Kebony

Beauty & Performance in Wood

International 2014

Kebony – What we do

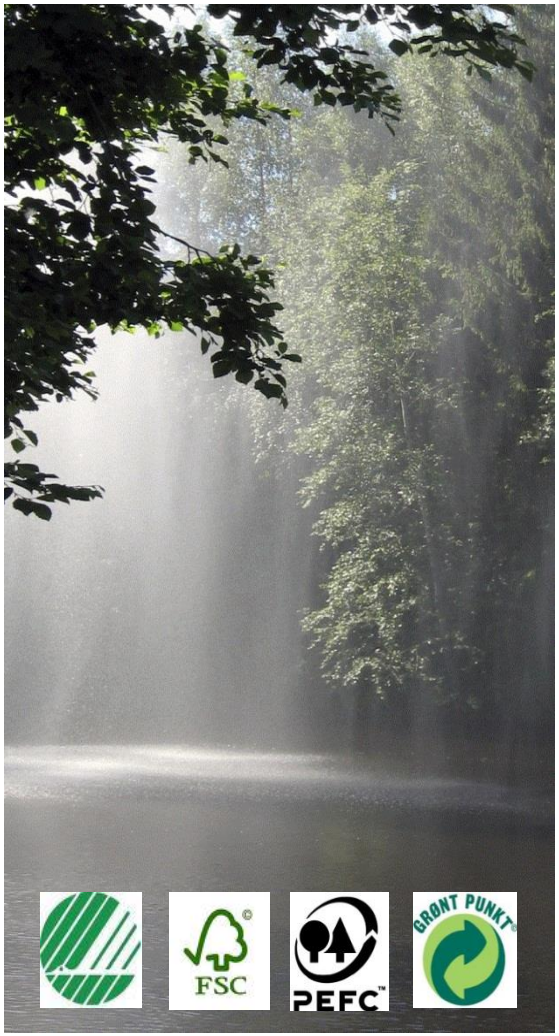
- The global demand for tropical hardwood cannot be sustainably satisfied.
- EU legislation coming into affect March 2013 prohibits illegally harvested timber.
- Kebony offers a solution that is;

  A sustainable and cost efficient alternative to tropical hardwood

  An alternative to traditional toxic wood protection from impregnation of metal based chemicals.

  Kebony's wood modification technology transforms fast growing sustainable wood species to give them the performance of tropical hardwood.
- Kebony's mission:

"Kebony – to revolutionizes the use of wood by delivering long lasting, high quality, aesthetically pleasing and environmentally friendly modified wood products"



Kebony product features

- Outstanding Durability
- Great aesthetics
- Dimensionally Stable
- Excellent Compressive Strength
- Sustainable and environmentally friendly
- Cost-Effective
- Resistant
- Easy to maintain

The Kebony process (1/2)

Input

Wood
- Biodegradable
- Soft woods
- Moisture sensitive
- Inconsistent quality

Renewable liquids from biomass
- Processed from plant waste
- Sugar canes
- Corn cobs
- Wood

Technology

Impregnation
- The liquid has the capacity to swell wood cells
- The alcohol polymerizes and the resultant polymer is permanently grafted into the cell walls

Curing
- After the impregnation the wood is heat cured to temperatures above 100° C

Drying
- The cured wood is dried and the finished product is ready for shipment

Output

Wood
- Extended lifetime
- Enhanced structural properties
- Consistent quality
- Environmentally friendly





