Case study: Mould in New Homes

The image below is surprisingly more common than you would expect. This is a brand new home which has not yet been handed over to the new owners.

How Can This Happen?

Framing timber will have been through a lengthy and meticulous treatment process prior to arrival on a building site. From the sawmill, the timber will be graded, moisture tested, vacuum pressure treated with Boron, weighed, packed, wrapped and stored in the yard ready delivery to suppliers. This is a tried and tested system replicated by most suppliers.

The following case study explains the entire process from sawmill through to delivery on site. It clarifies the moisture issues and illustrates that correcting the problem will probably never happen due to cost and practicality. The 'Summary' offers the only realistic solution to prevent mould infesting our homes and buildings.

1.0 **Treatment Plant Process**

The entire process from sawmill through to the wrapping shed is generally undertaken with military precision making it clear that errors are highly unlikely regarding the management of chemical formulas, timber grading and computerised moisture testing systems. There is generally a 'Moisture Control and Mould Remediation Process' also illustrating the level of quality control. The process to this point does not seem to highlight any obvious mould or moisture issues.

1.1 **Storage/Wrapping Shed**

The wrapping or packaging sheds commonly have no walls due to fork-lift access and manoeuvrability of stock. A typical shed would have an estimated eaves height of around 4m as per the image below. This could be a point of consideration for elevated moisture levels within the timber. It is common to find open, block-stacked, strapped pallets located to the very edge of the shed perimeter directly below the eaves line. This will expose the timber to the high climatic levels of RH and certainly increase the vulnerability of direct rain leading to potential moisture ingress, especially during the wetter winter months. Open sheds will allow entry of surface water within the shed, much of which can pool directly below the timber pallets which are only approximately 50-60mm off the ground.

The timber pallets at this point can sit for several weeks directly exposed to rain and frequently in raised humidity depending on location and current climate.

This is the point that the timber is no longer monitored which inevitably places it in a position of vulnerability to increased moisture levels.

1.2 **Moisture Content Readings**

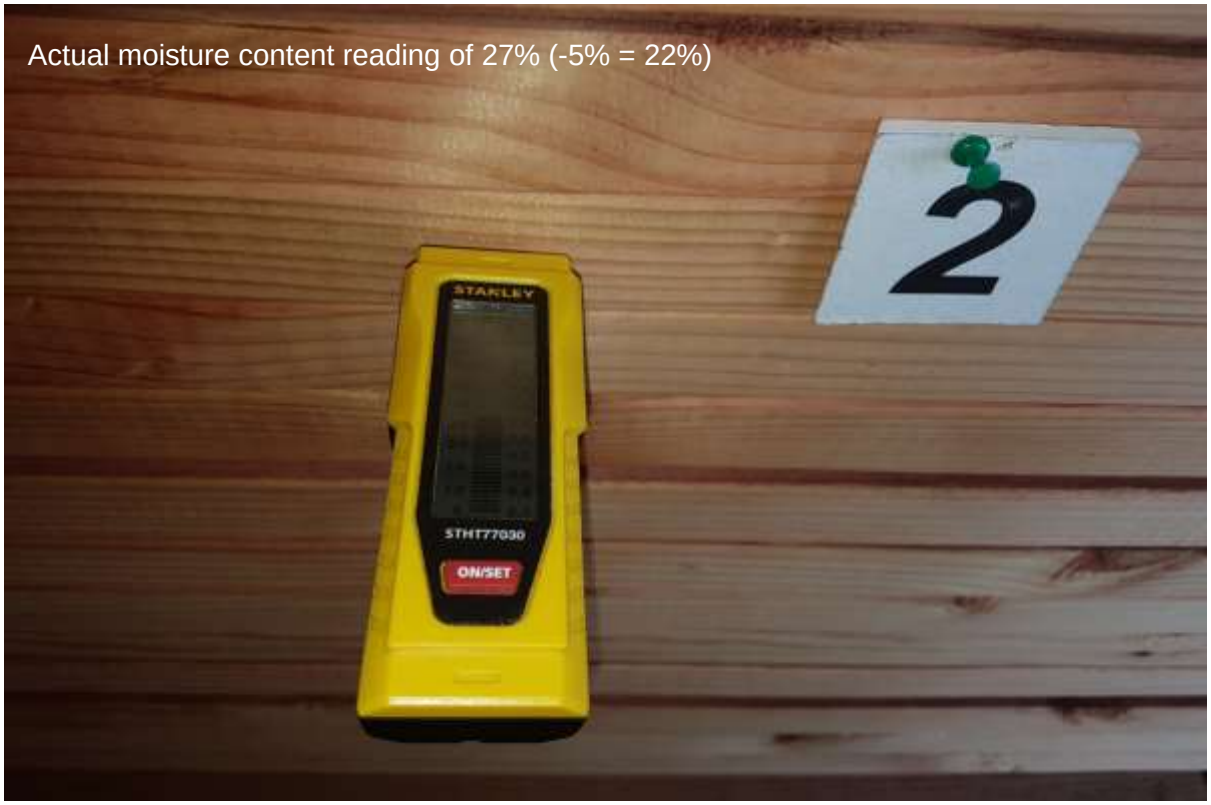
During a recent site visit, moisture content readings were taken and based around the wrapping shed due to the timber at this stage having already gone through the treatment and moisture testing process. It was important to assess the current moisture contents at the pre-wrap stage as no further analysis was required at this point prior to despatch.

