STBA
SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

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RACHEL BEVAN ARCHITECTS

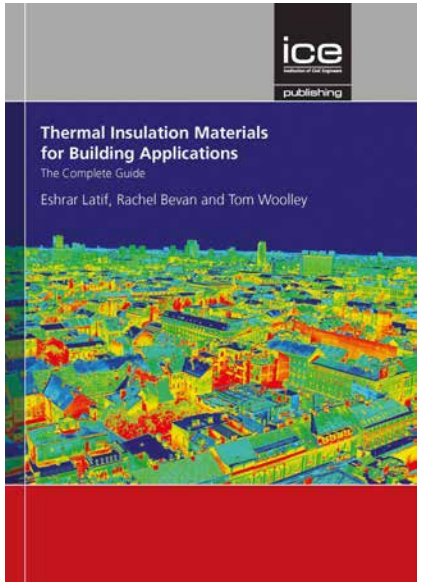
The STBA SPAB 2020 Online Conference
Day 1 - 6th October - EMBODIED CARBON

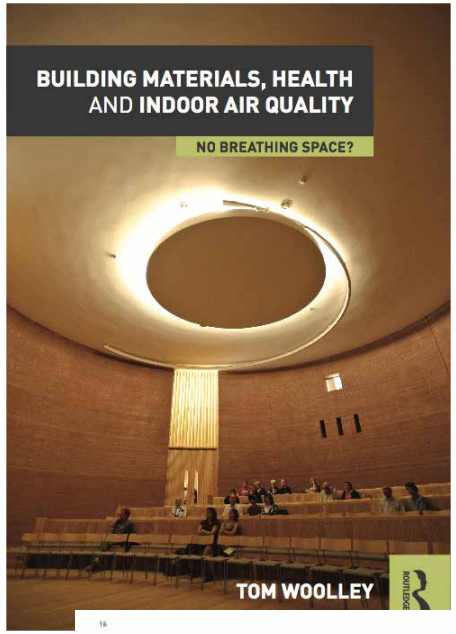
Dr. Tom Woolley
Retrofit: why the use of low embodied energy, low carbon breathable materials is crucial

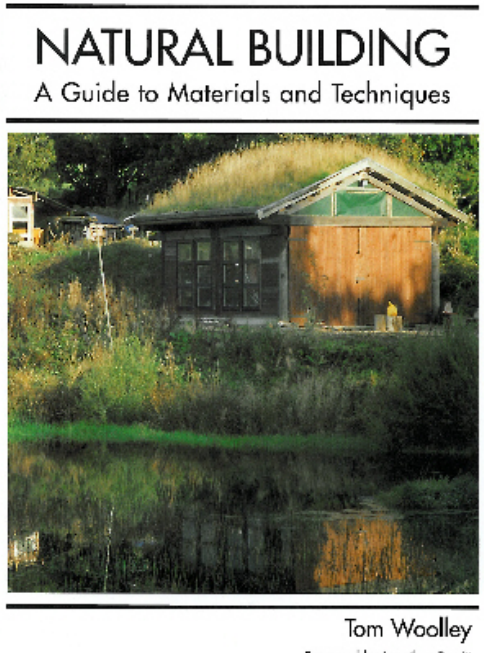
The lesson we learn from considering embodied energy is that we need to work towards a massive reduction in the use of non breathable plastic petrochemical insulation materials

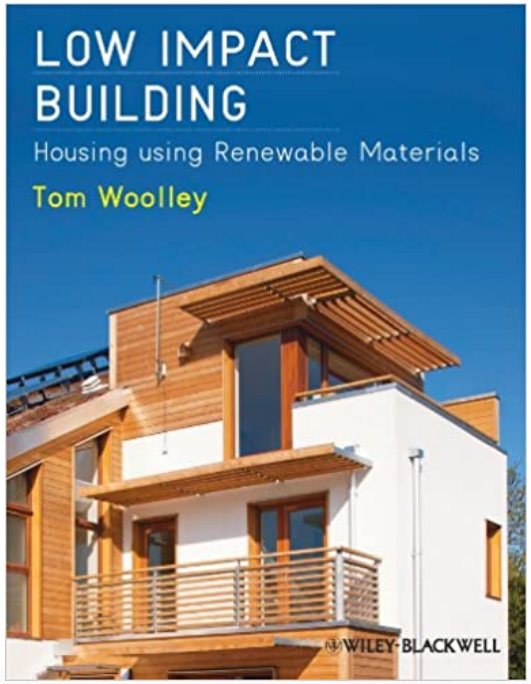
Many organisations calling for better insulation send out mixed messages about this issue

You can read more about my ideas in these books, the latest SEDA magazine and a forthcoming series of articles in Built Environment









Embodied Energy = CO2 emissions = Pollution

The production of plastic foam insulations causes toxic pollution

So severe is the toxic waste that it has led to European factory closures

Last price: 4.8800 ↓

Ercros

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Home » Press room » Estimated impact to Ercros of banning the use of mercury technology and Covestro plant shutdown from December 2

Estimated impact to Ercros of banning the use of mercury technology and Covestro plant shutdown from December 2017

Barcelona, 20 January 2016. - As Ercros has been reporting in its annual accounts, the European Union has banned from 11 December 2017, the use of mercury technology in the production of chlorine and caustic soda, a fact that coincides in time with the decision announced by Covestro (formerly Bayer) to close its MDI plant. Due to Covestro is the largest consumer of chlorine from Vila-seca I factory, the closure of its plant makes unnecessary the investment that Ercros should undertake to replace

CONTAMINATED SLUDGE CLEANUP BEGINS ON SPAIN'S EBRO RIVER TO REVERSE TOXIC LEGACY

LONDON, England

By Tom Freyberg
Chief Editor, WWi magazine

Sponsored by

Elimination of chemical pollution in Flix Reservoir

› Project management
› Control and supervision of construction works

SPAIN / TPF Getinsa Euroestudios

Project management for the elimination of chemical pollution in the Flix Reservoir

The Flix Factory carries out its activity on the right side of the Ebro River. The waste water from the factory caused the accumulation of silt containing mercury and other types of heavy metals which suppose a risk for the environment and for the use of water resources (supply and watering). For this reason, a sheet pile wall was built on the riverbed to isolate the work area. The project also comprises the removal of polluted silt with a suction dredger, the treatment of silt in the facilities built to that effect and its transportation by a conveyor belt to the spillway located at a distance of 6 km from the reservoir. Additionally, an emergency water supply system was developed for the town of Tortosa based on the water collection from wells together with an Emergency Plan in the event of river pollution.

The closure of factories in Spain and Germany has led to shortages of plastic foam insulations

THE IRISH TIMES Tue, Dec 24, 2019

Kingspan and Quinn exposed to insulation ingredient shortage

Insulation group 'confident' issue won't have material effect on its business

Tue, Oct 25, 2016, 04:43

Joe Brennan

Kingspan and Quinn Industrial Holdings have told customers they could only supply them with a fraction of their average weekly purchases of insulation materials of this product range for a period. Photograph: Chris Ratcliffe/Bloomberg

Kingspan and Quinn Industrial Holdings Ltd have been forced to temporarily curtail the supply of some insulation ranges as the European provider of a key ingredient has run short of stocks.

THE IRISH TIMES Tue, Dec 24, 2019

Builders face insulation 'headache' amid key chemical shortage

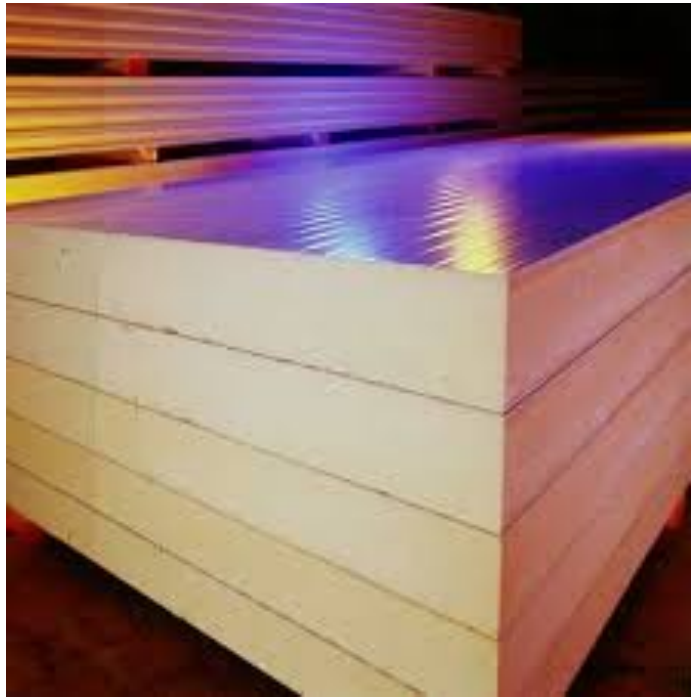
Scarcity sees Kingspan, Quinn Industrial Holdings and Xtratherm cut insulation supply

