ASBP The Alliance for Sustainable Building Products

ASBP The Alliance for Sustainable Building Products | NATURAL FIBRE INSULATION GROUP

Airtightness, Breathability and Condensation Risk

An introduction to breathability – Dispelling misconceptions and the importance of sorption

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Airtightness, Breathability and Condensation Risk in Buildings

NATURAL FIBRE INSULATION GROUP

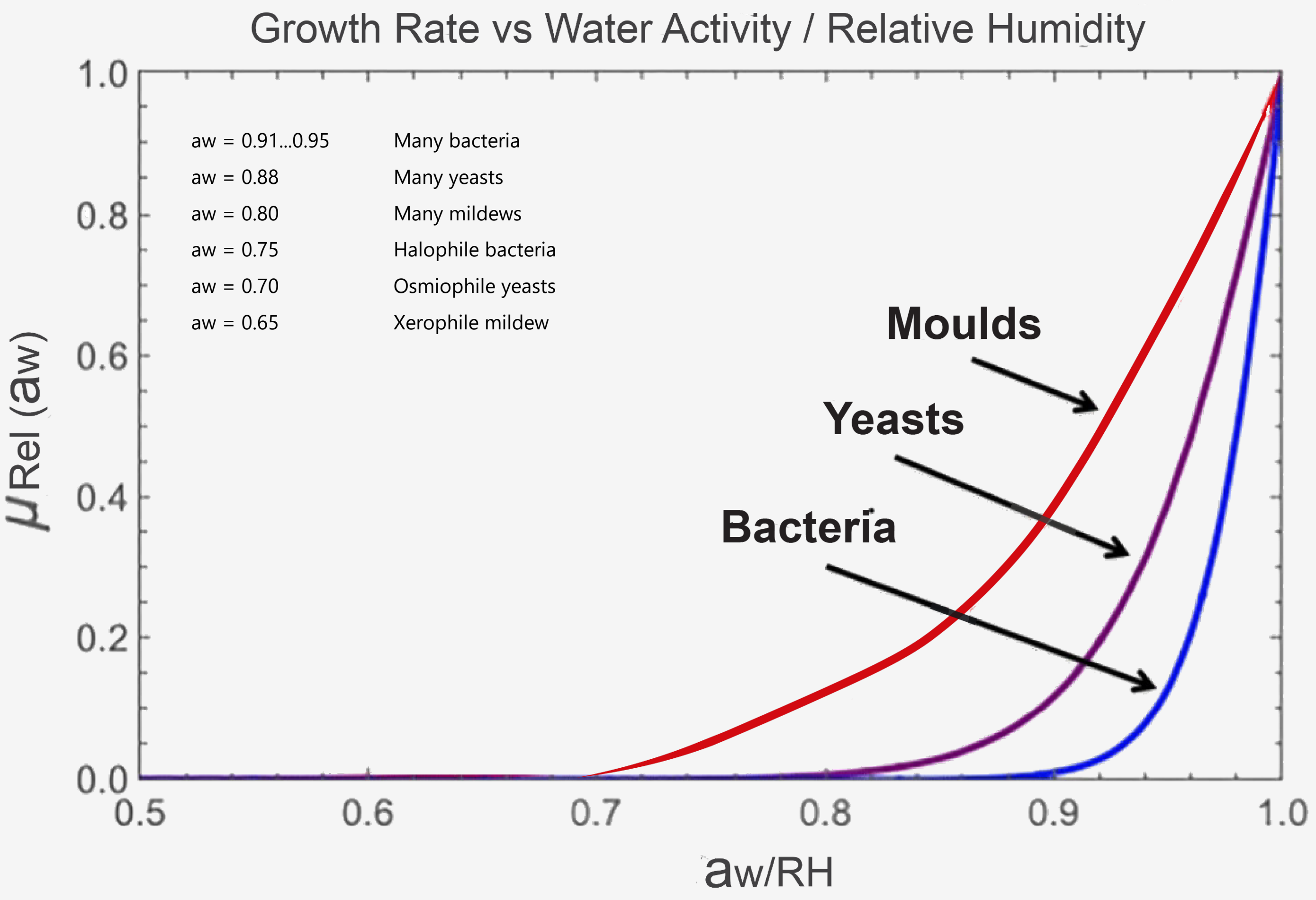
backtoearth | CELTIC sustainables | ecological BUILDING SYSTEMS | ecomerchant | IndiNature | lime|green | MIKE WYE | SCHOOL OF NATURAL BUILDING | SOPREMA | STEICO engineered by nature | thermafleece Nature's finest insulation | Tŷ-Mawr

Busting the Myths - Mould

Mould cannot grow on hydrophobic materials. ~~wrong!~~

Almost all surfaces contain enough food for microbes to live off.

Mould, yeasts and bacteria can grow on hydrophilic <u>and</u> hydrophobic surfaces if the humidity and surface water activity is high enough. right!



Busting the Myths - Hygroscopicity

Hygroscopicity is always a good thing. wrong!

Hygroscopicity is always a bad thing. wrong!

Hygroscopicity is not a quantitative definition so whether hygroscopicity is good or bad depends on the degree of hygroscopicity and how and where a material is used. right!

Hygroscopic Classification	Mass gain at 24h @ 25°C & 80% RH
Slightly hygroscopic	<2% and ≥ 0.2%
Hygroscopic	<15% and ≥ 2%
Very hygroscopic	≥ 15%
Deliquescent	Forms a Liquid

Classification doesn’t say whether the water is “bound” or “free”, i.e. harmless or harmful.

Busting the Myths - Breathability

Breathability is a substitute for ventilation. wrong!