Please note that framing timber treated with boron will exhibit elevated moisture meter readings due to the presence of the treatment chemicals. For example a resistance-type meter reading of 24% will correspond to a true 20% moisture content. Wood that is freshly treated may in addition exhibit high moisture gradients that will further exaggerate the apparent moisture content.
Boron treatment applied to wood using a vacuum-pressure treatment process will add an average of 5% to the actual moisture content of the wood. After treatment and on exposure to air, the moisture content will revert to the equilibrium moisture content for those conditions. Drying will not occur to any appreciable extent while the wood remains block-stacked.

This situation does make moisture reading slightly difficult but approximate calculations can be achieved by deducting 5% as illustrated.

Actual MC reading of 25% (-5% = 20%)

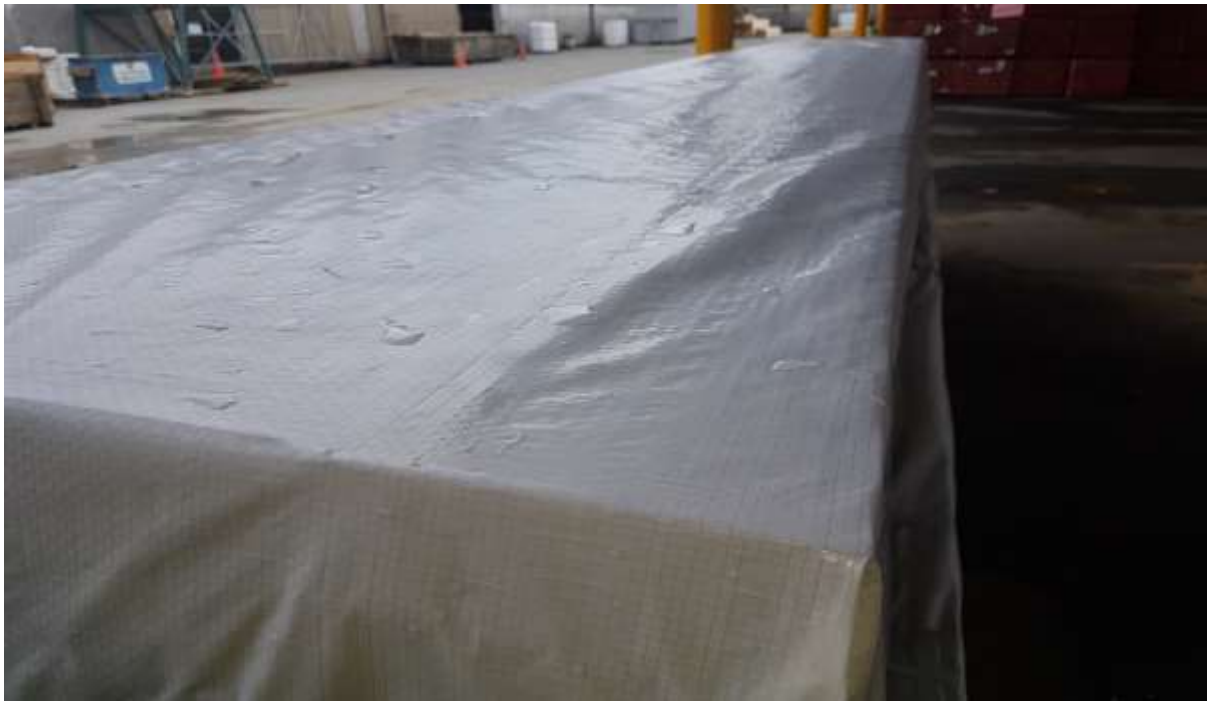
The image above and below illustrates a moisture reading to the end and side of the same piece of timber. It was located centrally within the wrapping shed to the edge of the pallet meaning it would have been generally protected from direct rain but open to RH (Relative Humidity)