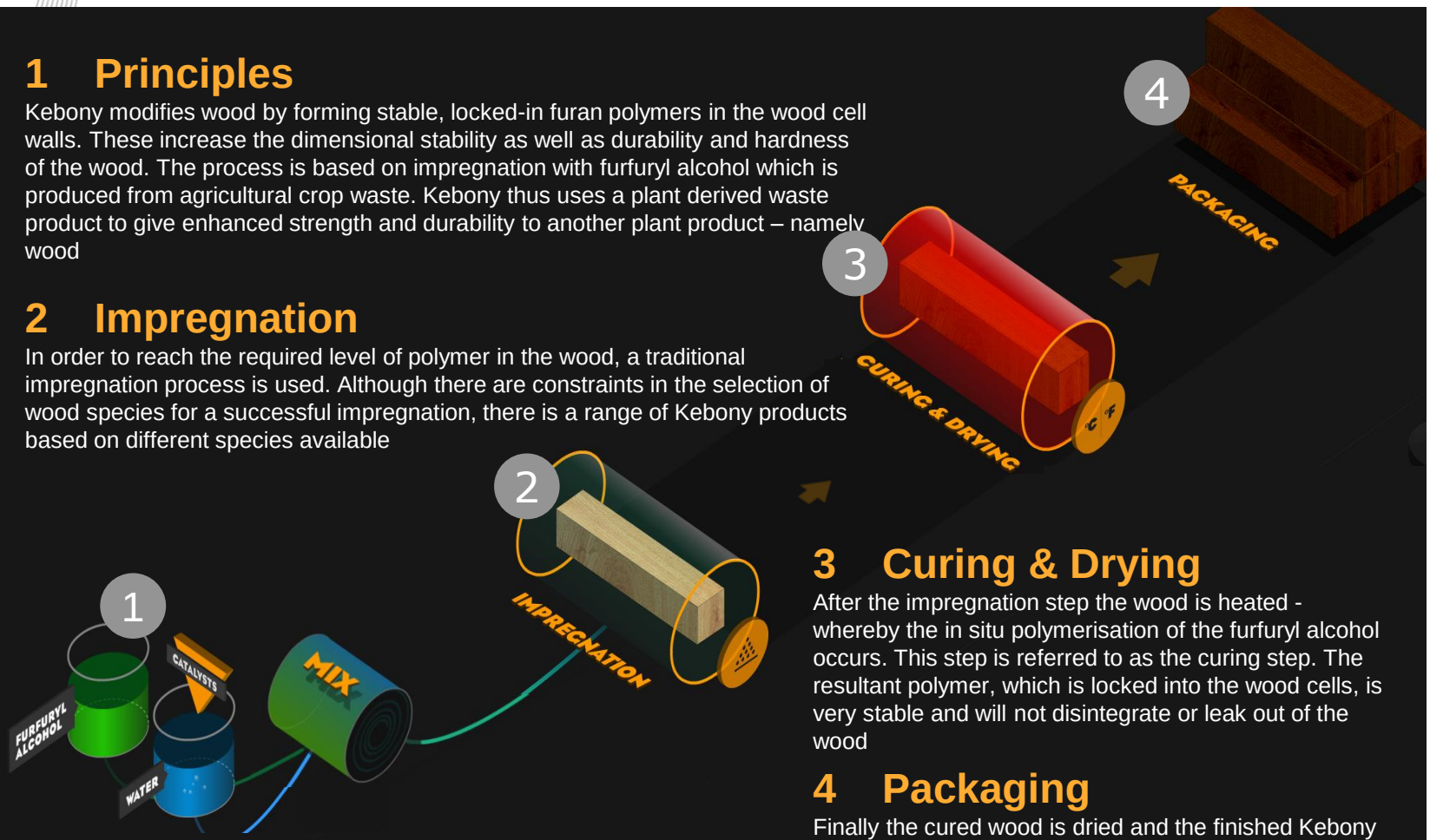

The Kebony process (2/2)

1 Principles

Kebony modifies wood by forming stable, locked-in furan polymers in the wood cell walls. These increase the dimensional stability as well as durability and hardness of the wood. The process is based on impregnation with furfuryl alcohol which is produced from agricultural crop waste. Kebony thus uses a plant derived waste product to give enhanced strength and durability to another plant product – namely wood

2 Impregnation

In order to reach the required level of polymer in the wood, a traditional impregnation process is used. Although there are constraints in the selection of wood species for a successful impregnation, there is a range of Kebony products based on different species available



3 Curing & Drying

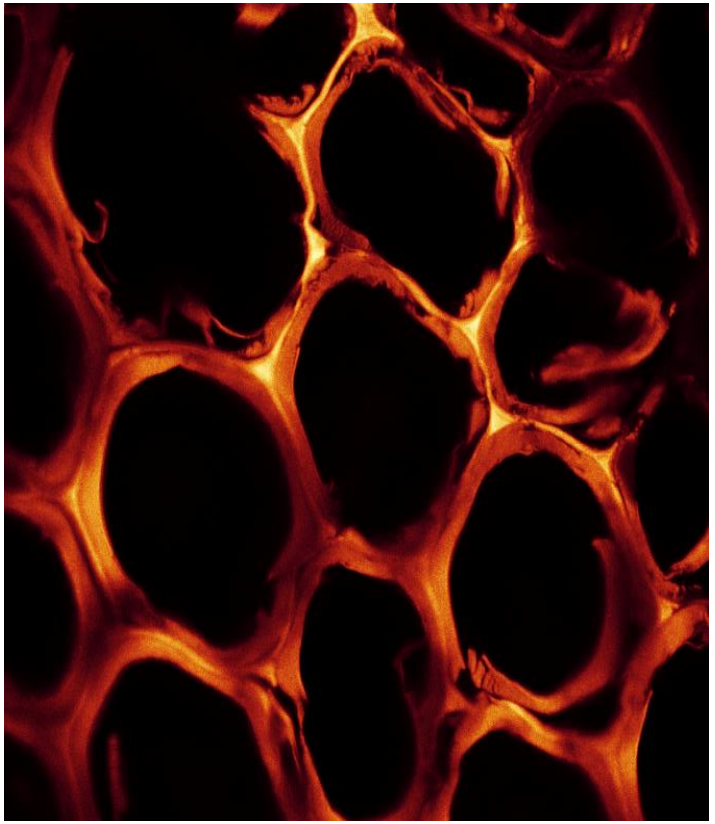
After the impregnation step the wood is heated - whereby the in situ polymerisation of the furfuryl alcohol occurs. This step is referred to as the curing step. The resultant polymer, which is locked into the wood cells, is very stable and will not disintegrate or leak out of the wood