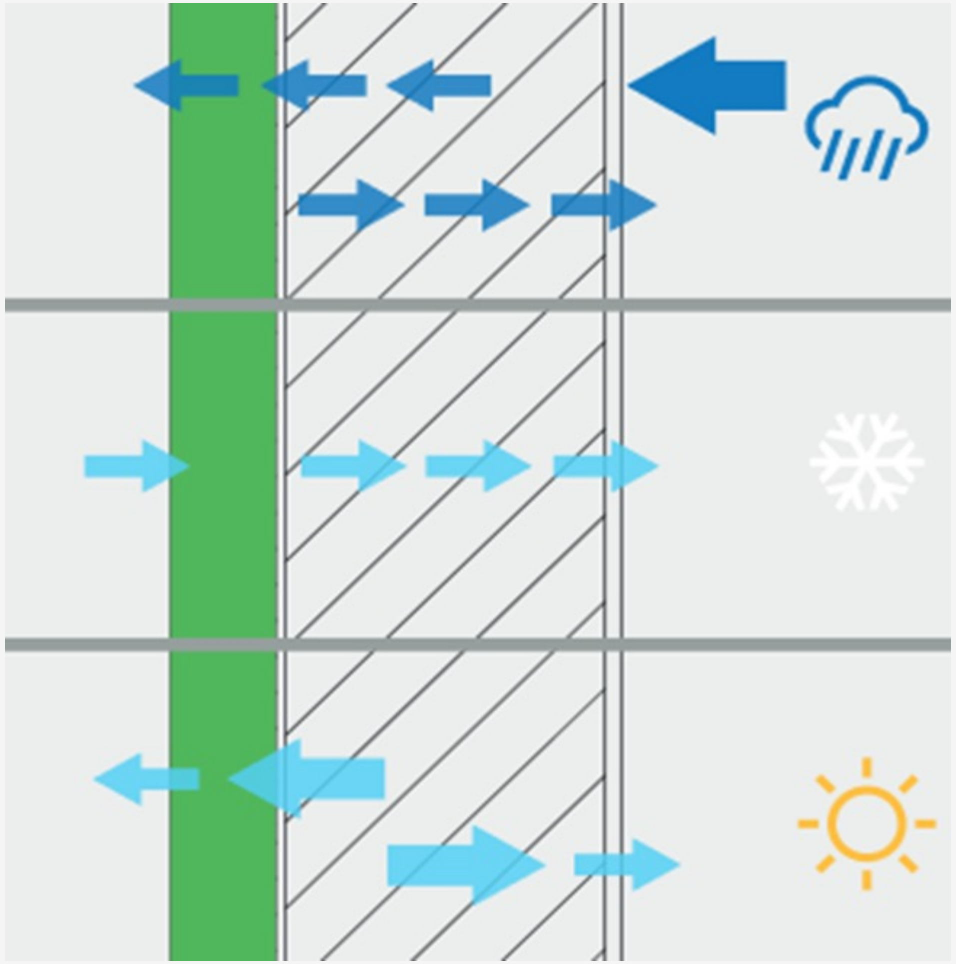
Breathability compliments ventilation to promote moisture balance. right!

If something is airtight it can't be breathable. wrong!

A material can resist air pressure (air tight) but still be vapour open. right!

If something is vapour open it's breathable. wrong!

Breathability requires water vapour openness and vapour sorption in combination. right!



Busting the Myths – Water Vapour

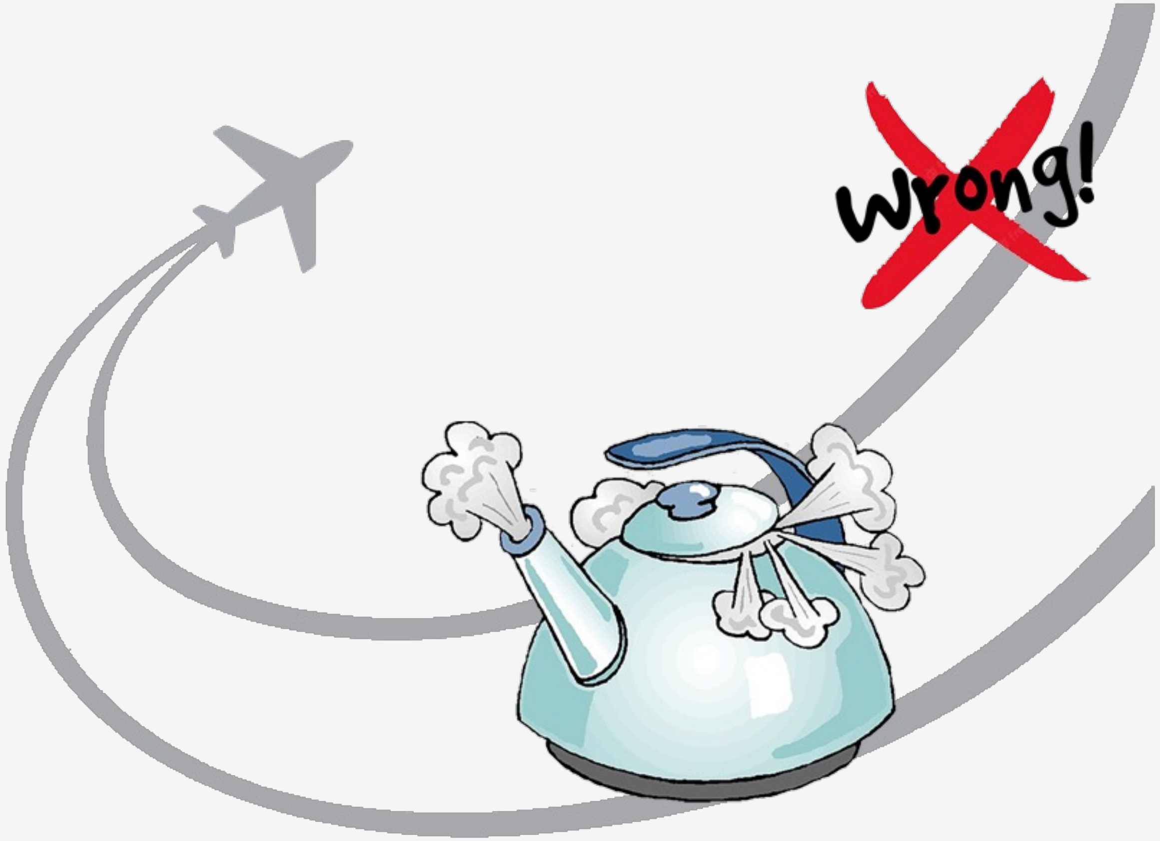
Clouds, vapour trails from aircraft and kettles boiling show water vapour. wrong!