Above: Tightly stacked timber with reduced airflow to centre of shed location also illustrating the volume of moisture on the concrete floor slab. Relative Humidity averaging 70%.

Actual MC reading of 40% (-5% = 35%)

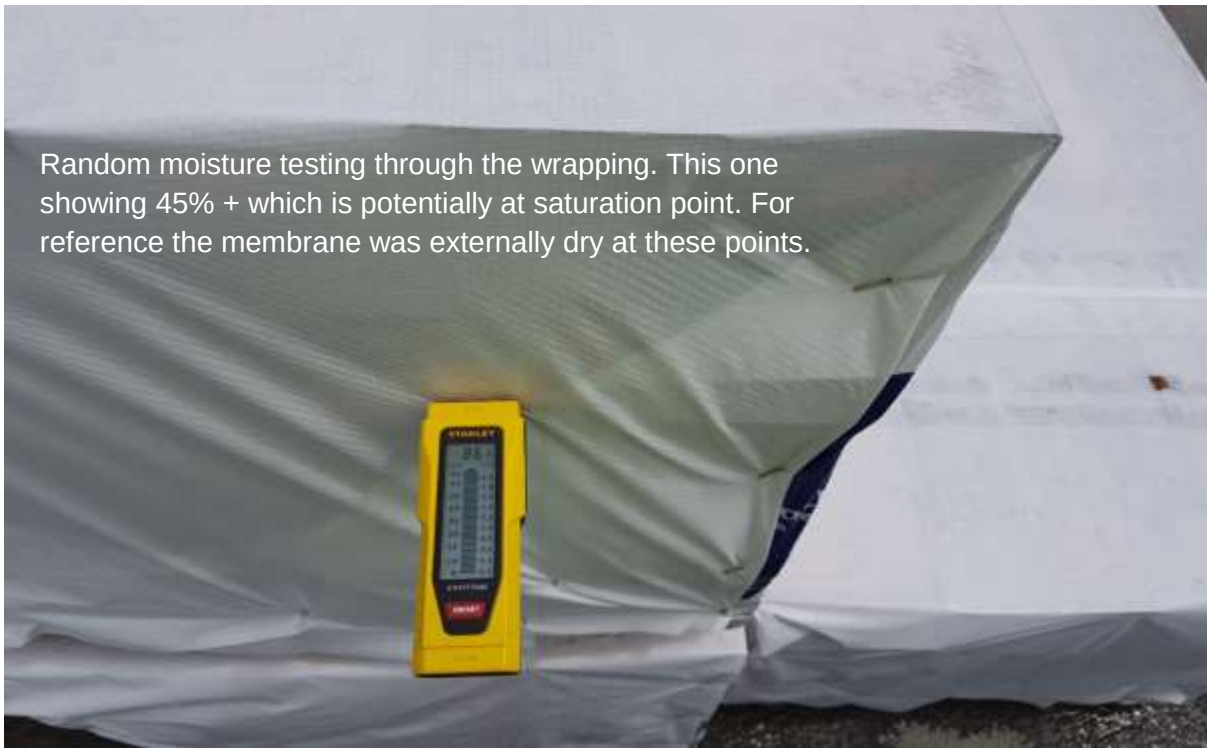
1.3 **Wrapping**



The membrane used for pallet wrapping by the majority is watertight polythene and non-breathable. It is tightly wrapped to top and all side elevations but not the underside. This task is undertaken in the wrapping shed where the stacked timber pallets are generally standing for several weeks depending on current demand. This is the period, especially in the wetter winter months where the moisture content can increase prior to wrapping.