4 Packaging

Finally the cured wood is dried and the finished Kebony product is ready for shipment or further machining

Technology at the wood cell level

- In the **Kebony** process the FA is *impregnated* into the wood cell wall structure, and subsequently *polymerised* to **furan polymers** that are "grafted" to the cell walls.
- These polymers are very stable, and will not degrade or leach out of the wood.
- The presence of furan polymers in the cell walls partly **blocks the cell walls ability to absorb water**
- The blocking by the polymers also leads to **reduced shrinkage**



- *Cross section of Radiata pine; cell walls containing furan polymer, image through fluorescence microscopy (L. Garbrecht Thygesen, RVAU, Copenhagen, 2006).*
- Fluorescence caused by furan polymer
- Cell walls are invisible in this system without the fluorescence from the polymer

Production facilities

- Kebony's first production facility was established in 2003 and replaced in 2009 with a new industrial scale plant.
- Main elements in the plant:
  - 1 impregnation autoclave
  - 4 curing chambers
  - Transport system
  - Machining line
- Production capacity is approx. 25 000m³ per year
- Plant designed for further expansion
- Kebony's Headquarter - Oslo (Norway), R&D and production - Skien (Norway).
- Distributors - Scandinavia, UK, France, Germany, Switzerland, Italy, Portugal, US, Korea and Singapore.

Kebony is very durable and stable

Wood species *) Treated sapwood	Maximum movement %	Hardness (Brinell)	Durability
Kebony Radiata	4	Hard	Very durable
Kebony Maple	6	Very hard	Very durable
Kebony SYP	5	Hard	Very durable
Kebony Scots pine	6	Hard	Very durable* / durable
Massaranduba	6 - 11	Very hard	Very durable
Ipe	6	Very hard	Very durable
Teak	4 - 6	Hard	Very durable
Bangkirai	11	Very hard	Durable
Iroko	6	Hard	Durable
Garapa	4 - 8	Hard	Durable
Oak	4 - 6	Hard	Durable
Red Cedar	8	Soft	Durable
Siberian larch	7	Soft	Durable / moderately durable