Vapour trails and clouds are composed of droplets of liquid water condensing.

Water vapour is a colourless odourless gas. right!

Water exists as both a liquid and a gas at room temperature. right!

Collisions with other molecules keep water in the air as a gas.



Water Sorption (Adsorption & Desorption)

Water sorptive materials bind and release (adsorb & desorb) water to balance their water content with the relative humidity (RH) of the surrounding air.

Influenced by **Porosity** & **Polarity** of a material.

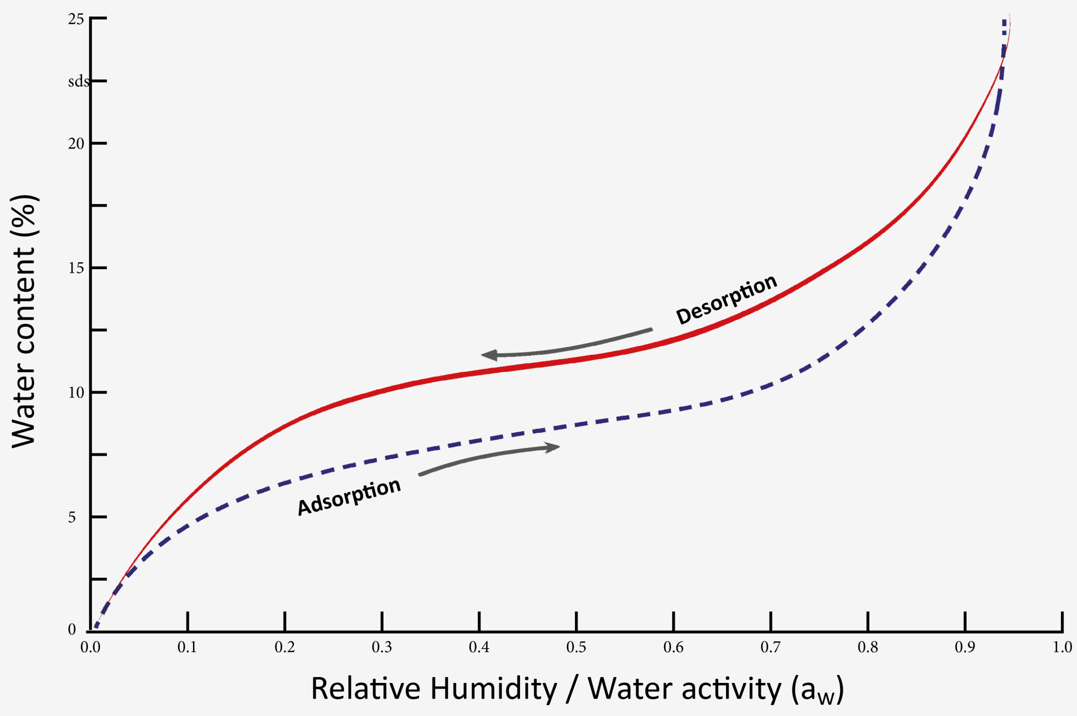
Porous materials are generally more water sorptive.

Polar molecules are more water sorptive.

As relative humidity rises more water is adsorbed than desorbed so moisture content rises.

As relative humidity falls more water is desorbed than adsorbed so moisture content falls.