1.4 **Despatch Yard**

The framing timber pallets are now complete and ready for delivery to the building suppliers. These pallets can be frequently standing for several months leaving them open to the elements. This is the point where the moisture issues begin.



Random moisture testing through the wrapping. This one showing 45% + which is potentially at saturation point. For reference the membrane was externally dry at these points.

1.5 **Diurnal Cycle**

The cause of the mould growth is assisted by two issues. A partial increase in moisture levels to the timber will be occurring during the storage of the product in the wrapping shed which is generally several weeks. This increase will vary according to seasonal climate and duration. Once wrapped and stored in the yard for several more weeks, trapped moisture will create condensation within the pallet and increase the moisture content. This is predominantly caused by a 'Diurnal Cycle' which has a more scientific explanation as follows;

Biodet services Ltd: (Microbiologist Consultants) - "All natural commodities have natural water content even when considered dry, and have an ability to release or absorb this moisture dependent on the temperature. They are called hygroscopic materials, such as timber. The level of moisture varies with each commodity. There is a tightly bound fraction of water, which is considered the safe moisture content. Above this level, the water is more loosely bound and available for fungal growth. Fungi have the ability to grow when a hygroscopic material is in equilibrium with air of relative humidity greater than 70%, particularly if there is poor air movement and poor ventilation, such as timber wrapped in polythene.

Diurnal temperature changes also play a part. As the temperature falls at night, loosely held moisture in the air will condense out as dew on the underside of the plastic wrapping and will drip back onto the timber. As morning comes and the ambient temperature rises, this dew will evaporate, but the timber remains damp enough to initiate the growth of superficial, usually xerophilic (able to grow at minimal moisture levels) fungi. At night as the temperature falls the process will be repeated"

1.6 **Conclusion**

Graphic evidence of the 'Diurnal' process illustrating saturated timber below the membrane within the pallet. This is often overlooked as what is occurring inside the thick, white polythene wrapping is not always visually apparent.

Below: An example of the same problem but here we have clear polythene which visually illustrates the effect polythene has on wrapped timber. This image was actually from another case study showing how the timber was wrapped in the suppliers yard and delivered to site.

For reference this timber was not packaged in the yard during wet weather and this was a summer build in Tauranga.

This timber was saturated within the packaging and went on to form mould within the new home prior to lining. This illustrates the moisture issues encountered during the current process from treatment plant to suppliers yard through to delivery on site.

ASSESSOR REPORT

Above – Framing timber being stored in the open yard prior to customer delivery.

Below & right – Different suppliers utilising the same storage methods which appears to be generic throughout the country.