Tue, May 9, 2017, 05:52

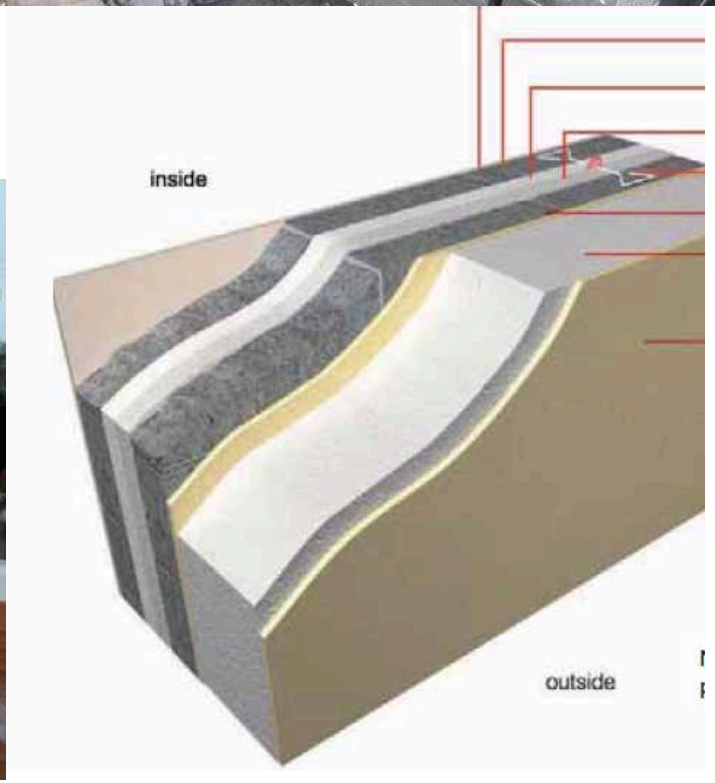
Joe Brennan

Construction site insulation. Photograph: iStock

The main insulation materials used in buildings today are made from high embodied energy, hazardous, petro-chemicals that damage health and the planet but *energy efficiency zealots* continue to promote their use as the only "available technology"

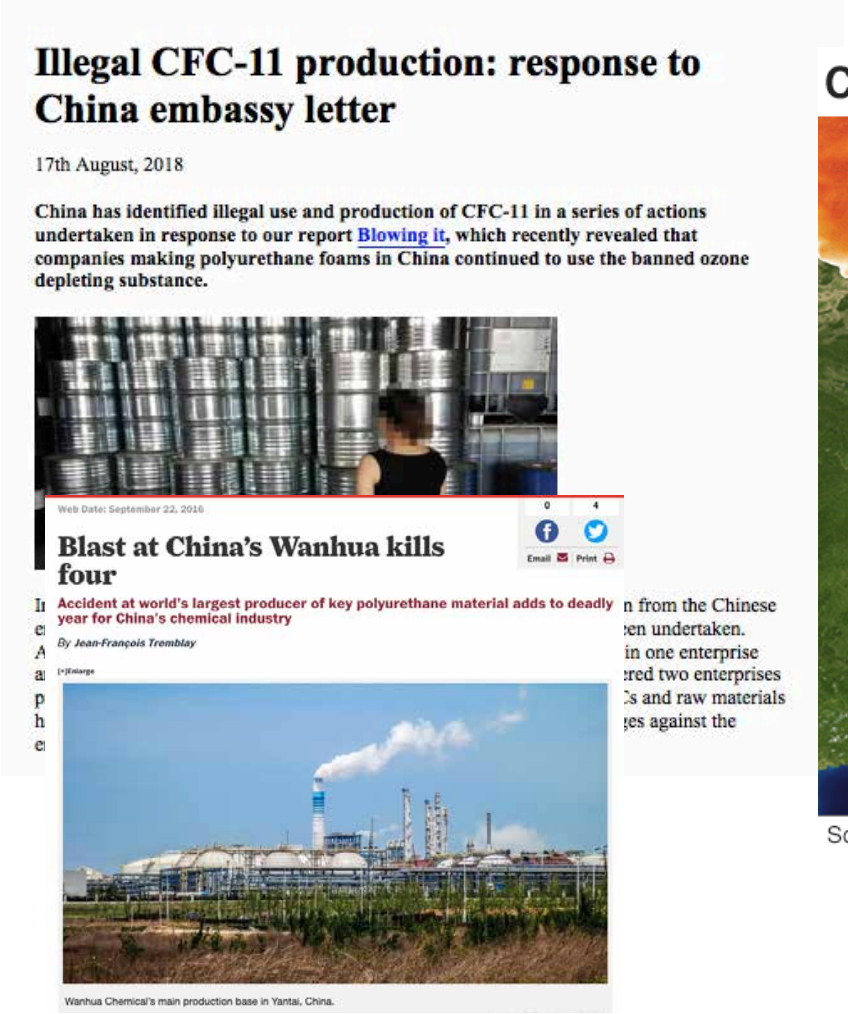


Typical insulation materials made of petrochemicals



Due to the clamp down on toxic pollution caused by isocyanates and other chemicals used in plastic foam insulation in Europe, production has largely moved to Asia.

Huge increase in CFC emissions, banned in 1992, have been traced to Chinese insulation manufacturers



Illegal CFC-11 production: response to China embassy letter

17th August, 2018

China has identified illegal use and production of CFC-11 in a series of actions undertaken in response to our report Blowing it, which recently revealed that companies making polyurethane foams in China continued to use the banned ozone depleting substance.

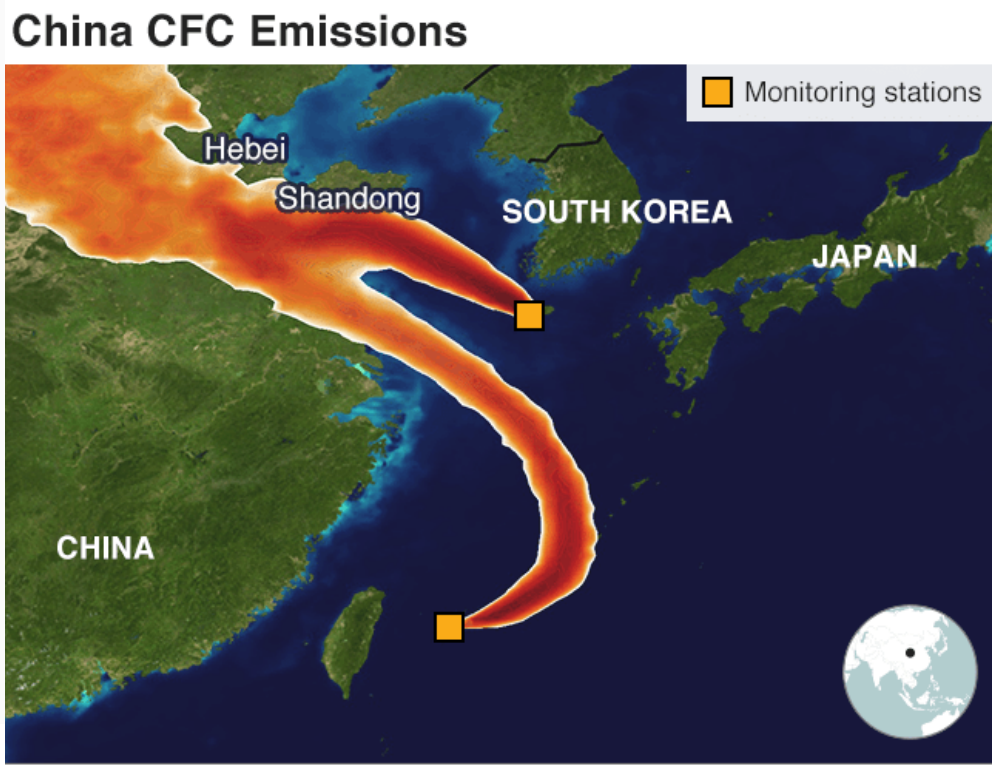
Web Date: September 22, 2016

Blast at China's Wanhua kills four

Accident at world's largest producer of key polyurethane material adds to deadly year for China's chemical industry

By Jean-François Tremblay

Wanhua Chemical's main production base in Yantai, China.



Embodied energy of insulation materials is largely ignored and good data is hard to find

- Limitations in current life cycle assessment (LCA) calculation methods and high uncertainty of available data are recognized and reflected in the analyses through studying available environmental product declarations of various types of insulation materials and by modelling a typical semi-detached residential building in the UK as the case study. The results of such approach illustrate 'optimum insulation thicknesses' beyond which the embodied energy penalty outweighs operational energy savings.
- **Embodied energy data implications for optimal specification of building envelopes**
- **Shahaboddin Resalati**,Christopher C. Kendrick &Callum Hill
  Journal**Building Research & Information**
- Volume 48, 2020 - Issue 4 Published online: 27 Sep 2019

- **A comparison of the environmental impacts of different categories of insulation materials**
- CallumHill AndrewNorton JankaDibdiakova
- **Energy and Buildings**
- Volume 162, 1 March 2018, Pages 12-20

Embodied Energy:
"The Carbon Spike"

Initial embodied emissions never recovered over a 25 year life cycle.

We need to reduce the use of high embodied energy petrochemical materials NOW

Sustainability **2011**, *3*, 1170-1189; doi:10.3390/su3081170

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

A Longitudinal Study on the Carbon Emissions of a New Residential Development

Jukka Heinonen *, Antti Säynäjoki and Seppo Junnila

Figure 3. Total emissions of the residential area during the 25 year life cycle.