Water content v's Relative Humidity



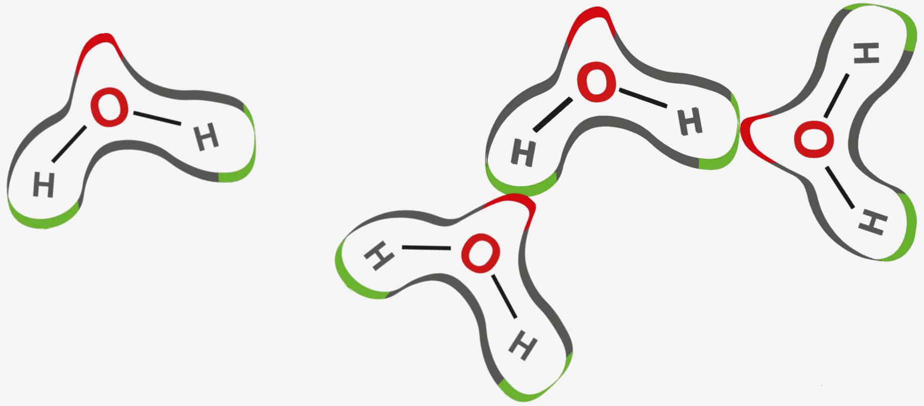
Water Sorption & Bound Water

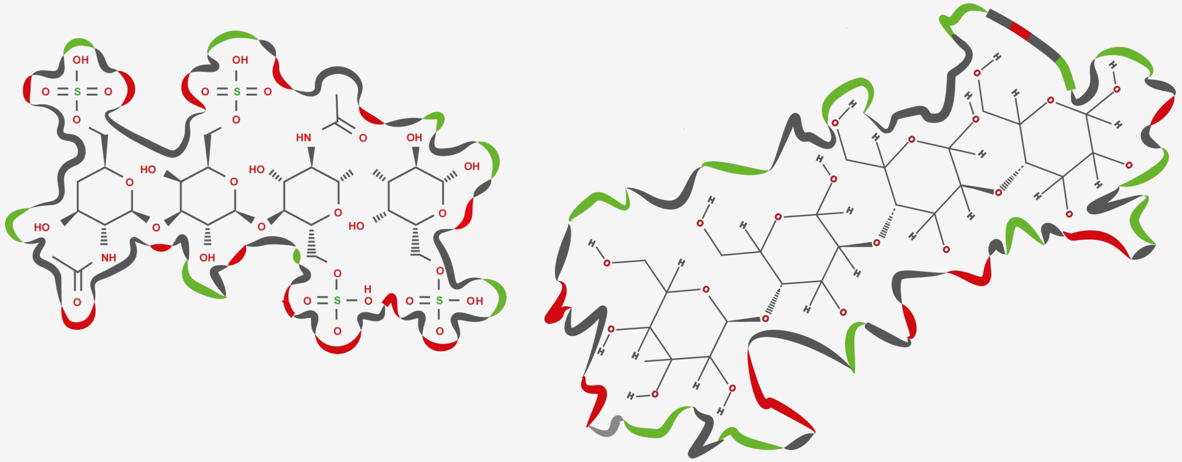
Water molecules have an uneven electrical charge which creates poles like a magnet on each water molecule.

Like magnets, poles like to stick to opposite poles.

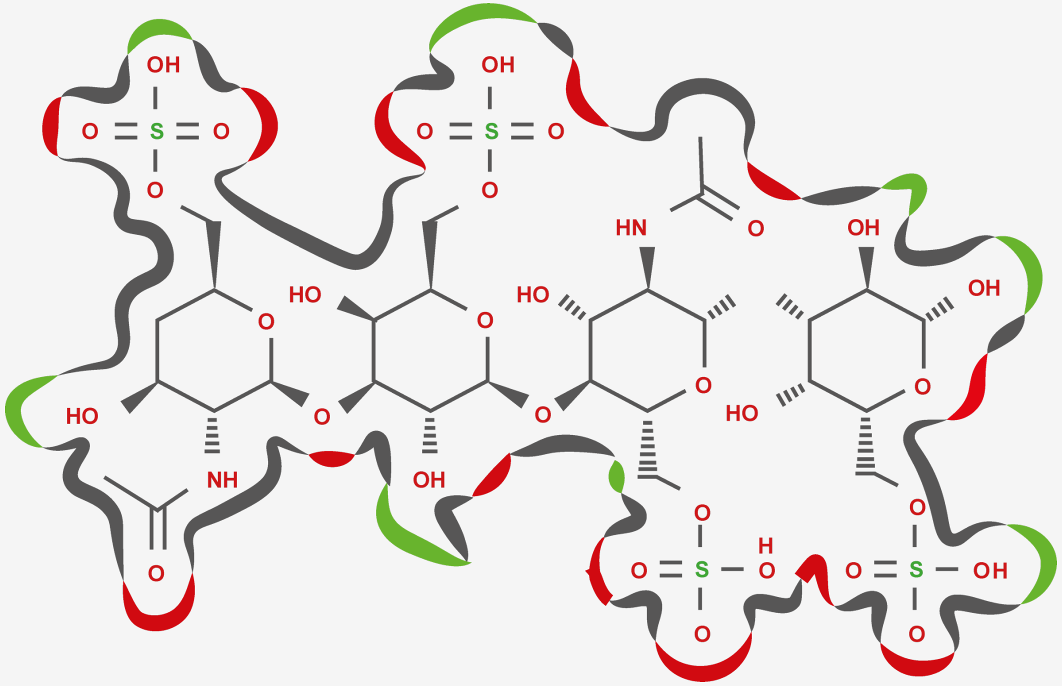
Water molecules can stick to themselves (cohesion) or they can stick to other molecules with uneven electrical charges (adhesion).

Increasing porosity provides more pathways for water to bind to the molecular backbone of a material.