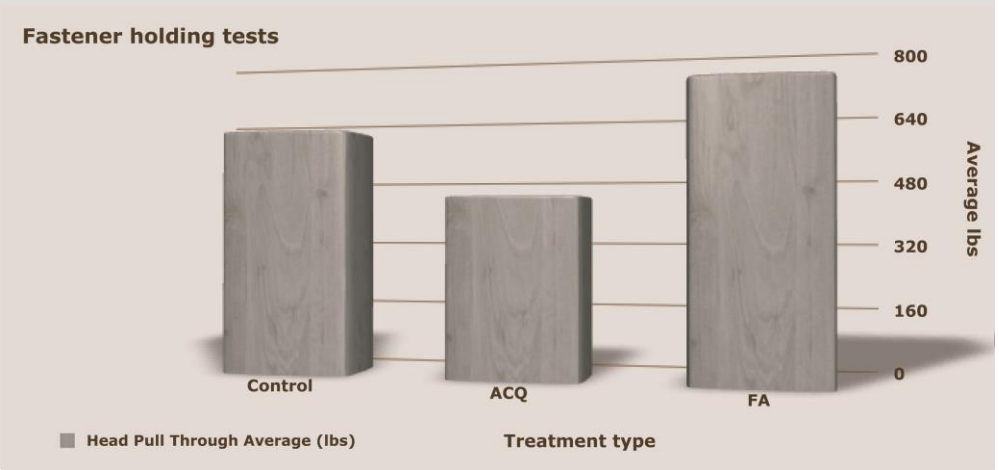
Fastener properties

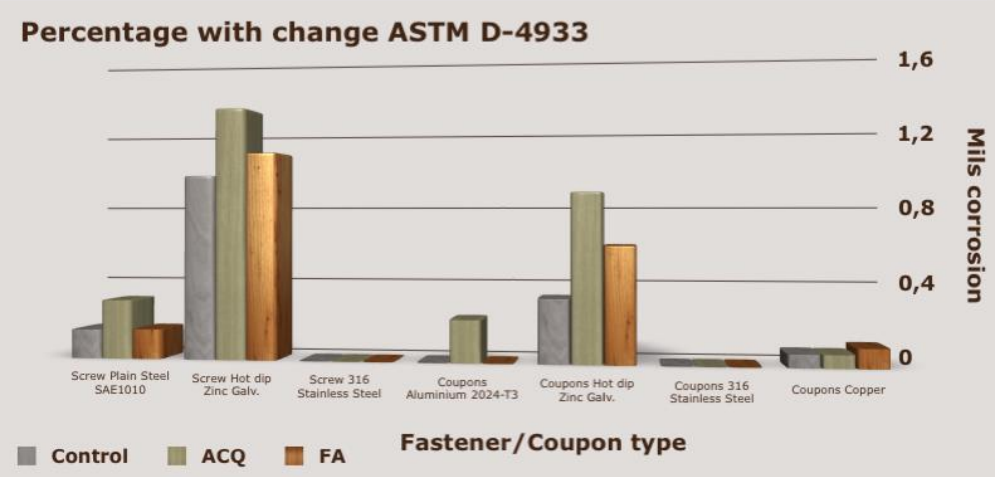
Fastener holding ASTM D-1761 and fastener corrosion AWPA E12

- Kebonized SYP performed significantly better than untreated and copper treated SYP in the Head Pull through tests This means Furfurlated SYP will hold tighter and better in the field