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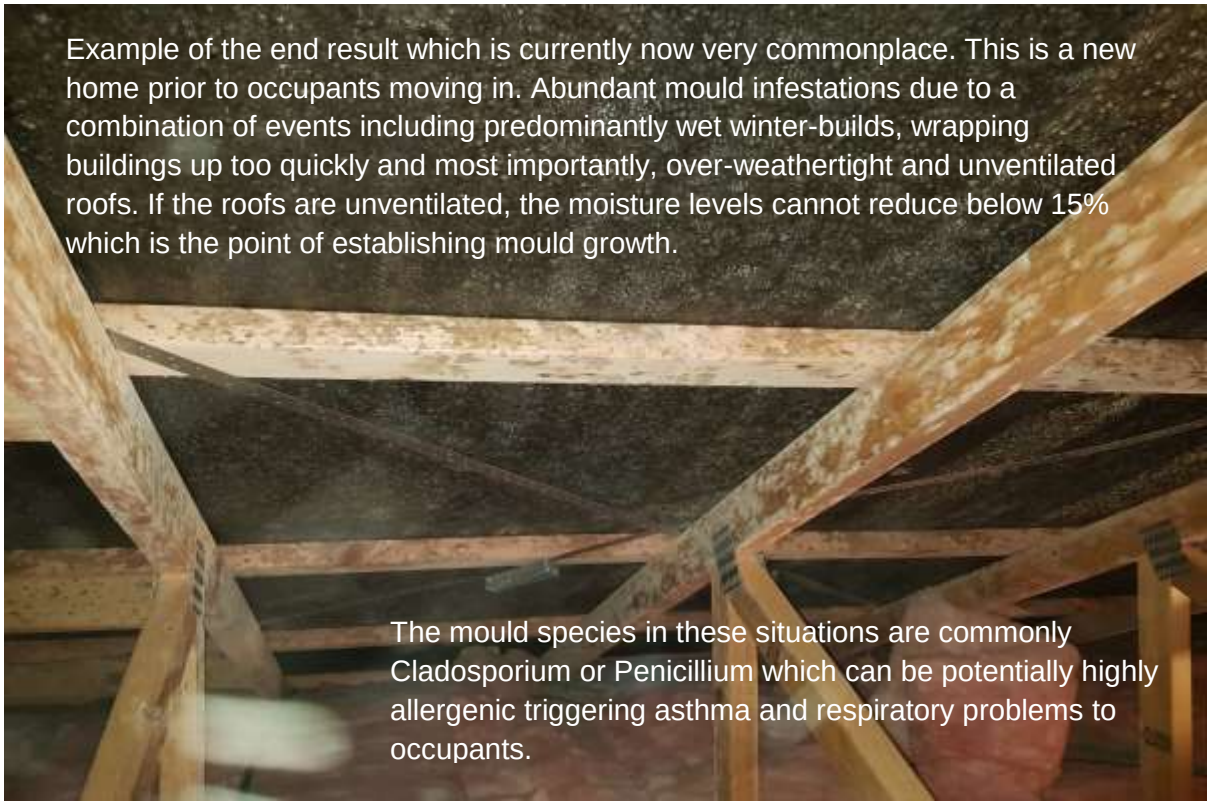
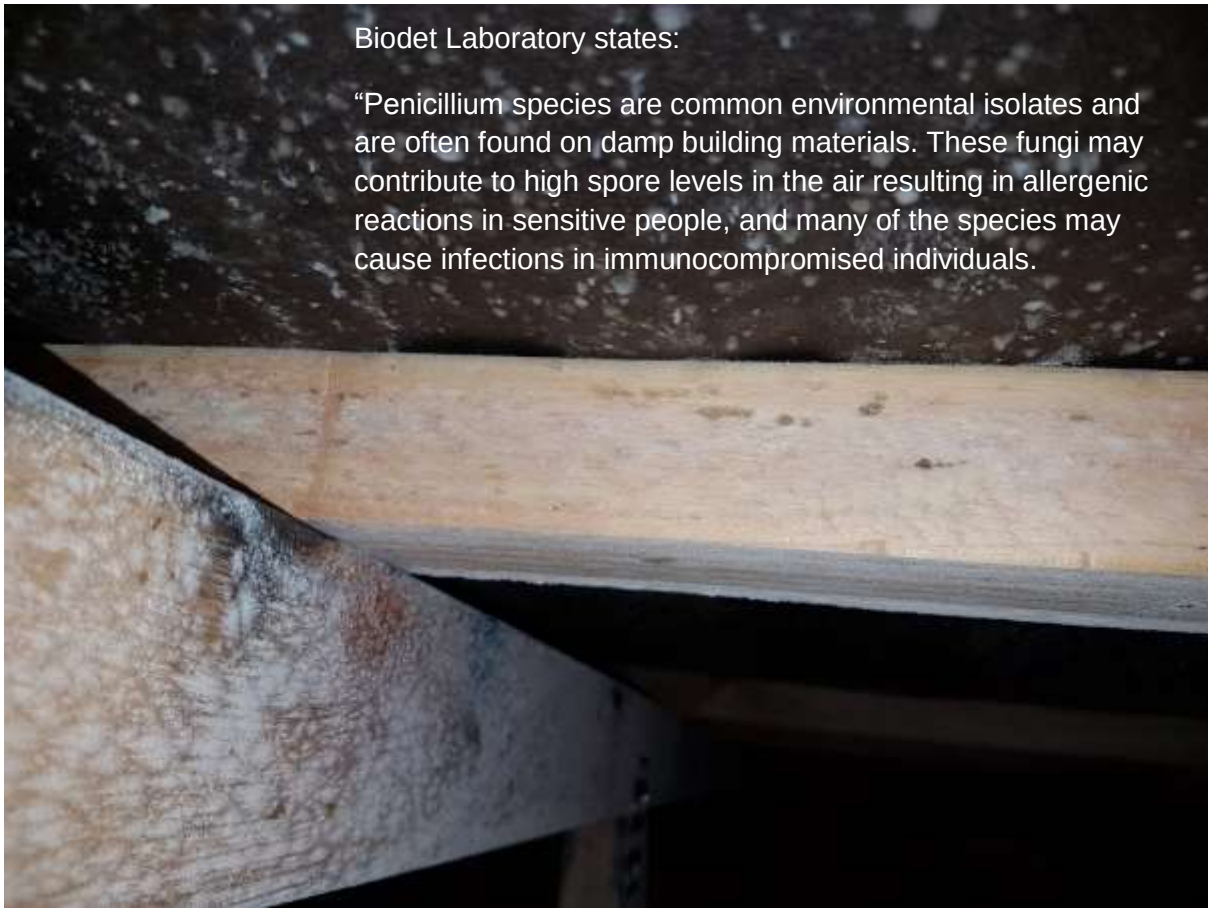
ASSESSOR REPORT