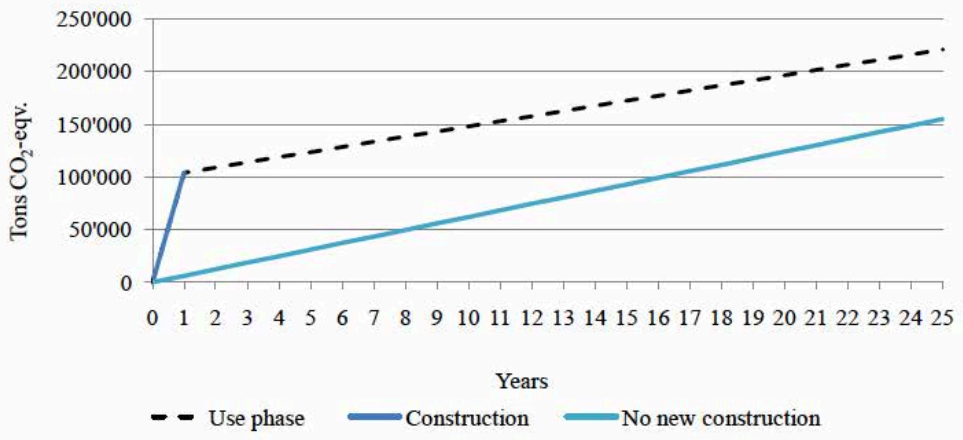
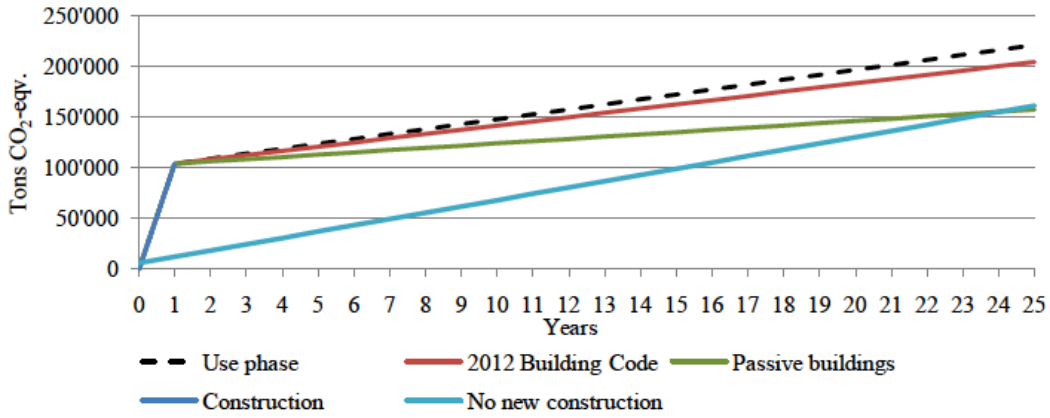
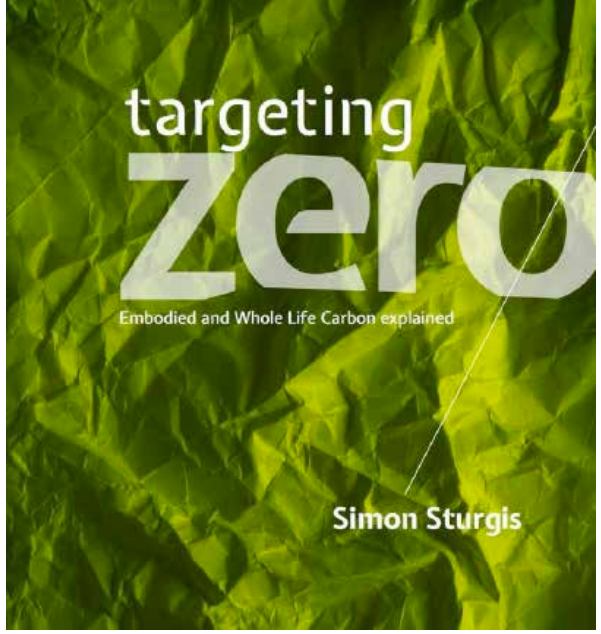


Figure 4. The life cycle emissions of the residential area with the different building energy efficiencies.



Simon Sturgis in a critique of the Green Construction Board Route Map argues that it fails to take account of whole life emissions and the need to adopt a holistic approach which counts both embodied and life time emissions.

"the total embodied content for say, blocks of flats and many non-domestic buildings, is nearer 60-65%. Passivhaus is in the region of 90+% embodied."



There is a general assumption that all insulation materials are much the same, are inter-changeable and can easily be used in all retrofit scenarios Doesn't matter what fossil fuel products you use and where you use it you can still end up with damp!

CWI

IWI

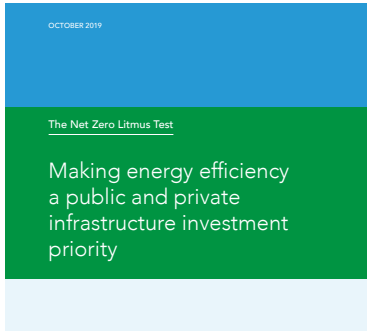
EWI

<u>However 95% of the organisations calling for zero carbon, green new deal, retrofitting thousands of houses, alleviating fuel poverty and so on almost entirely ignore the issue of ***insulation***</u>

Here are ten recent reports on housing, energy zero carbon and retrofit. In over 600 pages insulation is only mentioned 50 times and then only in a very vague and general way

The Green Construction Board

48 pages 2019.
insulation only 8 refs



Net Zero Litmus Test
2019. 48 pages.
Only mentions insulation 3 times

Zero Carbon Manchester
2017 26 pages
insulation mentioned only once

Zero Carbon Hub. 2014
44 pages
Insulation only mentioned twice

Energy Efficiency Infrastructure Group
2017
88 pages

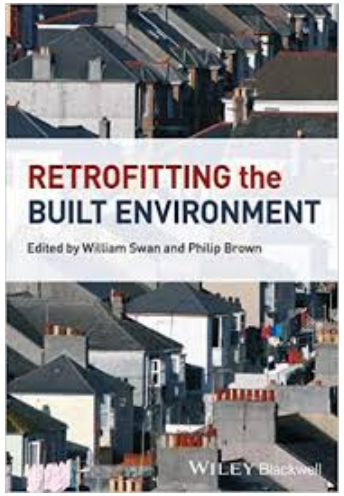
Only mentions insulation and then only in passing 9 times

2019 22 pages

Insulation only mentioned 10 times but only in passing

32 pages
2018
Only 6 references to insulation

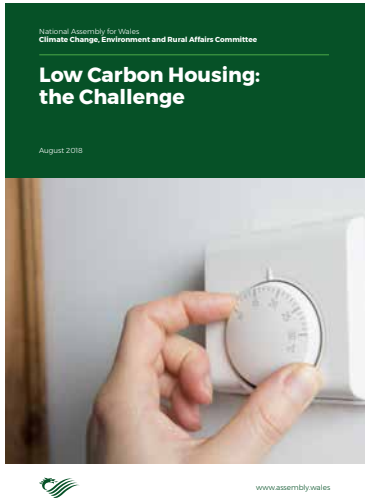
Green New Deal.
2018?
37 pages with 8 insulation refs but mostly repetition



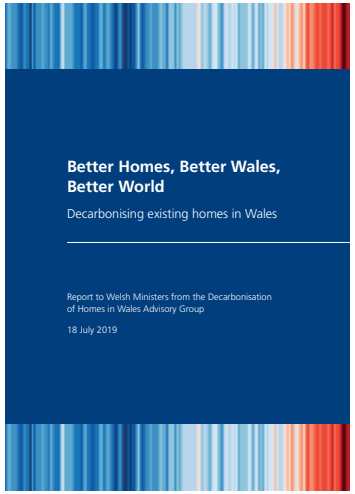
234 pages published 2013
Only 5 pages refer to insulation materials

2019 Only mentions insulation twice

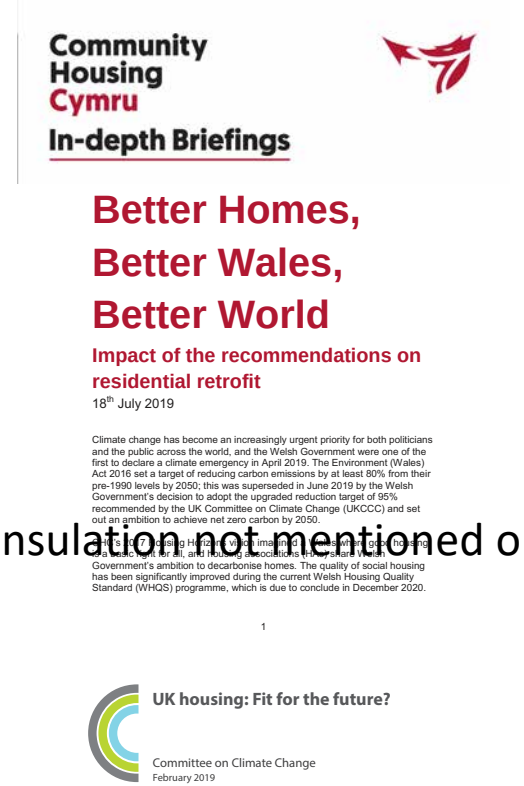
How can you discuss retrofit and de-carbonisation without discussing how to insulate homes safely and effectively?



44 pages
Insulation only mentioned 5 times

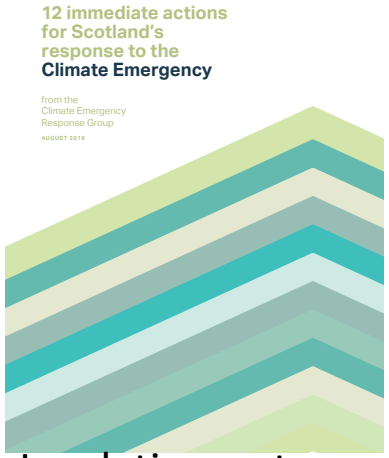


2019
66 pages
Insulation only mentioned once



Insulation not mentioned once

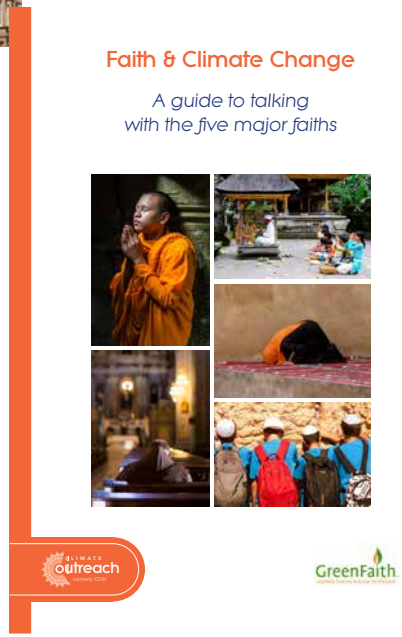
Insulation mentioned 3 times



135 pages and insulation mentioned 33 times but without any discussion of materials

Insulation not mentioned at all

Even God cannot help: Faith and Climate Change
33 pages but insulation isn't mentioned once



This is the worst (2019) UK GBC ..insulation not mentioned at all

UK GBC
Together for a better built environment

ADVANCING NET ZERO

Net Zero Carbon Buildings:
A Framework Definition

APRIL 2019

Advancing Net Zero Programme Partners

Lead Partner:

Programme Partners:

REDEVCO FOUNDATION · bam · Berkeley Group · GROSVENOR · HOARE LEA · JLL

House of Commons

Business, Energy and Industrial Strategy Committee

Energy efficiency: building towards net zero

Twenty-First Report of Session 2017–19

Report, together with formal minutes relating to the report

Ordered by the House of Commons to be printed 9 July 2019

HC 1730
Published on 12 July 2019
by authority of the House of Commons

These are the best documents as they do recognise the importance of insulation and go into some detail

Each Home Counts
An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy

Dr Peter Bonfield, OBE, FREng

Department for Business, Energy & Industrial Strategy | Department for Communities and Local Government

December 2016

Insulation and retrofit problems are we going to see more with the new Green Homes scheme

49. Over the years, householders have experienced energy saving interventions, such as damp proofing and solid wall insulation, which have not delivered the benefits that were promised. This has eroded householders' confidence in such activities. Mark Harris from the Homebuilders' Federation gave the Committee an example of the historical problems:

> "I was working at Bridgend council delivering Arbed schemes, and we were merrily cladding buildings and filling cavities full of insulation. Five years later, we've got companies setting up now to take cladding off and to take insulation out because we've realised that, actually, either it wasn't the right thing to do or the skill set that delivered it wasn't properly skilled and it was done in a rush."[47]

Standards of installation

From BEIS

80. If the housing stock is to be decarbonised, almost every home will need some energy efficiency improvements. Yet scams and poor standards of workmanship have blighted confidence in energy efficiency installations.[196] Issues such as damp from poor installations, hard sell approaches, and scams related to the Green Deal have "exacerbated" the problem.[197] If there is limited trust in energy efficiency schemes, there will be limited progress in housing decarbonisation and fuel poverty alleviation.

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HOT TOPIC

Cavity wall insulation problems are a headache for homeowners

Many are wary of green initiatives after bad installations left them with big legal costs and repair bills

Hugh Graham

Sunday September 13 2020, 12.01am, The Sunday Times

Twm Davies has been fighting the guarantor for more than two years to try to remove insulation from his Surrey house, which has damp
VICKI COUCHMAN

FRUSTRATION OVER ADDED BURDENS ON PAS2035 INSTALLS

25 JUNE, 2019

Recent revisions to the PAS 2035 standard for energy efficiency retrofits have sparked concern within the industry that undue burden will fall upon the professionals tasked with delivering the efficiency measures, such as condensing boilers.

The Heating and Hotwater Industry Council (HHIC) believes **the new standard could leave vulnerable householders without heating and bury installers in mountains of red tape.**

Kingspan

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How to register as a Green Homes Grant installer

19 August 2020 | Kingspan Insulation UK

Through the Green Homes Grant scheme, the government is making £1.5 billion of funding available for energy efficiency refurbishments to dwellings in England with a further £500 million to be made available via the local authority delivery scheme. With the scheme set to open in September, installers need to act quickly to ensure they are certified to carry out this work.

In this blog, we answer common questions about the scheme and how installers can get involved.

Will new grant schemes simply repeat the mistakes of the past?

Mould and damp: Retrofit disasters CWI case studies. Many are in Wales

RETROFIT PROBLEMS

HOME » FINANCE » PERSONAL FINANCE » ENERGY BILLS

Green Deal nightmares: 'British Gas botched our insulation – then offered £50 Nando's meal'

Non-existent cashback and dodgy works have left these householders out of pocket. We share their stories below

Heidi and Jonathan McInally-Henry say Green Deal works carried out on their home have left it barely habitable

The great cavity wall calamity: 1.5 million homes are blighted by damp after cowboy builders cash in on a Government insulation drive

- **Millions of homeowners persuaded to sign up to scheme with promise of cheaper bills by call-centre staff and salesman trying to meet targets**
- **The Government scheme was meant to make homes energy efficient**
- **But experts claim homes were not suitable for cavity wall insulation**
- **Victims left with houses riddled with damp and mould from botched fittings**

By BEN ELLERY FOR THE MAIL ON SUNDAY
PUBLISHED: 22:48, 21 January 2017 | **UPDATED:** 01:19, 22 January 2017

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BBC Radio 4 – Cavity Wall Insulation

By Kirsty | CWI, home | Comments are Closed | 9 November, 2018 | ♥ 0

BBC Radio 4 have reported the issues many people are suffering from caused by Cavity Wall Insulation. The report illustrates what can go wrong when Cavity wall insulation is installed incorrectly.

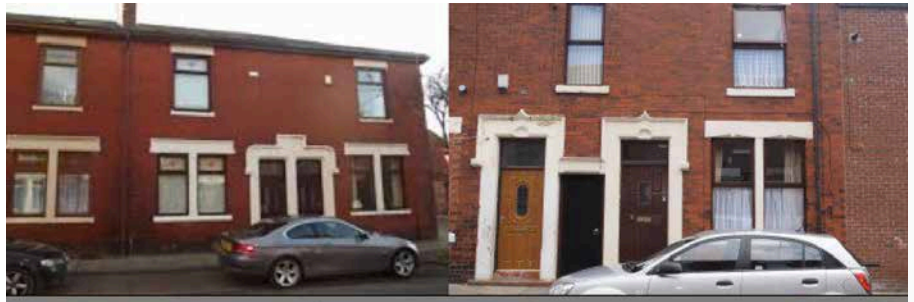
Listen to the recording below

"BBC Radio 4 - 09/11/2018"

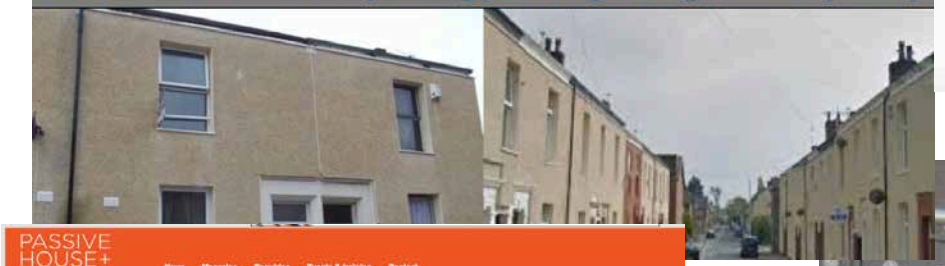
00:00 00:00

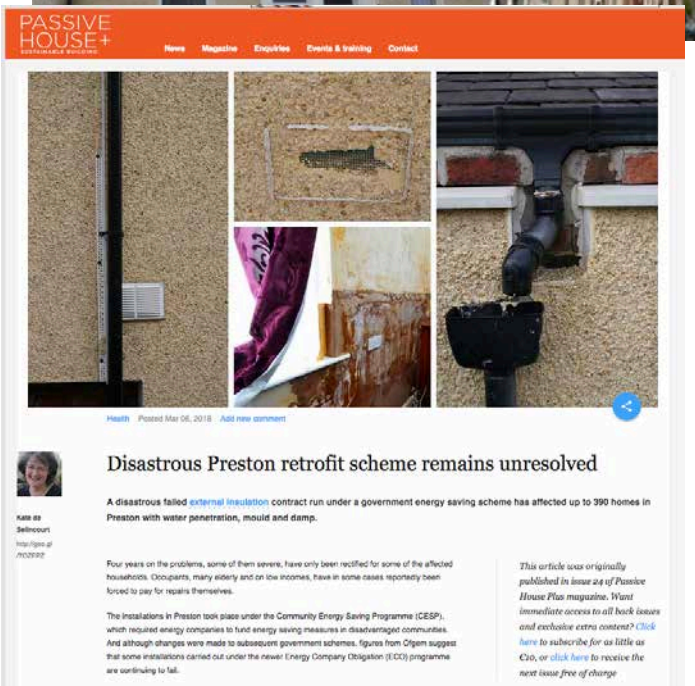
1. "BBC Radio 4 - 09/11/2018" 8:23

One of the best documented disasters Fishwick in Preston



FISHWICK Community Energy Savings Programme (CESP)





PASSIVE HOUSE+

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Health Posted Mar 06, 2018 Add new comment

Kate de Selincourt

Disastrous Preston retrofit scheme remains unresolved

A disastrous failed external insulation contract run under a government energy saving scheme has affected up to 390 homes in Preston with water penetration, mould and damp.

Four years on the problems, some of them severe, have only been rectified for some of the affected households. Occupants, many elderly and on low incomes, have in some cases reportedly been forced to pay for repairs themselves.

The installations in Preston took place under the Community Energy Saving Programme (CESP), which required energy companies to fund energy saving measures in disadvantaged communities. And although changes were made to subsequent government schemes, figures from Ofgem suggest that some installations carried out under the newer Energy Company Obligation (ECO) programme are continuing to fail.