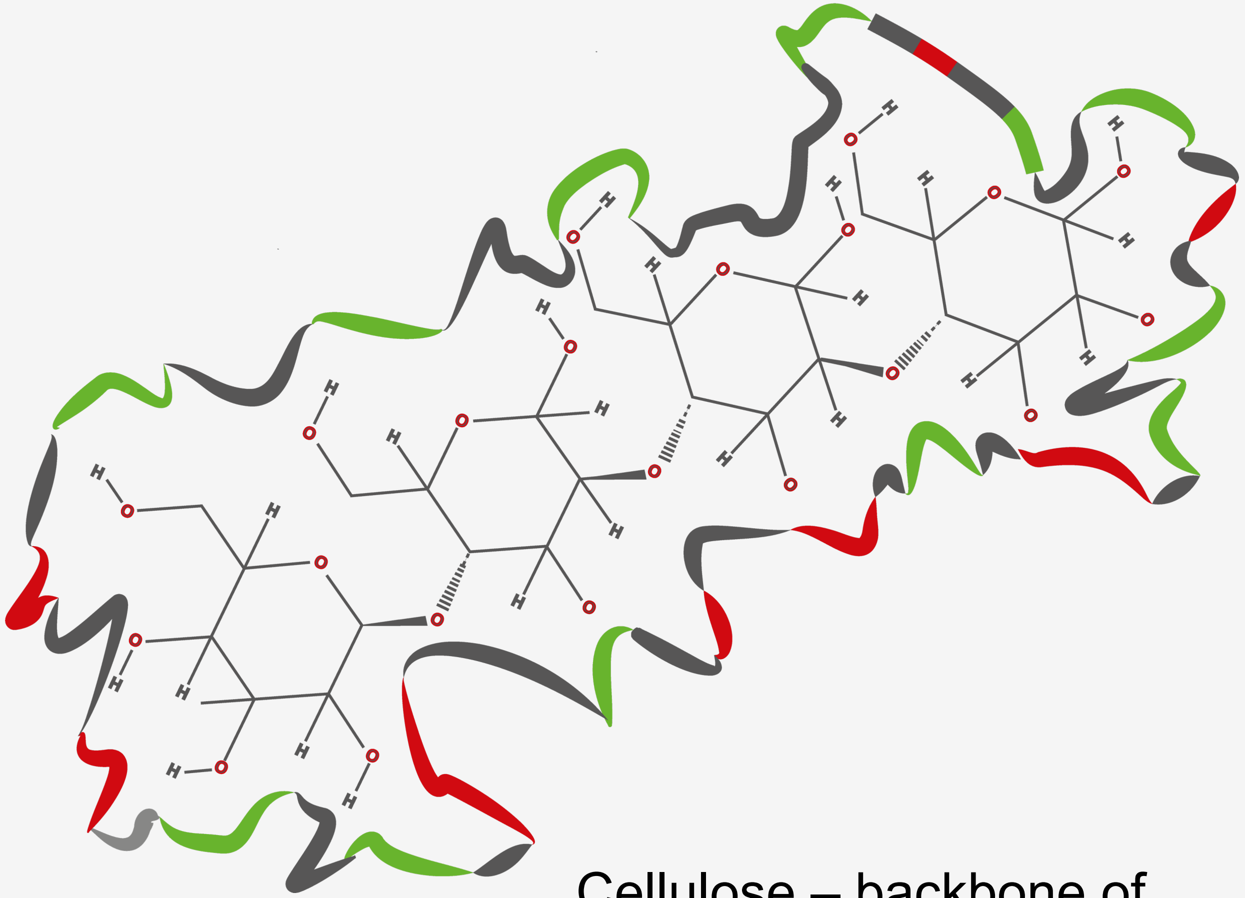




Natural Fibre Backbone



Keratin – backbone of wool



Cellulose – backbone of wood and plant fibres

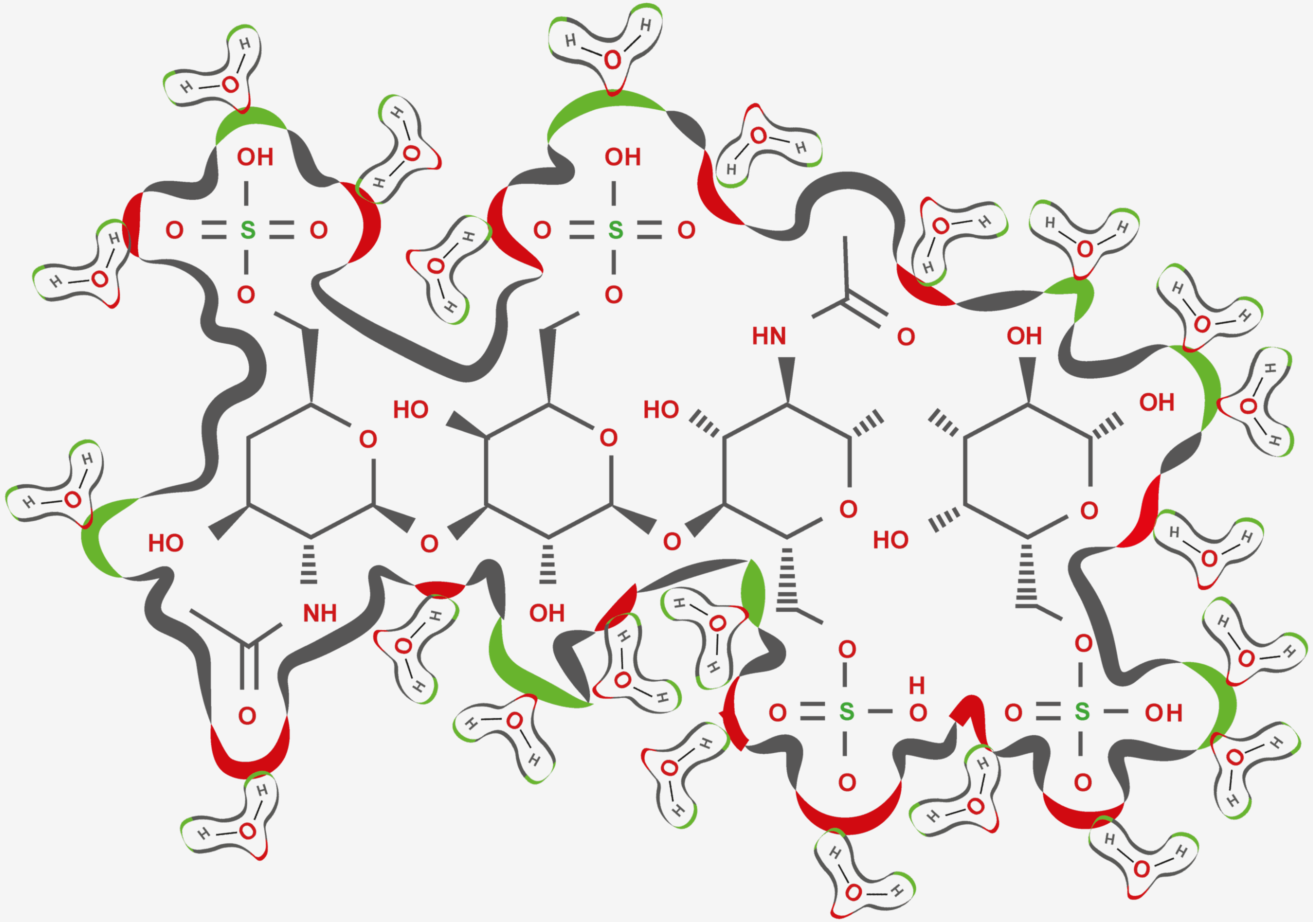
Bound Water – Mono-Layer

Water is tightly bound to fibre backbone.

Can only be removed at RH<30%.

Always present under normal building conditions