1.7 **Summary**

From the information provided, we know the mould issue commences from the wrapping stage in the treatment plant. This raises a few obvious questions.

Is there a practical alternative solution to polythene wrapping?

Probably not as breathable or vapour permeable membranes will allow moisture into the pallet resulting in the same outcome.

Can the pallets be stored indoors to avoid climate exposure?

Highly unlikely as this would be a costly exercise and not all sites would have the additional room required for such a large storage facility.

Can ‘Mouldicides’ be added to the treatment process to avoid mould growth?

This has already been tried but the longer the timber remains wet, the more dilution takes place making it ineffective by the time the timber dries out.

So how do we prevent the mould growth?

As explained, we cannot change the Diurnal Cycle, the climate, humidity and the suppliers

are probably not going to change their current methods due to cost and practicalities. Consequently we need to look at the end solution.

Boron treated framing timber is used commonly on frames and trusses. These are the two major areas to focus on. If we cannot change the elevated moisture content of the timber being delivered to our sites, we have to at least ensure the moisture levels at pre-line inspection stage are below 15% which is the point of establishing mould growth.

It is a common rule of thumb that 20% moisture content is a ‘pass’ level. In fact ‘Winstone’ Gib board has a maximum in-service moisture level of 16% for their wall product. Biodet can confirm that mould growth can establish on timber at 15% so it would appear that this is the benchmark we should be setting.

New homes are currently being built so quickly that they are fully lined within a few weeks of being wrapped up. Areas of high humidity and the wetter winter builds will experience high moisture levels during the drying out process. An average 200m2 concrete slab will contain over 1000 litres of water which takes 4-6 months to fully dry out. Add to that an additional 250 litres of paint along with the wet trades (tiling and gib-stopping).

Where does this moisture go?

Unlike the USA, Canada, UK and most of Europe, we do no use a vapour barrier on our ceiling linings. This results in the internal vapour rising and becoming trapped in an unventilated and overly-weathertight roof void.

Is there a solution to prevent mould?

The most important solution is a passively ventilated roof as this is the only natural method of lowering the moisture content beyond a point of possible mould growth. This should be the safeguard required if damp or mouldy timber should infiltrate into a new building. Unfortunately the pending changes to the Code of Practice have been ongoing since 2014 and still not yet completed. This change will be ensuring ventilation of roofs is mandatory but due to incomplete testing, only sarked, skillion and flat roofs <5deg will be applicable on release at this stage. This unfortunately will not include ‘Cold Roofs’ as per the images above simply due to current incomplete research.(Note: Cold Roof = flat ceiling with roof void/attic space). Quite clearly from the images above, all roof designs should be passively ventilated as they are in USA, Canada, UK and most of Europe. These nations ensured roof ventilation was mandatory back in the nineties after experiencing the exact same problem.

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