This article was originally published in issue 24 of Passive House Plus magazine. Want immediate access to all back issues and exclusive extra content? Click here to subscribe for as little as £10, or click here to receive the next issue free of charge

zoe conway @zoeconway1 · 8h

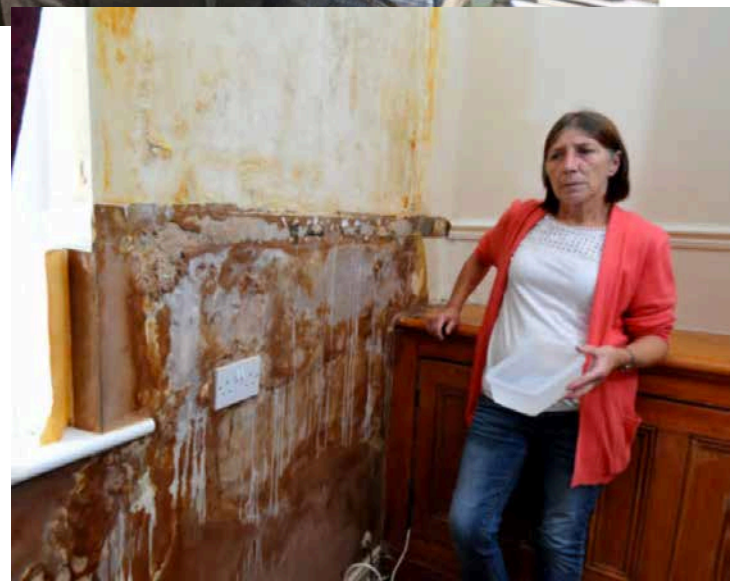
This is Virginia Gill's bedroom wall. She lives in Fishwick, Preston where a home insulation scheme has gone terribly wrong. She doesn't know who to turn to for help. Listen to her story at 0730 @BBCr4today #r4today

zoe conway

@zoeconway1

Following

This is Afshar Hussain. She has mushrooms growing in her kitchen. When it rains, water pours into her home. She lives in Fishwick, Preston where a home insulation scheme has gone horribly wrong. Hear her story at 0730 @BBCr4today #r4today



Deterioration Since October 2015

Another picture of Porch Interior – showing water ingress. Taken Mar. 2016

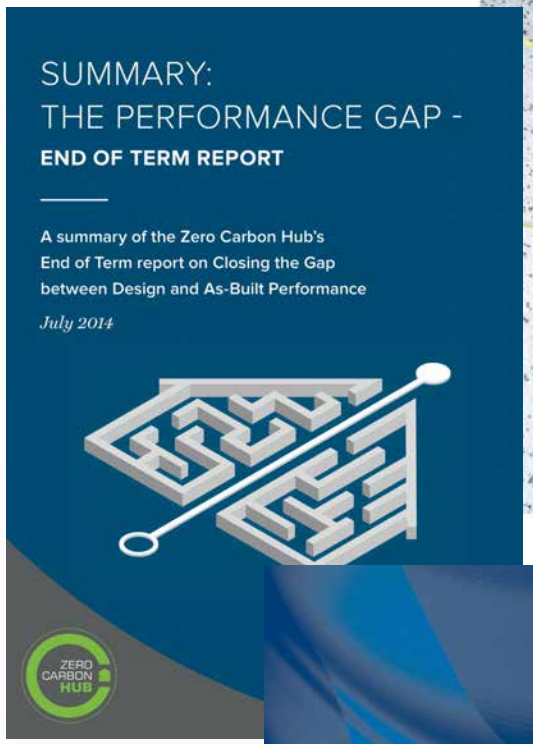
Now on to the exterior – below taken 14th Feb. 2016, note poor finish to silicone and messy fin to the topcoat which is spread over UPVC trim. Hardly done with great care.

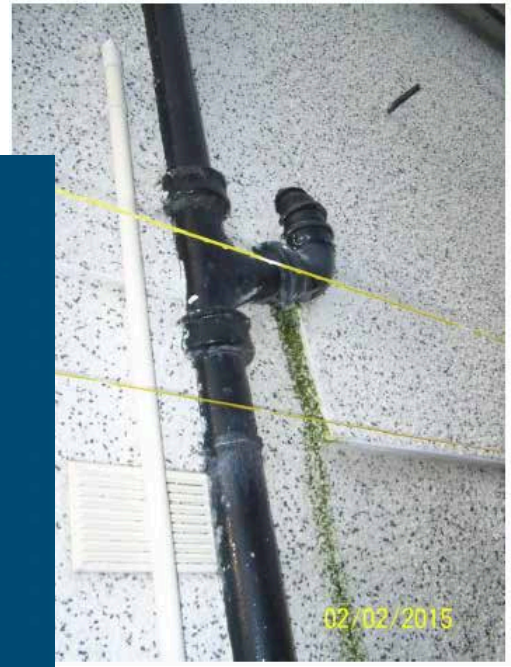
Deterioration Since October 2015

Porch - Taken Dec. 2016 EWI obstructing the drip bead allowing water ingress and algae growth

Carmarthenshire EWI disaster

The Performance Gap literature just blames bad builders
But fails to recognise the inadequacy of high embodied energy petrochemical materials





FIRE AND FLAMMABILITY

We're two years on from Grenfell, so why do these fires keep happening?

Luke Barratt

It's not just unsuitable cladding – a host of other safety issues are not being addressed by authorities and building owners

▲ 'Images from after the fire show that much of the cladding on the top two floors has been burned away or has fallen off.' Firefighters tackle Friday's blaze at The Cube in Bolton. Photograph: Peter Byrne/PA

Barking, Crewe, Clapton, Worcester Park and now Bolton: 2019 has seen at least five major fires in blocks of flats. The latest blaze hit the Cube, a student

THEME: FIRE SAFETY TEXT: MARTIN SØRENSEN / PHOTOS: IF

If test shows potential risks with PIR sandwich panels

A burning issue

A new If study indicates that PIR sandwich panels may react in a fire to a greater extent than their fire class rating would suggest.

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Cardiff flats fire safety funding offer 'insulting'

By Paul Martin
BBC Wales Live

16 October 2019 Sha

Residents 'safe' after Cardiff high-rise flats fire

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Bolton Cube student block fire: Everything we know so far

At least 40 fire engines and 200 fire fighters battled the blaze throughout the night

The catalogue of failures that make this huge Cardiff apartment complex a 'major concern' fire risk

Two reports identified a series of fire safety issues across the whole development with more than 450 flats

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Clapton flats fire: Woman rescued during 'suspicious' blaze

2 hours ago

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Witnesses described seeing a large window on the top floor "explode" sending debris to the ground

ITV REPORT 9 September 2019 at 11:19am

Worcester Park fire: 'It's gone' - fire rips through block of flats

A four-storey residential block has been destroyed after a fire ripped through the building in the early hours of Monday.

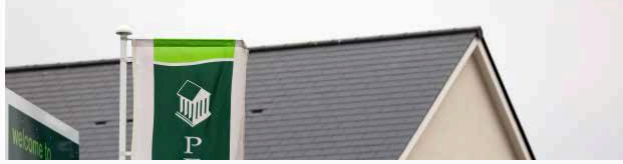
FIRE WARNING Persimmon and Bellway new-build homes 'are fire risk', BBC Watchdog investigation finds

House builders are required to make sure the homes they sell meet fire safety standards

By Alice Grahns, Digital Consumer Reporter
1 May 2019, 0:01 | Updated: 1 May 2019, 8:37

HUNDREDS of new homes constructed by Persimmon and Bellway Homes have been built with "potentially dangerous fire safety issues", an investigation by BBC Watchdog Live has found.

The Persimmon properties were sold with missing or incorrectly installed fire barriers, designed to prevent the spread of fire, according to a new episode airing on BBC One tonight.



'New-build homes not fire safe', BBC investigation finds

1 May 2019

Share

Houses developed by Persimmon Homes and Bellway Homes have potentially dangerous fire safety issues, BBC Watchdog Live has found.

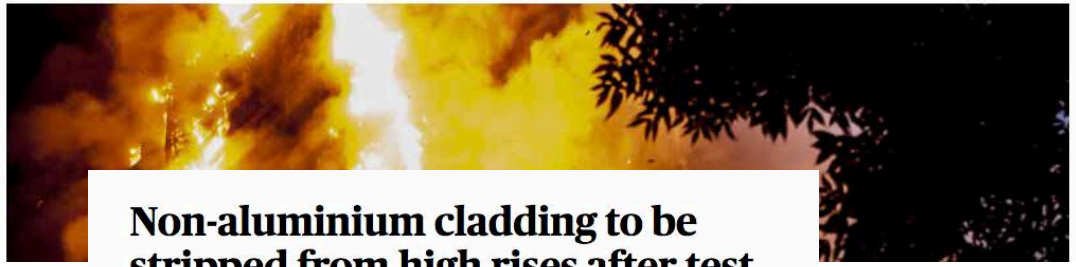
FIRE SAFETY

Germany's Burning Issue

After the horrific tower block inferno in London, fire protection experts are lining up to warn authorities about the risk from dated insulation used in German housing.

David Reay

06/28/2017 - 05:00 PM • Share now



Non-aluminium cladding to be stripped from high rises after test failure

NEWS 15/01/18 7:30 AM BY NATHANIEL BARKER

Non-aluminium cladding which had previously been considered safe will be stripped from an east London high rise after experts warned the system may not resist the spread of flame.

Just because the insulation panels don't catch fire as quickly as things like gasoline, once on fire, they present fire fighters and residents with a barely manageable threat. Dirk Aschenbrenner, president, German Fire Protection Association

Insulating materials in Germany are primarily made of expanded polystyrene - commonly known by its BASF brand name of styropor. About 720 million of these thermal insulating systems were installed in buildings of all sizes nationwide between 1960 and 2012 - although not always to current standards. And there lies the problem.

The building material is classified as "flame-resistant" and is protected from direct contact with flames by layers of plaster, among other things. For that reason, it is considered safe and is permitted for residential and office buildings up to a height of 22 meters (72 feet).

But this can result in "many completely misunderstanding the safety situation," says Dirk Aschenbrenner, chief of the Dortmund Fire Department and president of the German Fire Protection Association. He warns: "Just because the insulation panels don't catch fire as quickly as things like gasoline, once on fire, they present fire fighters and residents with a barely manageable threat

Even where good practice is promoted the case for vapour open materials needs to be stated much more strongly
With stronger warnings of the dangers of plastic insulation

HYBRID WALL INSULATION (HWI)
HWI is often appropriate where EWI is not suitable for the front of a building (usually on grounds of appearance), but is suitable elsewhere. In these cases, IWI may be applied at the front of the house while the sides and back can have EWI applied.