Mono-Layer water behaves like a solid not a liquid.

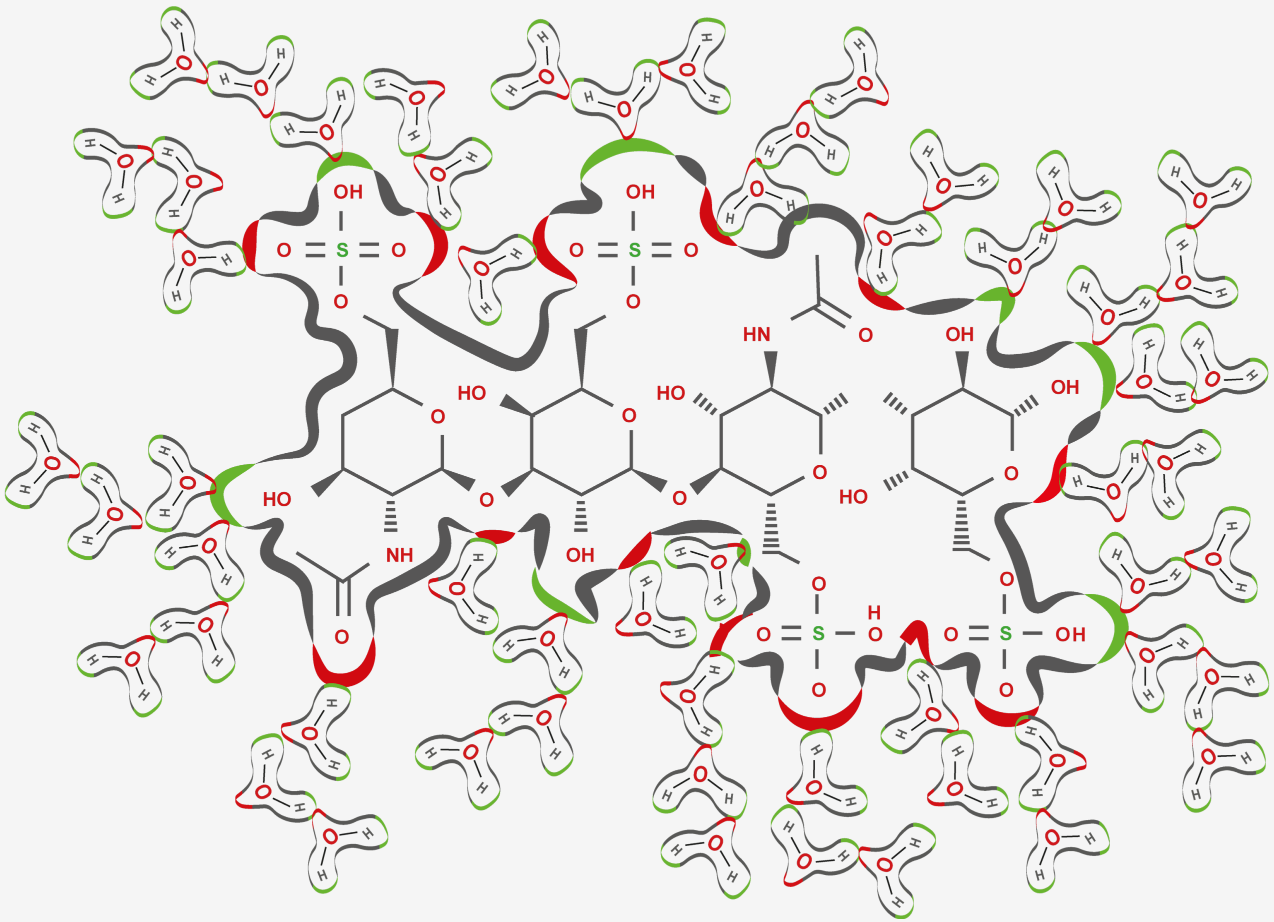


Bound Water – Multi-Layer

Less tightly bound. Water does not behave like a liquid.

Bonds weaken when further away from the backbone and water becomes more free to move by capillarity

Present at RH 30-80% approx.