- Kebonized SYP is overall less corrosive than ACQ treated wood

Source: Virginia Tech, Department of Wood Science and Forest Products

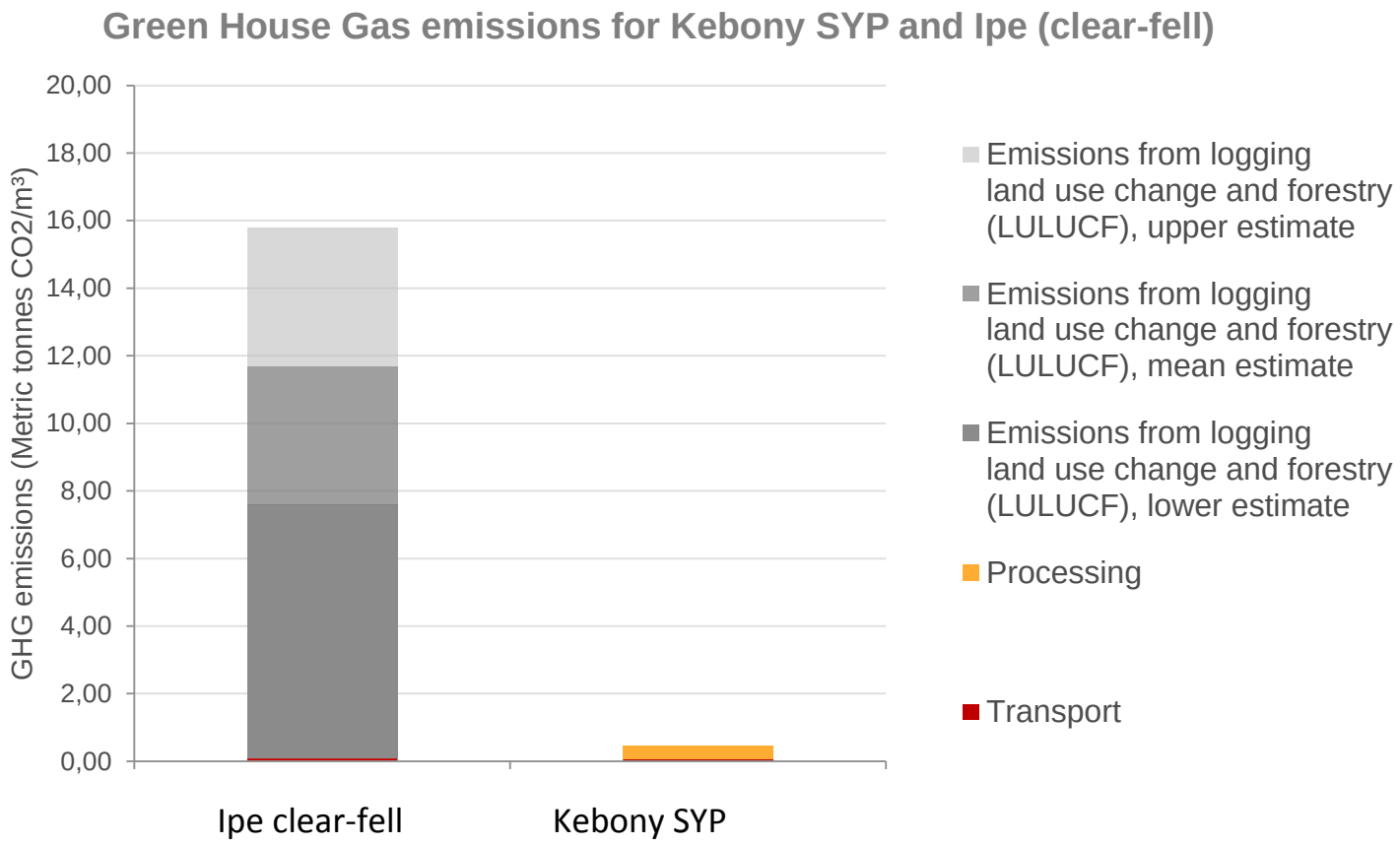




Strong environmental friendly profile

- Kebony Scots Pine, Radiata Pine & Maple are FSC 70% mixed sources
- Kebony SYP is PEFC certified
- The only material that has achieved the Nordic ecolabel the "Swan" within the category Durable wood
- Awarded the prestigious Technology Pioneers 2014 by World Economic Forum for its innovative green technology.

Kebony - A Big Environmental Impact



Source: Bergfald & Co, a leading Norwegian environmental advisory company

Aesthetics of Kebony

- Turn into a silver grey patina when exposed to the elements
- Requires no maintenance
- Can be surface treated with UV oil to keep the brown color but this will require regular maintenance
- The performance of the wood remains the same, only the color changes over time

Kebony is not slippery

Dry environment

Following the grain:	86
Across the grain:	106

The requirement for sport flooring is above 80

Wet environment

Following the grain:	42
Across the grain:	37

>35	No slip risk
25 – 35	Certain slip risk
<25	Slippery

Source: Pendulum test / SP Trätek

Kebony vs. selected competitors

Parameter	Kebony	ThermoWood	Accoya
Modification principle	Furan polymer	Heat treatment	Acetylation
Appearance	Brown, greying on weathering	Brown, greying on weathering	Pale, good colour stability on weathering but vulnerable to staining fungi
Strength parameters	Improved stiffness	Reduced bending strength	Bending strength unchanged from parent wood
Hardness	***	*	**
Dimensional Stability	**	**	***
Fastener holding strength	***	*	**
Durability	***	**	***

The Kebony Brand – Key messages

Aesthetic & Modern

Hard & Super-durable

Low maintenance

KEBONY

Innovative

Environmentally friendly & Sustainable resource

Reduced lifecycle cost

Kebony – International media


goinggreen

From Norway, an eco-alternative to teak


BLUEPRINT
THE LEADING MAGAZINE OF ARCHITECTURE AND DESIGN

Kebonization Process Creates an Alternative to Tropical Hardwoods


ORWAY

TOTAL U-TURN? FRANCE'S OIL GIANT WARMS TO NUCLEAR

POCKET POWER DON'T LEAVE HOME WITHOUT...

SHOCK AND AWE THE BEST CARS FOR NEXT YEAR

CNBC BUSINESS

WWW.CNBCMAGAZINE.COM EUROPE/MIDDLE EAST/AFRICA DECEMBER 2009

NEXT!

THINGS THAT WILL CHANGE THE WORLD IN 2010


Sustainable alternatives to hardwood by Kebony

Kebony was founded in 1997 to develop and commercialise the technology of its namesake product, a sustainable alternative to tropical hardwood.

Using a process termed "Kebonization," sustainable softwoods such as maple, beech and pine are given the same aesthetic and physical properties as rainforest timber, presenting architects and developers with environmentally-friendly solutions for all manner of projects.

In order to develop the final product, the softwoods are injected with a formula including Furfuryl alcohol, a waste by-product of sugar cane production. The wood is then

New Brunswick, on environmentally friendly wood modification methods. These patented modification methods were developed through many years of collaboration between research groups in Norway, Sweden and Canada, and universities and institutes in Germany, the Netherlands, South Africa and the US.