MATERIALS
The materials specified and used in a SWI project should be selected on two main criteria: a) **technical compatibility**

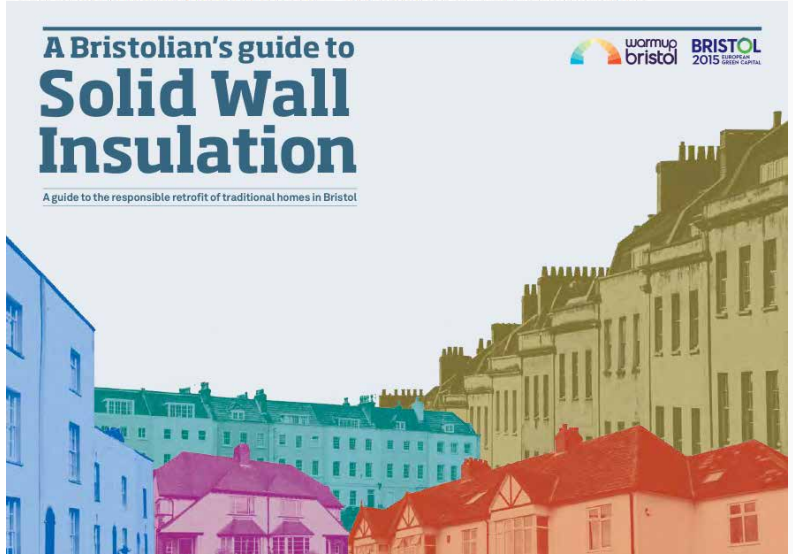
IWI) moisture-closed systems may be necessary.

Environmental impact is another important consideration, but more for your overall impact on the environment than for their effect on your building. If you are mainly motivated by concern for nature or by climate change issues, then it would be counter-productive if the energy and resources you save by insulating your home are outweighed by the environmental impact of the works.

- How far have the installers travelled?
- How much material is wasted (through offcuts, and so on)?

You can find out more about the environmental impact of materials from the Alliance for Sustainable Building Products (ASBP) at www.asbp.org.uk.

Examples of moisture-open (wood fibre board) and moisture-closed (EPS) insulation materials



Bristol guide fails to address the issue of materials
apart from references to vapour open and vapour closed
What is the point of vapour closed materials?

Excellent decision making protocol by Nicholas Heath
But illustrated with EPS EWI
another possible retrofit disaster scheme

We have to make up our minds and go for Vapour open materials with low embodied energy

HEMPCRETE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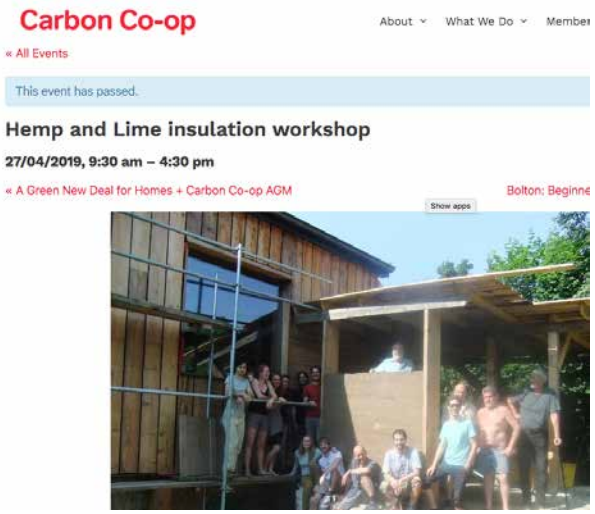
Hemp-Lime Insulation & Building for Self-builders / DIY retrofit
22nd February, 10:00 am – 4:00 pm
« Masterclass: Hemp/lime for building professionals
Energise: a day of retrofit learning and inspiration »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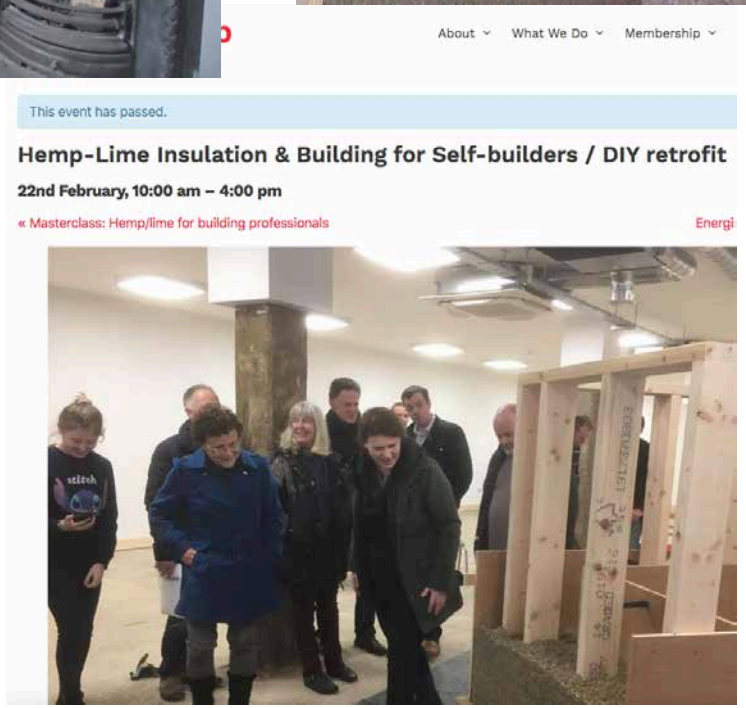
Hemp and Lime insulation workshop
27/04/2019, 9:30 am – 4:30 pm
« A Green New Deal for Homes + Carbon Co-op AGM
Bolton: Beginne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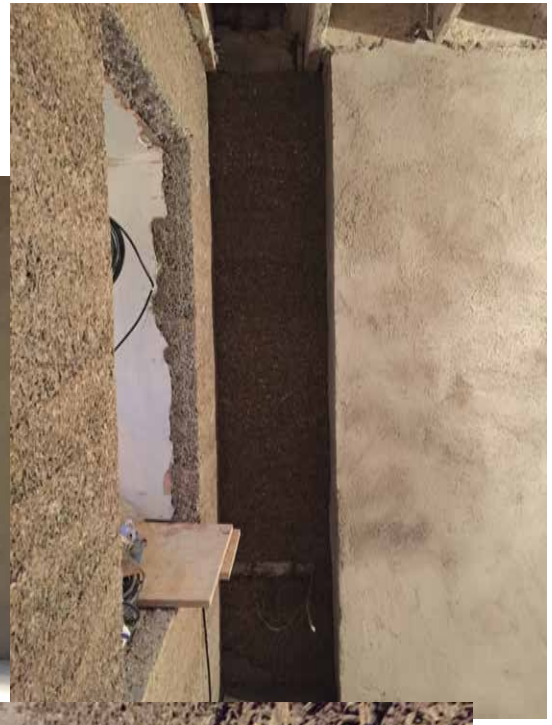
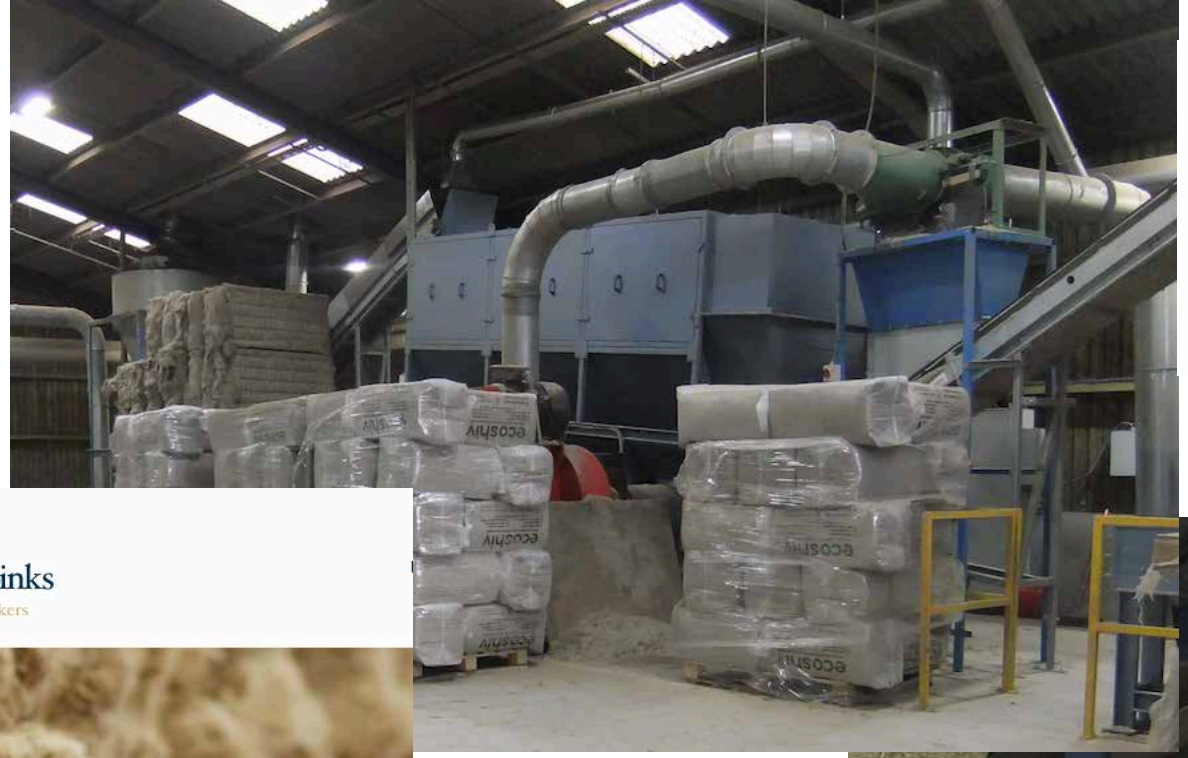


HEMP COOPERATIVE
IRELAND — EST. 2018

Supply of hemp readily available



British Hemp Alliance

Harrison Spinks
The True Bedmakers

What is hemp and how do we use it

BETTER-THAN-ZERO-CARBON BUILDINGS

ZERO CARBON HOMES

Hempcrete is a "better-than-zero-carbon material". More atmospheric carbon is locked away in the material for the lifetime of the building than was used in its production and use.

