Information Sheet for Damage Management Technicians

BRITISH DAMAGE MANAGEMENT ASSOCIATION

THE PROCESS OF DRYING – Permeance (Part 2 of 3)

The third information sheet in this series will consider humidity in relation to the drying process

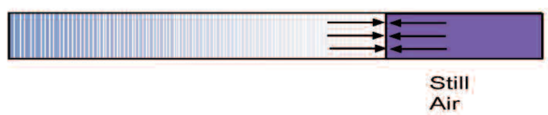
IN CONSIDERING HOW MATERIALS ARE AFFECTED WHEN WET, this second information sheet in the Process of Drying series will assist understanding of how this relates to the 'science of drying' and impacts on the drying process

DRYING SATURATED MATERIALS –1

Like heat, moisture moves from a region of high vapour pressure ('high temperature') to regions of low vapour pressure ('low temperature')

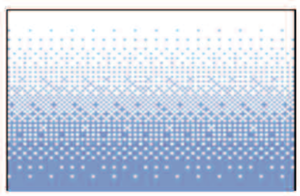
Once all the surface water has been removed from the dry end then moisture will start to diffuse across the material because of the difference in vapour pressures.

But it can't get any 'dryer' than the surrounding air because the vapour pressures in the air and the material will equalise. Like reaching the same temperature.

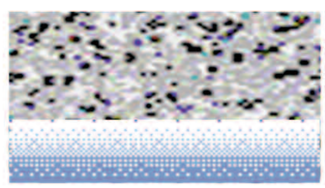


DRYING SATURATED MATERIALS –2

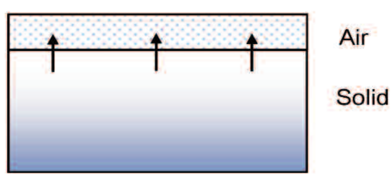
In fine grained materials moisture tends to move by capillary action, like blotting paper, with vapour diffusion close to the surface



In coarse grained materials moisture tends to pool under gravity and then evaporate into the spaces in the upper region. This is why coarse grained material show high levels of RH throughout the structure until almost all the free water is removed.



In both cases the transfer of moisture into the surrounding air will depend on the difference in the water vapour pressure between the air and the material.



PERMEANCE

The permeability of a material is a major factor in the capability and performance of the drying regime adopted by a Damage Management company. The ability of a material to allow water to pass through it also has a direct corellation to the amount of water the material retains in its structure after being exposed to water directly as a liquid, or indirectly as a vapour.

Permeance (perm) is the measure of water vapour flow through materials of specific density.

The lower a material's permeance, the more effectively it will repel moisture. However, once moisture is absorbed its removal will progress at a slower rate than in materials of higher premeance.

Hence the difference in drying times of different materials.

PERMEANCE FACTOR	MATERIAL
Limitless	Air
50.0	Plasterboard
20.0	Plaster on lathe
11.0	Mineral wool
11.0	Hardboard (standard)
5.8	Corkboard
5.0	Hardboard (tempered)
3.8	Expanded polystyrene (beaded)
3.2	Concrete 1:2 full mix 1" thick
3.0	Matt oil based paint 1 coat
2.4	Concrete block
0.8	Brick 4" thick
0.5	Asbestos cement board 0.2" thick
0.4	Concrete 1:2 full mix 8" thick
0.4	200mm masonry
0.4	Plywood exterior glued 0.5"

Take a simple scenario, of a building structure exposed to a ground floor pipe leak that covers the entire ground floor with 2 inches of cold clean water.

Firstly, the textile floor covering (carpet) will react to direct contact with water in the same way as the textiles we wear when they are immersed in a washing machine. The drying capabilities of these types of items, depends vastly on the fibre type and construction/manufacturing methods.

We cannot put them on a spin cycle and tumble dry them. So, dependent on the cost effectiveness, taking into account the effects of shrinkage, these materials will either be removed for restoration/disposal or dried onsite. The ease with which water can permeate these materials also allows the water, as a vapour, to escape quite rapidly and consequently the potential drying time can usually be measured in hours or days as a maximum.

If the floor covering is of a fibreboard construction (laminate type flooring), the permeance levels make the materials react like cardboard, which expands rapidly and the adhesion within it breaks down, hence the general response to this type of material is to remove it for disposal.

However, if the flooring is hardwood plank or block, with lower levels of permeance, then the drying capabilities depend entirely on the fixing method, the sub-floor on which it is laid, the age and condition of both the flooring itself and it's sub-floor and, most importantly, the volume of water or water vapour and the amount and the time it has been allowed to permeate the floor.

