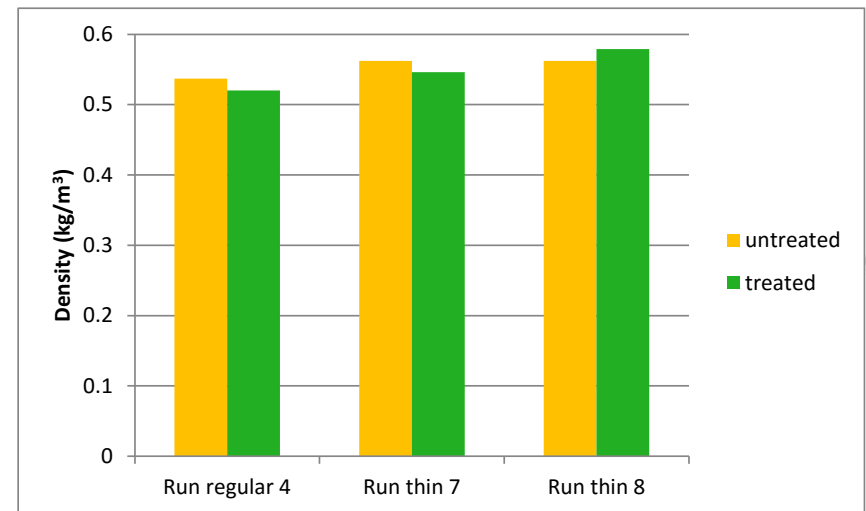




Main observations

Density and weight change:

- Mild thermal treatment showed very small change in density
- Not statistically significant
- Plank by plank weight loss of -0.48% to 8.53%
- Density variation between planks was greater – relating to proportion of juvenile wood





Main observations

Mechanical properties:

- Small clears tests (BS 373) for 3-pt bend, hardness
- No significant loss of strength due to mild thermal treatment
- Hardness in radial
- Tangential orientation revealed tendency to split along growth ring boundary
- There are still differences between high density (LW) and low density (EW) regions





Main observations

Adhesion tests:

- PVA and polyurethane glues tested in lap shear tests
- EN 205 tests under D1, D2 and D4 conditions
- No loss of performance against control samples (beech)
- Polyurethane glues used in lamination tests
- EN 302 tests of resistance to delamination





Main observations

Machinability and surface quality:

- Sample planks from each batch selected for planing and observation
- Mild thermal modification provided lowest observed defects
- Good machining techniques, and sharp well maintained tools are still required





Route to market

- The project team included three companies with treatment facilities
- It also brought together a cohort of companies who use timber in joinery and added value products
- Trials by companies were seen as essential to understanding the product
- Parcels of timber prepared for trial and feedback





Upgrading Welsh Timber to Fulfil Future Market Potentials

Dimensional stability

Use class 2, 3 or 4 WPG

MOE & MOR

Equilibrium moisture content



Surface finish

Jointing and gluing

Clean edges and no splinters

Product life span

Cost

Energy

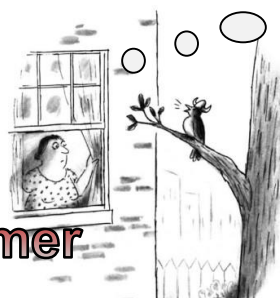
Fitness for purpose



Joiner



Scientist



Customer

What a nice window

How long 'til I paint it?

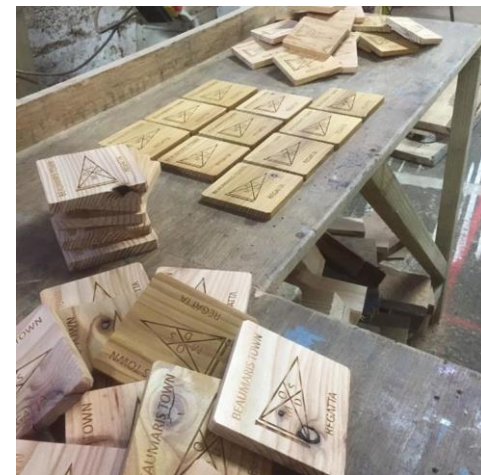
Wow it opens!





Company trials and demonstrators

- Useful comments on handling in different machines and processes
- Identification of new products





BC Materials



INNOVATION IN BIO-MATERIALS FOR INDUSTRY

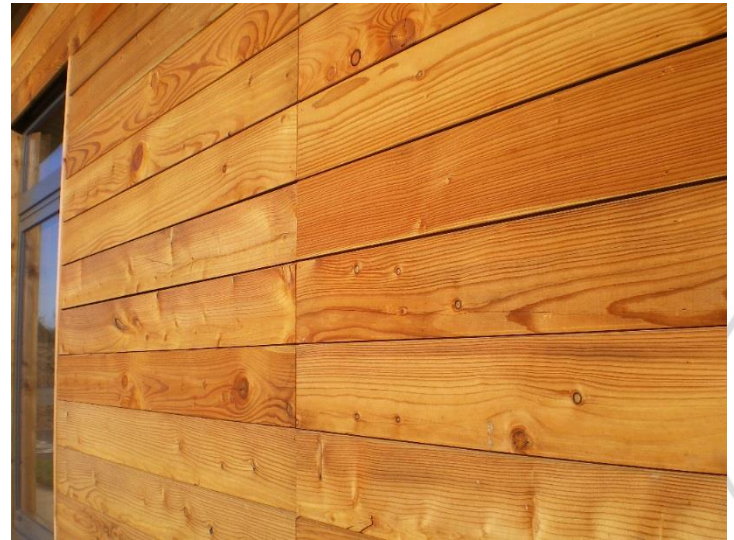
Demonstration





Conclusions

- The larch timber retains a natural colour
- It works well and avoids traditional machining problems for larch
- Very limited change in density
- The natural durability of larch heartwood remains





BC Materials



LOW CARBON, ENERGY & ENVIRONMENT
RESEARCH NETWORK WALES RHWYDWAITH YMCHWIL
CARBON ISEL, YNNI A'R AMGYLCHEDD CYMRU



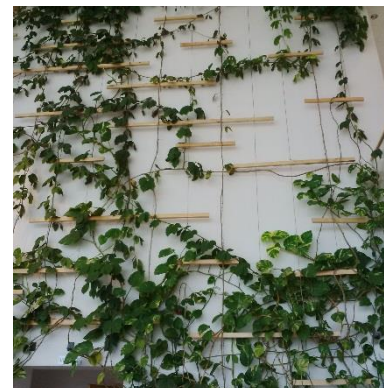
Cyngor Cyllido Addysg
Uwch Cymru
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Council for Wales

hefcw

INNOVATION IN BIO-MATERIALS FOR INDUSTRY

What next?

- Continuing investigation into coating systems
- The use of mild thermally modified larch in exterior applications
- Evaluate durability aspects
- Activities with Cardiff School of Architecture and Aberystwyth University in Sêr Cymru NRN-LCEE Plants and Architecture cluster





Acknowledgements

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- And the National Research Network for Low Carbon Energy and Environment (NRN-LCEE) Plants and Architecture cluster





Any questions?