Lime Green's State of the art mixing plant

Continuing over 500 years of lime production on Wenlock Edge, the UK's leading manufacturer of lime based mortars, renders and plasters, Lime Green recently completed the construction of our state of the art mixing plant. The building frame required over 150 tonnes of steel. Twenty three storage silos holding over 600 tonnes of raw materials provide the capacity for a daily manufacturing output of approx. 100 metric tonnes. A sophisticated software system ensures highly accurate computer-controlled batching of ingredients for all lime-based products.

> "I like what you have done and I have no doubt that this brave investment will benefit and secure your business well into the future."

Joe Orsi of Orsi Contini Consultants,
Historic Buildings Specialist

K Lime

Product Data Sheet

Hemp Lime Binder

Hemp Lime Binder is a low density, hydraulic lime based binder used in the manufacture of hempcrete (hemp concrete). Hempcrete is a bio composite building material which provides enhanced thermal properties to walls and roofs using sustainable materials.

Typically Hemp Lime Binder is blended with hemp shiv and water to create hempcrete as a semi-dry mix. The hempcrete is then normally cast around a steel or timber frame to create a solid, non-load bearing wall. The hydraulic lime used in manufacturing K Lime Hemp Binder is manufactured to BS 459-1; K Lime Hemp Binder is ISO 9001 & 14001 approved.

- Can be cast or sprayed
- Provides some racking strength for the frame
- Robust, highly breathable
- Sustainable, low environmental impact
- Provides both thermal resistance heat storage

MIX RATIOS

The density and strength of the Hempcrete can vary according to the mix ratio used.

Typical values:

Mix Ratios by weight

Hemp Binder (Kg)	Hemp Shiv (Kg)	Water (Kg)	Dry Density Kg/m³	Compressive Strength N/mm²
1.0	0.45	0.9	530	0.85
1.0	0.67	0.9	340	0.26

Mix Ratios by volume

Hemp Binder (L)	Hemp Shiv (L)	Water (L)	Dry Density Kg/m³	Compressive Strength N/mm²
1.0	2.7	0.74	530	0.85
1.0	3.95	0.73	340	0.26

The quantity of water to be added may vary depending on the water content of the hemp shiv.

MORTAR CONSUMPTION

Typically 1 cubic metre would require approximately 200 kg of binder, 90 kg of hemp shiv and 180 litres (Kg) of water.

MIXING AND INSTALLATION

Add hemp fibre first followed by the Hemp Binder mix for 30 seconds, then add the water and mix for 5 minutes to give a homogeneous mix.

The consistency should be a stiff, almost semi-dry paste

Temporary shuttering (maximum 600mm in one lift) should be installed to create the mould or formwork. The product placed into mould or formwork and lightly tamped into place. Shuttering should be left overnight and can be removed the following day.

PACKAGING AND STORAGE

The product is packed in 20kg bags.

The shelf life is 12 months if stored in dry off the ground in dry conditions, protected from frost and sunlight, in original unopened packaging.

TECHNICAL ADVICE

A technical advisory service is available on request.

In line with our policy of continuous product development, we reserve the right to change technical data without notice.

BSEN998-1 & BSEN998-2 Licence No. 514639

FM 85394 EMS 611117 OHS 611118

BSEN15824 Licence No. 560349

NSAI Certificate No: 09/0249

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Tel: 028 2826 0766 Fax: 028 2826 0136
Email: Sales@K-Rend.co.uk
www.K-Rend.co.uk

For ROI Sales
Classis, Ovens, Co. Cork, Ireland
Tel: 021 4872733 Fax: 021 4871705
Email: Sales@K-Rend.co.uk
www.K-Rend.co.uk

Study by Dr. Rosanne Walker at Trinity College Dublin on thermal and moisture performance of different retrofit insulations

Adjutant General's Building, Royal Hospital Kilmainham built 1805
Brick walls with lime render c.800mm

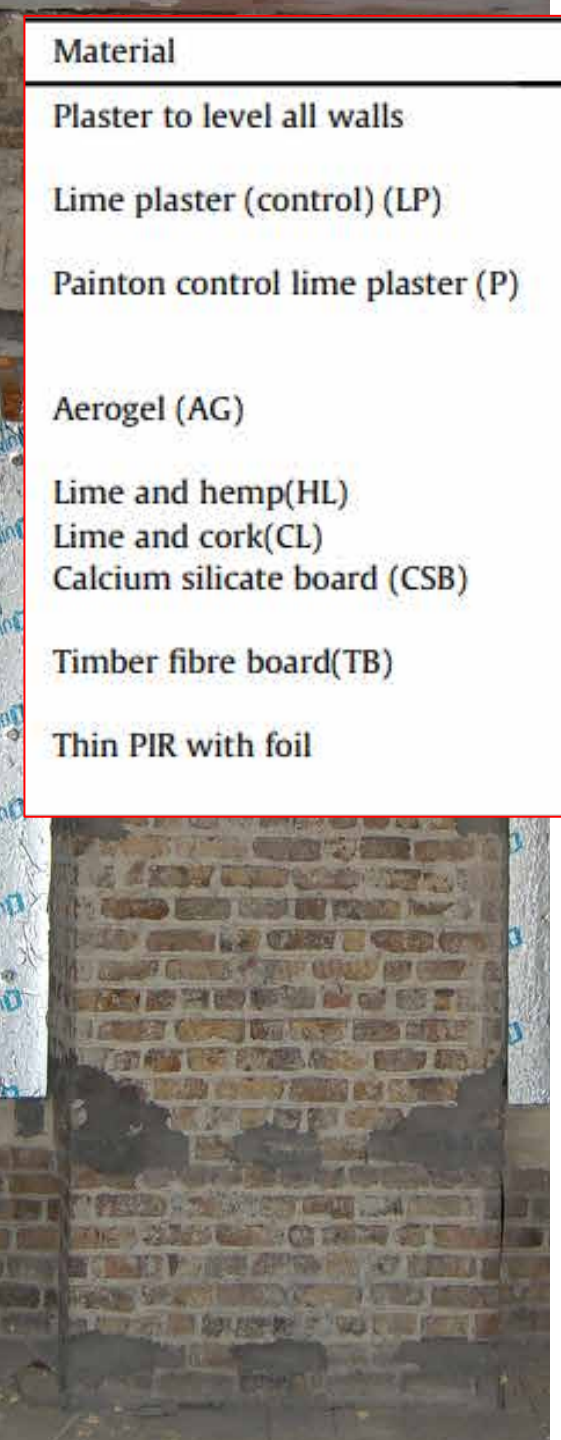
Internal plaster removed c.1990

Monitoring moisture in a historic brick wall following the application of internal thermal insulation

Walker_R, Pavia_S
Department of Civil, Structural and Environmental Engineering, Trinity College, Dublin 2, Ireland
email: walkerro@tcd.ie, pavias@tcd.ie

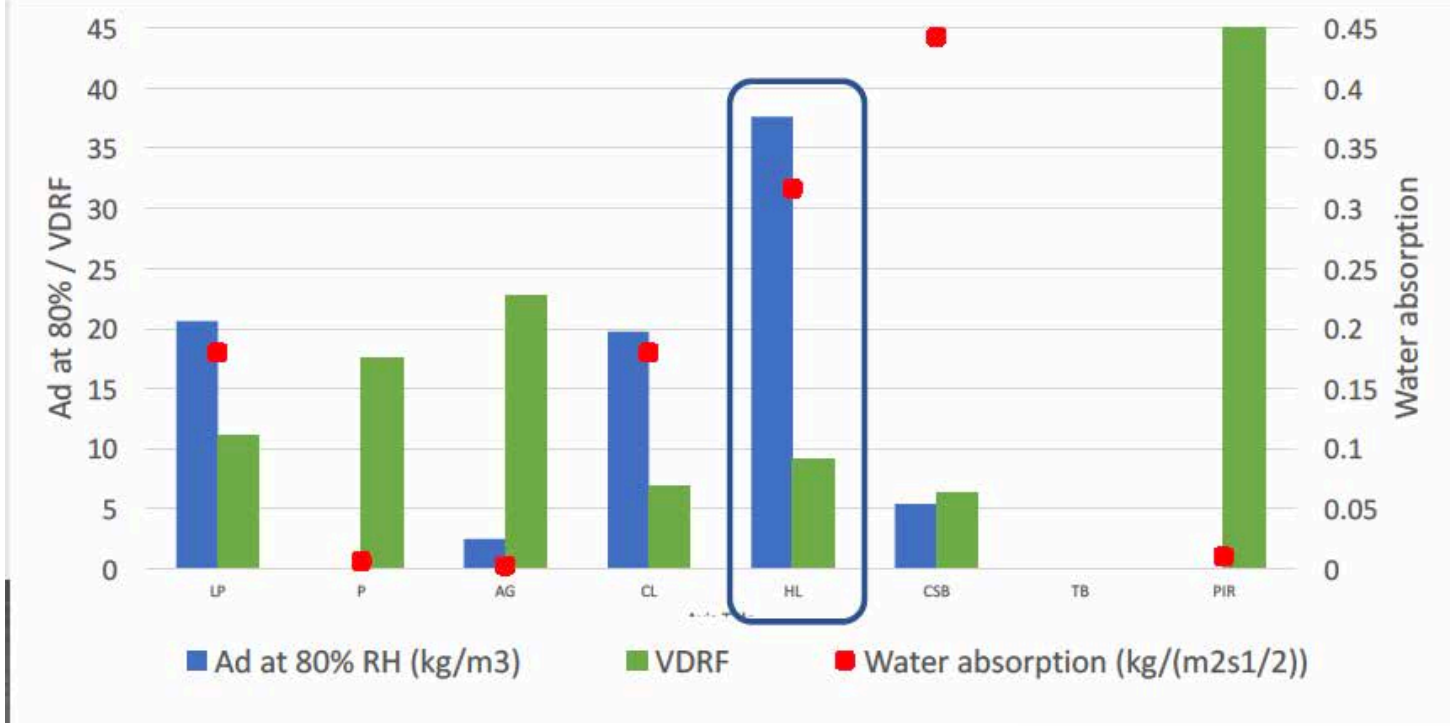
ABSTRACT: This paper monitors the in-situ moisture performance of a solid brick wall following the application of internal insulation using the timber dowel technique. Six internal insulations including thermal paint on lime plaster, aerogel (AG), cork-lime (CL), hemp-lime (HL), calcium silicate board (CSB) and PIR were applied to wall sections.
Improving the thermal performance of buildings reduces building operational energy and its associated negative impact on the environment. However, thermal insulation may increase moisture accumulation in walls undermining their long term durability and lowering their thermal efficiency. Currently, there is a lack of knowledge on the performance of traditional solid walls with respect to heat and moisture and the impact of internal insulation on their hygrothermal behaviour.
The changes in moisture recorded using timber dowels agreed with the moisture recorded using a commercial relative humidity (RH) probes. All the wall sections showed a reduction in moisture content over time as the construction moisture dried. The nature of the insulation significantly determined the wall moisture: after one year, the least vapour permeable and capillary active insulation (PIR, aerogel and paint) had higher moisture contents than the lime based insulation (LP, CL and HL). Moisture gradient across the wall (from the internal surface to wall mid-point) indicate that the lime based materials allow the dissipation of moisture towards the interior surface which is retarded by the low moisture permeability of the paint surface, aerogel and PIR.