Headquartered in Norway, the company currently employs 40 staff, but is looking to expand its presence globally.

"Kebony has had several enquiries from Gulf States and will definitely be working with this market as part of global expansion plans. The region has traditionally used stone and concrete for outdoor applications, but the trend

The Economist

converting hydroxyl groups into acetyl groups (a different combination of atoms) by first drying the wood in a kiln and then treating it with a chemical called acetic anhydride. The result is a wood that re-tains its shape in the presence of and is no longer recognised as w grubs that would otherwise atta thus extremely durable.

The products made by both c are completely recyclable, envir ly friendly and create woods tha actually harder than most tropic woods. The strengthened softwoods can be used in everything from window frames to spas to garden furniture. Treated maple is also being adopted for decking on yachts. The cost is similar to that of teak, but the maple is more durable and easier to keep clean.

Obviously treating wood makes it more expensive. But because it does not need to receive further treatments–a shed made from treated wood would not need regular applications of creosote, for ex-ample–it should prove economical over its lifetime. Kebony reckons that its pine cladding, for example, would cost a third less than conventionally treated pine cladding over the course of 40 years. Saving money, then, need not be at the expense of helping save the planet.


Print Page Email Story

JULY 2010
Cover Story
EUROPE'S 25 MOST CREATIVE COMPANIES

Europe's 23 million entrepreneurs, start-ups and SMEs will be the driving force behind the region's economic recovery. B companies that's dizzying – it's the disruptive Brown, Suzanne Frost, Erik Jaques, Lucy Fitz Trevor Huggins and Boyd Farrow


CHRISTIAN JEBSEN
CEO, KEBONY
CNN

Hard act to follow

Environment: Making softwoods more durable could reduce the demand for unsustainably logged tropical hardwoods

ONE of the reasons tropical forests are being cut down so rapidly is demand for the hardwoods, such as teak, that grow there. Hardwoods, as their name suggests, tend to be denser and more durable than softwoods. But unsustainable logging of hardwoods destroys not only forests but also local creatures and the future pros-pects of the people who lived there.

It would be better to use softwood, which grows in cooler climes in sustain-ably managed forests. Softwoods are fast-growing coniferous species that ac-count for 80% of the world's timber. But the stuff is not durable enough to be used outdoors without being treated with toxic preservatives to protect it against fungi and insect pests. These chemicals eventu-ally wash out into streams and rivers, and the wood must be retreated. Moreover, at the end of its life, wood that has been treated with preservatives in this way needs to be disposed of carefully.

One way out of this problem would be an environmentally friendly way of mak-ing softwood harder and more durable– something that a Norwegian company


Kebony's product is furfuryl

FINANCIAL TIMES

Northern exposure

Nicole Swengley introduces the Norwegian talents who are blazing a trail in the world of design

BOAT INTERNATIONAL

Alternatives to teak

Manufacturers turn to man-made solutions


TEAK ALTERNATIVES

Kebony has had more than 1250 articles the last three years, with international coverage including The Economist, CNN, Wallpaper, World architecture News and Deutsche Welle.

Media Quotes

Wallpaper*

"Lovely bones Dog retreat – Sustainable wood producer Kebony uses a patent-protected process to make wood more durable using biowaste liquids"

CHINADAILY

"Kebony is an award-winning product offering an alternative to tropical hardwood and treated wood, sustainable and environment-friendly"

CNBC

"50 things that will change your world"
"Europe's 20th most creative company"

HouseBeautiful

"Decking with a difference – Kebony uses an intense but ecofriendly treatment so that softwood behaves more like tropical times, resulting in harder wood"

BLUEPRINT
THE LEADING MAGAZINE OF ARCHITECTURE AND DESIGN

"..might ultimately spell the end of Europe's five billion Euros import of tropical hardwoods"

WIRED

"Alcohol saved the rainforest – Norwegian company Kebony is offering a green alternative – by transforming abundant softwoods such as pine"