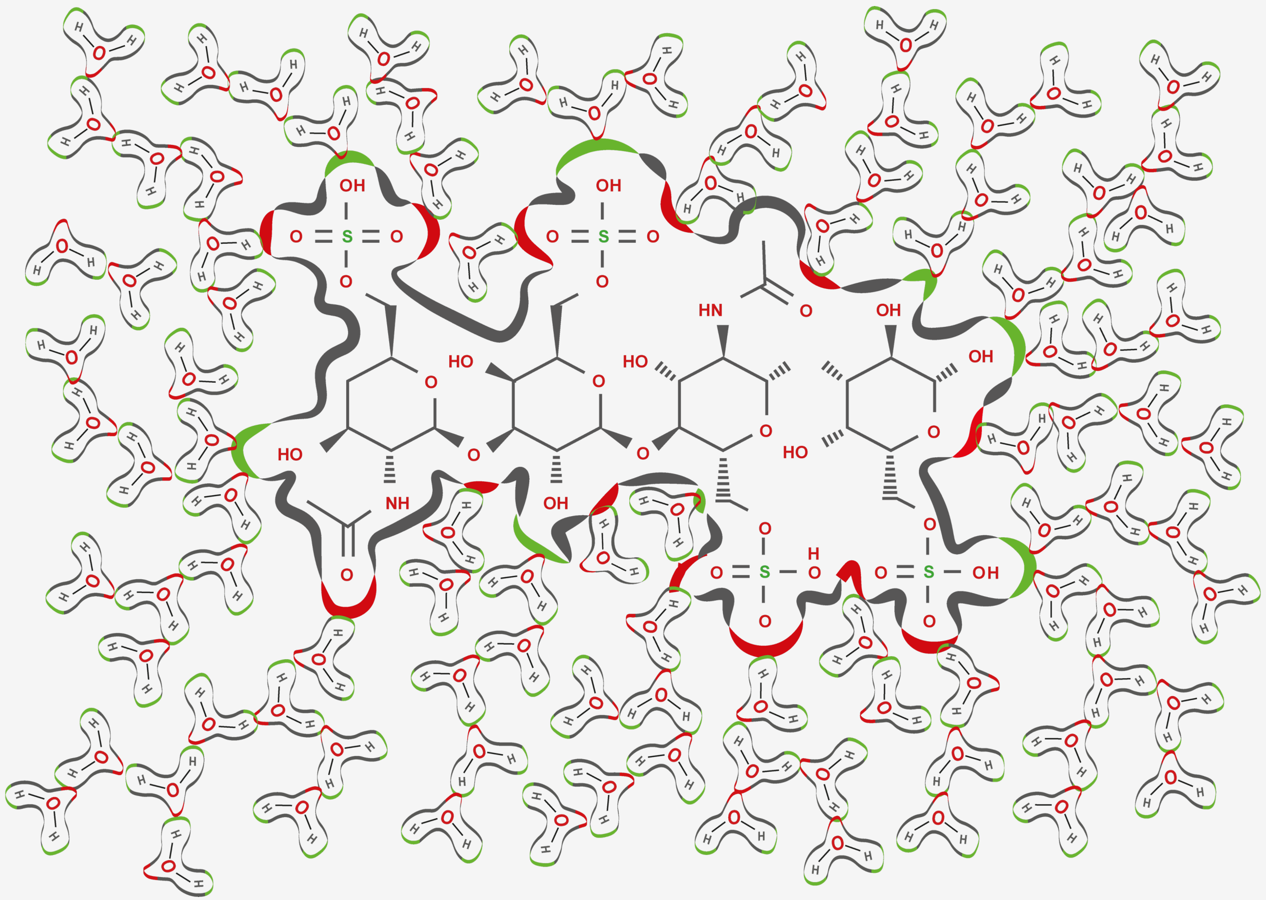
Capillary Water and Free Water

Capillary water is loosely bonded and more free to move.

Capillary water can facilitate moisture movement.

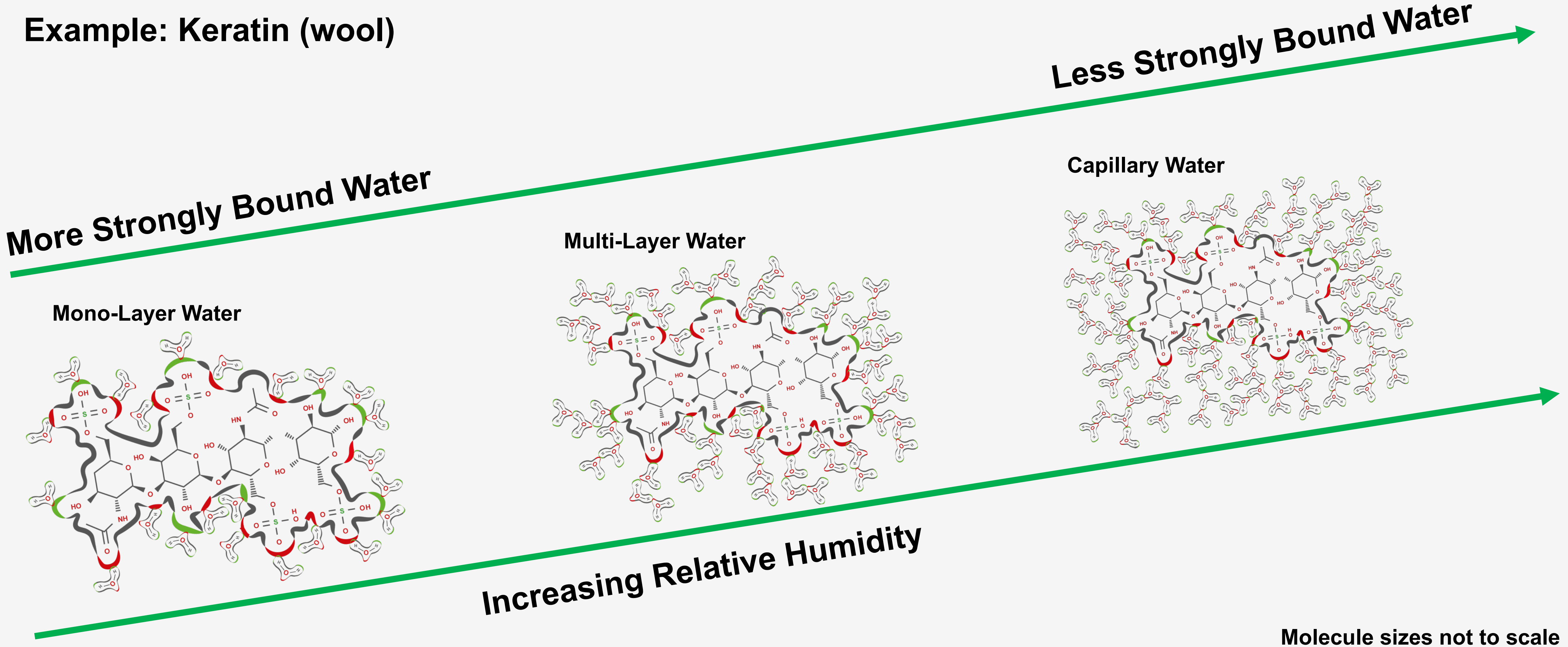
Present at RH 80%+ approx.