Material	Coat/thickness	Composition
Plaster to level all walls	Scud coat c.5–6 mm	2.5:1:0.63 sand:NHL5:water
	Scratch coat 25–75 mm to make walls plumb	2.3:1:0.67 sand:NHL3.5:water
Lime plaster (control) (LP)	Floating coat c.12 mm	3:1:0.60sand:NHL3.5:water
	Skim coat 3 mm	1:1:0.5 sand:NHL2:water
Painton control lime plaster (P)	Floating coat c.12 mm	
	Skim coat 3 mm	As above
	3 coats of paint	Emulsion with ceramic additives
Aerogel (AG)	19.5 mm aerogel and plasterboard	As per manufacture's spec using mechanical fixings
	Gypsum skim coat 3 mm	As per manufacture's spec
Lime and hemp(HL)	2 × 20 mm layers	Hemp:NHL2:water 1:2.9:3.5 (by weight)
Lime and cork(CL)	2 × 20 mm layers	Cork/lime: water 2.15:1 (by weight)
Calcium silicate board (CSB)	30 mm	As per manufacture's spec using adhesive to affix board
	proprietary skim coat c.6–7 mm	Basecoat with mesh imbedded (4–5 mm) and finish coat (2 mm)
Timber fibre board(TB)	40 mm	As per manufacture's spec using mushroom fixings
	proprietary skim coat c.6–7 mm	Basecoat with mesh imbedded (4–5 mm) and finish coat (2 mm)
Thin PIR with foil	37.5 mm	As per manufacture's spec using mechanical fixings
	Gypsum skim coat 3 mm	As per manufacture's spec

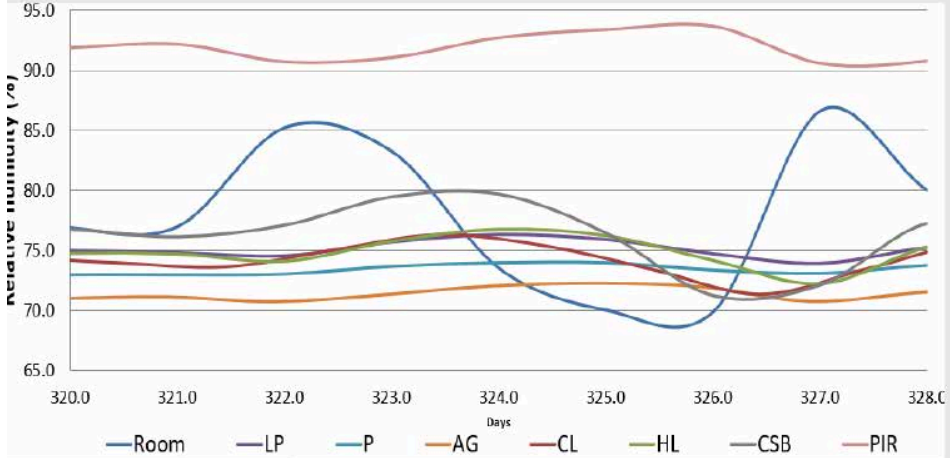


Hemp Lime and Cork Lime performed the best
In terms of regulating moisture and humidity

Moisture Properties



Wall response to varying room RH



Hemp Lime best in water absorption

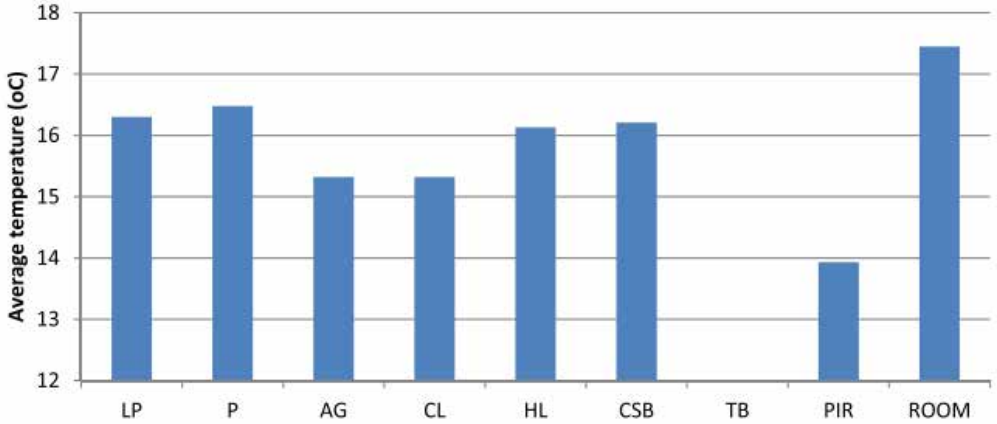


Fig. 11. Average temperature of the wall with different insulation measured at 130 mm depth from the interior wall surface. Error in TB readings.

Hemp Clay research alternative materials?

I am working on the use of clay binders
Which has lower embodied energy than lime

Indoor air quality…do we really want people to have poisonous chemicals in their homes?
High embodied energy fossil fuel materials also create hazardous emissions

“Isocyanates are highly reactive chemicals
That can cause skin, eye and lung irritation,
asthma and chemical sensitization”
US Environmental Protection Agency

Building and Environment 159 (2020) 106559

Contents lists available at ScienceDirect

Building and Environment

journal homepage: http://www.elsevier.com/locate/buildenv

Polyurethane insulation and household products – A systematic review of their impact on indoor environmental quality

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[b] Institute for Sustainable Heritage (ISH), University College London (UCL), UK

Environment International 75 (2015) 234–244

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Higher energy efficient homes are associated with increased risk of doctor diagnosed asthma in a UK subpopulation

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Hazardous emissions from PUR and PIR insulations
Isocyanates, polyols, flame retardants, blowing agents and catalysts, by products
Carcinogens and products causing respiratory problems

Research demonstrates that in isolation each group could impact human health, with some carrying higher risks compared to others [13,14].
During the production, and lifecycle, of PU products various organic compounds can be released from the foams into the indoor environment. Scarce data is available covering these emissions and to address the knowledge gap, a compilation of small studies was published by ASTM to provide further insight [15], followed by the ASTM D8142-17 standard for measuring SPF chemical emissions. This collection of reports provides data in relation to SPF emissions and their implications on indoor environmental quality (IEQ). Polyurethane products are found abundantly in modern indoor environments [8], however their cumulative volatile and semi-volatile organic (VOCs, SVOCs) long-term emissions and implications on human health are still largely unknown

The use of natural low embodied energy breathable materials is growing
But we must do all we can to restrict the use of petrochemical materials
THANKS FOR LISTENING

tom.woolley@btconnect.com

Blog: The advantages of using natural building materials

URBANE / BLOG NEWS

April 5, 2019

The use of natural building materials is a vital aspect of creating a sustainable, healthy home for the occupants and the environment. But, what are natural building materials and what exactly are the advantages of using them compared to conventional building materials?

SCIENCE · ENVIRONMENT

03 June 2015

Bioconstruction: Healthy and Sustainable Materials

Architecture | Change | Health | Sustainability and Ecology

EEA NEWSLETTER European Environment Agency

Issue 2019/1, 15 March 2019

Your quarterly update on Europe's environment

Editorial | Interview | Indicators & data | EEA news | In the spotlight | Upcoming events

Editorial

Healthy environment is a must for sustainable economy and equitable society

"The facts are clear: the global climate is changing and this change is man-made; the diversity of life on earth is being lost at an unsustainable rate; and our consumption and production systems are simply unsustainable.

Despite the magnitude of the task, it is still possible to build a sustainable future. The knowledge to steer this transition towards long-term sustainability is there. There is also growing public support for change. Now, we need to assume responsibility and accelerate this change."

Hans Bruyninckx, Executive Director

Bad indoor air quality can be another consequence of airtight insulated houses

Ministry of Housing, Communities & Local Government

Ventilation and Indoor Air Quality in New Homes

Health Effects of
Modern Airtight Construction

HEMAC Multidisciplinary Network

September 2019
Aecom Limited
try of Housing, Communities and Local Government

Dispatches Posted Apr 06, 2017 Add new comment

New build homes face emerging ventilation crisis

Despite increasing standards of insulation and airtightness, housing developers face few requirements to provide better ventilation and indoor air quality for new home buyers — beyond knocking extra holes in walls. But as reports of condensation and mould affecting new housing developments continue to surface in both the UK and Ireland, and research indicates many new homes may have poor indoor air quality, are developers finally waking up to the need for properly engineered ventilation systems?

Ian Mawditt has shown that pollutants from plastic foam *external insulation* exceeded safe limits inside his house when the MVHR system is turned off