Awards and recognitions

WORLD ECONOMIC FORUM

Technology Pioneer 2014

best business AWARDS

GlobalCleantech Summit and Gala 100
OCTOBER 9-10, 2013
WASHINGTON, DC

cma construction marketing AWARDS 2010 finalist Best Product Launch

selected by materio
www.materio.com

ttj Awards 2010

GRØNT PUNKT

CLEANTECH CONNECT 2012

HIGHLY COMMENDED PRODUCT OF THE YEAR
WAN AWARDS 2011

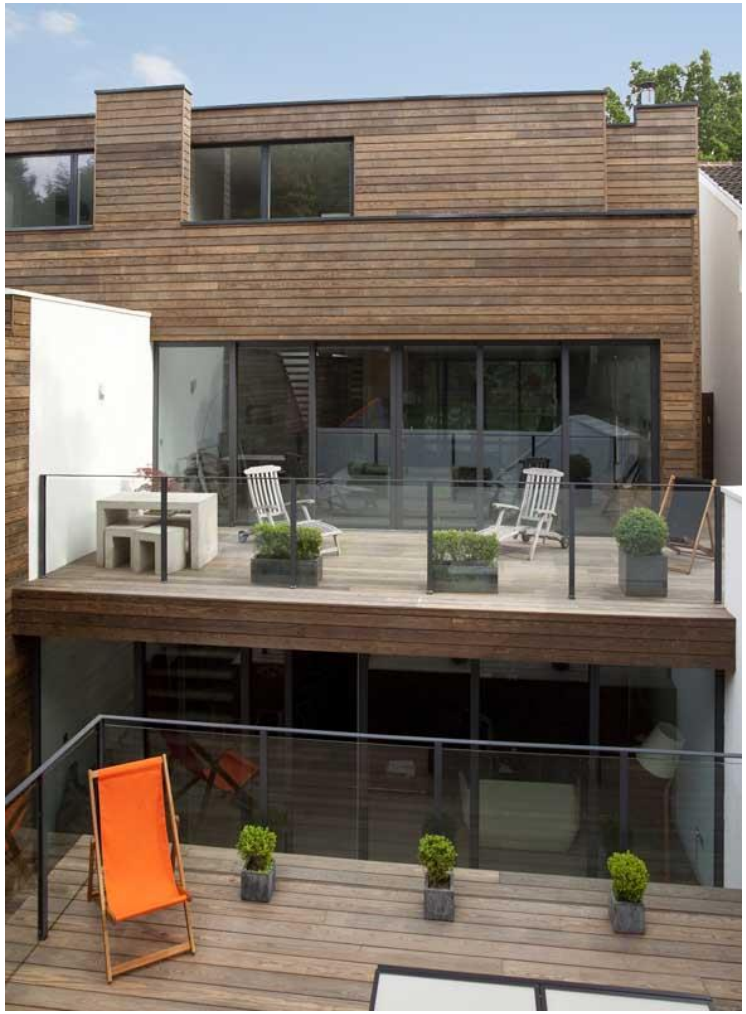