At very high humidity the outermost water is free to behave like a liquid (Free Water).



Influence of Relative Humidity

Example: Keratin (wool)



Molecule sizes not to scale

Sorption in Practice – Why Natural Fibres (NFI) Matter

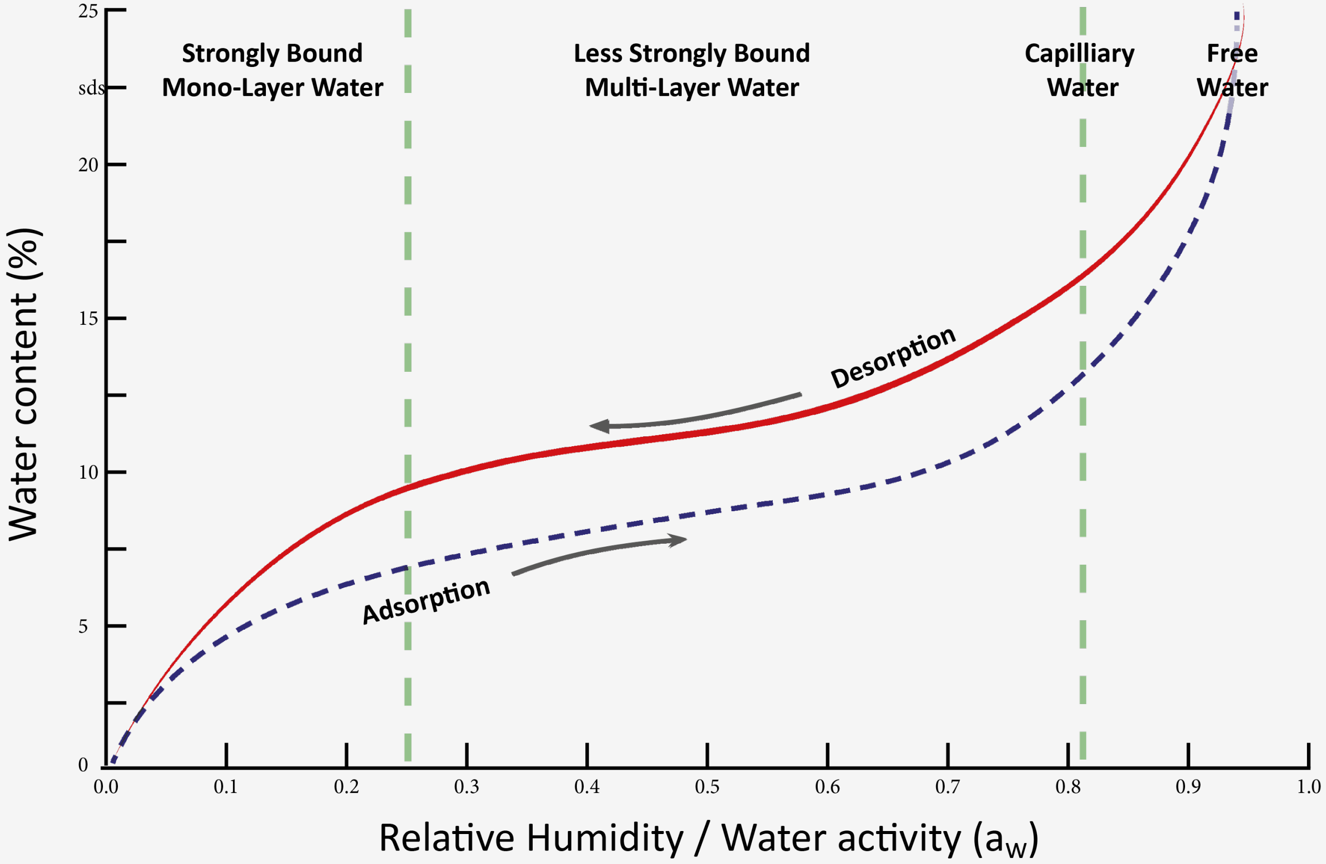
Sorption is an important aspect of a fully functioning breathable structure.

Sorption enables NFI to pull humidity away from the dew point as temperature falls.

NFI forms bound water which is less damaging than liquid water.

NFI transforms the building fabric into a safe moisture buffer.

Sorption is a predictable property that enables accurate modelling.



Thank you

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