The time factor is crucial to all building materials, as the longer the exposure to direct or indirect water or water vapour the more the pressures, by weight or volume, increase the capability of the water or water vapour to permeate into or through the material. Put simply, the longer the surfaces of the material are exposed to water as a liquid or vapour, the deeper the water will penetrate the material.

With this in mind, we can see how the different types of building construction, common in Northern Europe, may require different drying regimes – often with more than one drying technique needed in the same building.

1950s Construction

The post 2nd world war boom in housing produced the 1950's style of construction, which was composed of varying types of building materials with different ranges of permeability.

Once the floor coverings are removed, the base structure of this type of dwelling can be exposed. The most common was a concrete slab (float) of which each 1" depth has a potential permeance of **3.2**, with external 4" brick walls (potential permeance **0.8**), internal walls of concrete block (potential permeance **2.4**).

These walls sit upon the concrete slab (float), then the internal walls are covered in plaster, (potential permeance **20**), with timber skirtings and architraves (potential permeance **11**) fixed to the plaster.

Therefore, depending on the length of time and volume of water to which the building has been exposed, various parts of the structure will be absorbing water at different rates due to the variations in permeance of the materials.

The plaster and timber will quickly allow water into it and through it; hence the bricks, blocks, and concrete slab (float) will eventually absorb the water as a liquid or vapour. This type of building has not only materials that 'wet out' quickly, and can therefore potentially be dried relatively quickly, but also materials that 'wet out' slowly and consequently release moisture at much slower rates.

Modern Timber Frame Construction

In modern timber frame construction, we commonly have a concrete slab (float) laid onto a thermal installation barrier, which could be 1" polystyrene (potential permeance **1.6**). In some constructions the thermal layer is laid on top of the concrete, with a 1" screed or plywood flooring on top, (potential permeance **0.7**). This would then have a timber frame for the internal walls with plasterboard affixed to it, (potential permeance **50**), a layer of mineral insulation, (potential permeance **20**), then the external brick walls and, in some cases, external cladding.

This type of construction will have an external shell with low permeance, and an internal structure with high levels of moisture absorption. This makes the drying capabilities dependant on the structural design, with the potential of extreme differential drying rates.

Victorian Era Construction

The late 19th century terrace, or early 20th century semi-detached in most cases would have had traditional foundations, either dug down to an impervious layer of sub surface, possibly clay, to commence building on steady ground, or to a sufficient depth of footing to lay concrete.

These footings would have then had two walls of brick laid onto them, interwoven or tied together, or with a cavity (gap) between them, (the cavity was designed to limit the amount of moisture transfer from the outer layer to the inner layer).

There would then have been a layer of low permeance brick, and or a damp proof membrane, followed by the remaining courses of 'red bricks' to complete the building.

The flooring would be constructed by suspending timber joists on the inner courses of bricks, with floor boarding laid on them, and lathe and plaster on the underneath of the joists to form ceilings.

The internal partition walls were generally single course brick. Both internal walls and partition walls would have been covered with two layers of plaster, either 'lime' or 'gypsum'. Lime has the ability to allow water vapour to easily permeate through it, without retaining the moisture, whereas gypsum has a high permeance level, but due to its composition readily retains water within its structure.

Here we have some differentials in permeance levels, as well as the possibility of a material that allows a structure to 'breath'.

There is the low permeance levels of the brick, compared to the relatively high levels of the gypsum, plaster on the walls and in the lathe and plaster ceilings, and possibly the added complication of a material (lime), which readily allows water vapour to pass through it. There are also the additional high permeance levels of the timber flooring construction.

Furthermore, a major factor in this type of building construction is the void of air that is trapped under the ground floor, encased by the foundations (potential permeance **120**).

The issues relating to permeance become even more complicated when we examine buildings older than those discussed above, and those that utilise different types of stone as their core building material.

It is clear, therefore, that the ability of construction materials to allow moisture to permeate them, as a liquid or vapour, can have dramatic effects on the drying of the building when it has been exposed to large quantities of water.

For example, where we have a material with a high permeance covering a material with a low permeance (gypsum plaster on brick) the material of high permeance will allow the underlying material with low permeance to literally "dry" through it

CONCLUSION

The different types of materials within a structure greatly affect the speed at which the building dries. These materials not only have different permeance factors they also have different diffusion rates so, with the multitude of different building materials used in Northern European domestic and commercial constructions, a variety of drying techniques will have to be utilised.

A professional damage management company will have the ability to identify and access the necessary drying techniques and equipment needed to install appropriate drying regimes. They will also be able to hire in companies that specialise in a particular drying method.

It is now understood that, due to the complexities of drying different materials within the same structure, there will be occasions where several different techniques may have to be employed at different stages of the drying process.