WORLD ARCHITECTURE NEWS.COM

Kebony Scots Pine cladding

Kebony Scots Pine decking

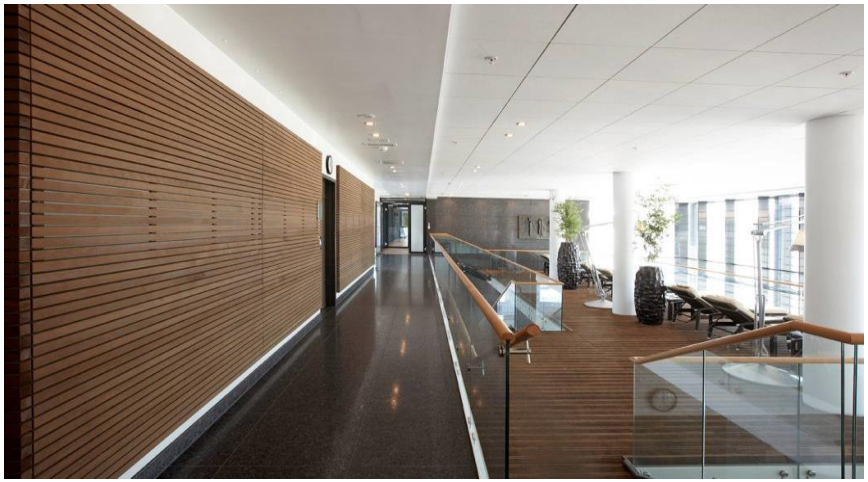
Kebony SYP decking

Kebony SYP cladding

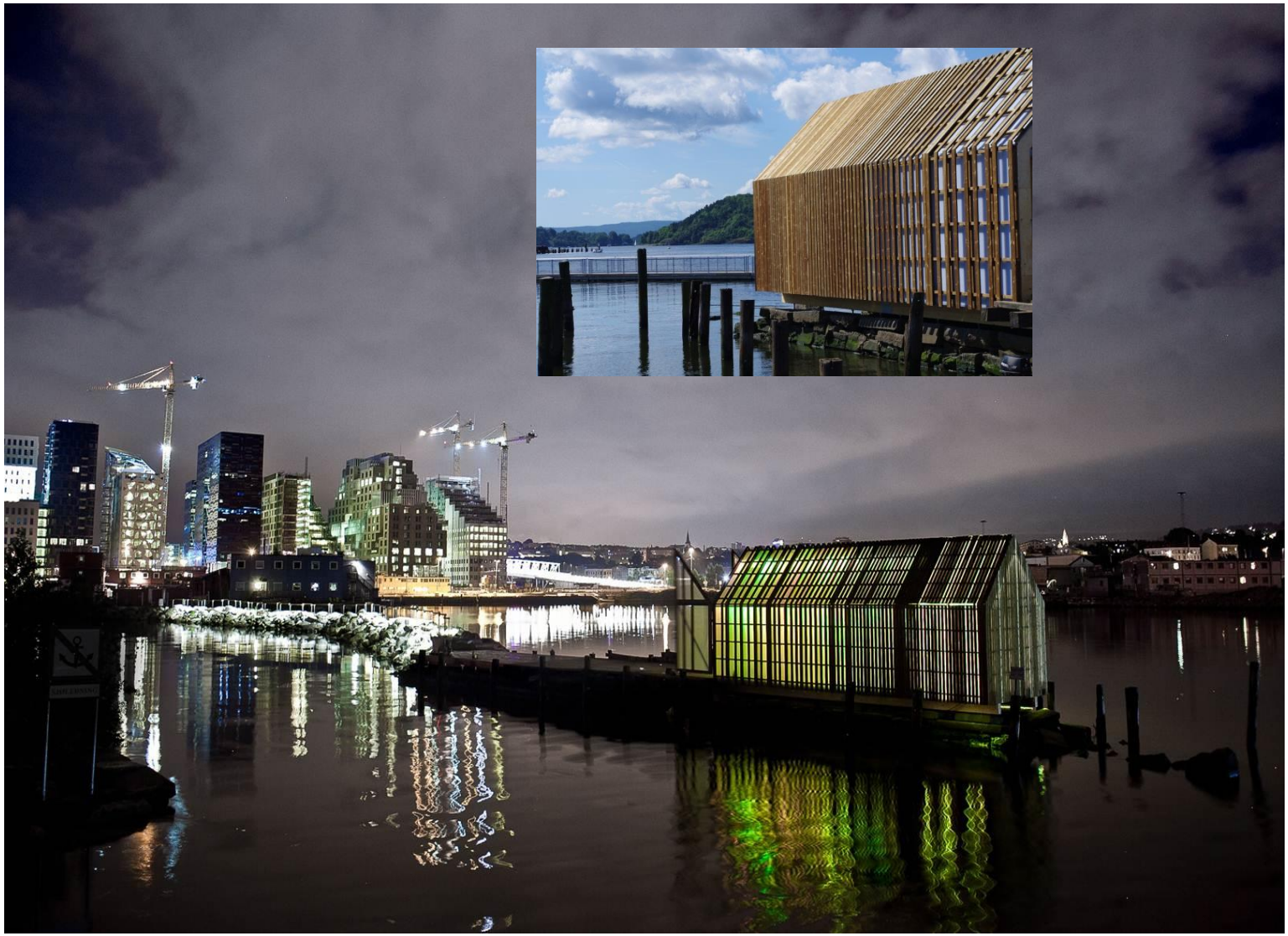


Kebony Radiata decking

Kebony in other applications



Kebony Architectural Design



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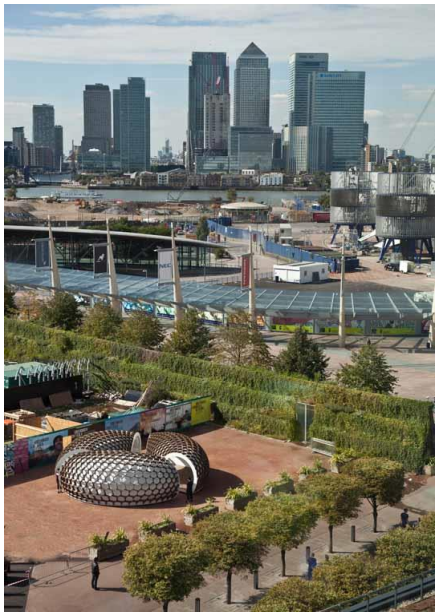

Kebony Architectural Design

The New Wood