PAM TIES LIMITED

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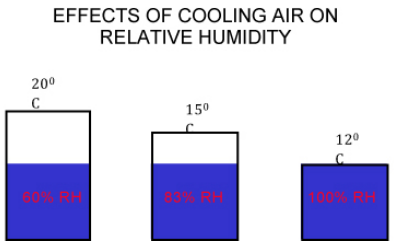
Understanding Condensation and the Internal Environment

It is well-known that surface condensation is the result of moisture laden air coming into contact with a cold surface.

In essence warm air can take up more water vapour then cold air and as such when it is cooled there comes a point where the air can no longer retain the levels of moisture present when it was warmer, and the air becomes fully saturated; any further cooling and the excess water begins to drop out as liquid water (condensate). This can lead to mould growth and increases in other biological agents.



As commented above the amount of water that can be held by the air depends on temperature. How saturated the air is with water is known as the **relative humidity**, thus with a constant amount of water in the air and change in temperature lead to a change in relative humidity. For example, imagine the air as a bucket, the warmer the air the larger the bucket; conversely the colder the air the smaller the bucket. The bucket (air) at 20°C in our example is 60% full with water (a relative humidity of 60%). If we cool the air to 15°C the bucket gets smaller so the same amount of water now forms 83% of its volume (relative humidity increases to 83%). And when cooled to 12°C the bucket is now full (relative humidity of 100%). Any further cooling and the bucket gets even smaller and so the water spills over-this is effectively condensation occurring, the spilled water being condensate. Of course the reverse will also happen - warm the air and the relative humidity will decrease.

It is the above relationship between atmospheric moisture and temperature that can lead to a misunderstanding when considering relative humidity alone in that a high relative humidity does not necessarily reflect a high level of moisture vapour in the air-the air may simply be cold (a small bucket).

However, high relative humidities, irrespective of temperature, and condensation in the domestic environment are important in that they will significantly increase the risk of mould growth, dust mite numbers, and other biological agents which may, if conditions persist, lead to some health problems for some people who are particularly sensitive to these agents.

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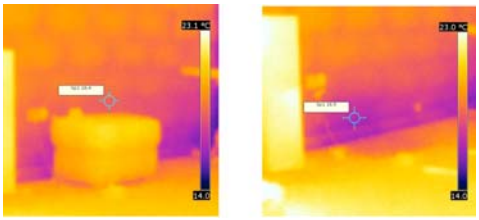
It was found that the winter internal conditions in 'normal' properties, ie, without recorded condensation/damp issues were around an average of 60% relative humidity and less at 20°C. Properties where there were deemed to be problems had high relative humidities (70% plus).

In cases investigated it is not uncommon to find a high relative humidity in problem properties not because of an excess water vapour production from life-style activities but simply due to the property being maintained at too low a temperature. For example, if say the lounge was at say an average of only 16°C and the average relative humidity was 80%, i.e., the risk of mould/dust mite increase was high, we should increase the air temperature to a more reasonable 20°C and assuming no extra internal moisture production, the relative humidity would drop to around 65-66%, a more respectable figure taking conditions out of the 'risk zone' for development of biological agents. If this cannot be done then there is often very little in the way of cost effective alternative action that can be implemented.

A further factor to be considered relates to the boundary layer of air against a structure. For example, external facing walls are typically at a lower temperature in winter than the internal environment. As such the boundary layer of air will be at a higher relative humidity. If sufficiently cold this may lead to 'risk' levels of relative humidity developing in this boundary layer and in the extreme causing condensation.



It has also been shown that the surface temperatures of walls are closely related to internal air temperature - raise the air temperature and the wall *surface* temperature is raised quite rapidly with it. If the air cools then so does the wall surface. Thus maintaining a constant warm indoor temperature raises *surface* temperatures of walls thereby maintaining a lower relative humidity in the boundary layer of air for a given amount of water vapour. However, this appears not to be the case behind furniture and larger items in contact with walls. This is depicted opposite where the piece of furniture has been moved and the lower temperature of the wall behind it is seen as a darker blue area, approximately 2°C lower. Here there is an absence of warm air flow behind these structures to warm up the surface and in these cases the overall wall temperature

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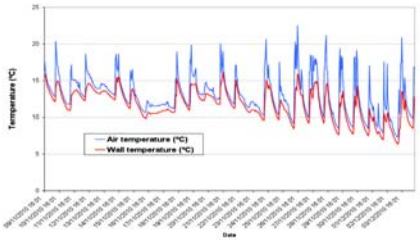
governs the temperature of the boundary layer of stagnant air behind these structures; this leads to colder stagnant air and an increase in relative humidity sufficient to cause mould to develop in some cases.



Similarly problems occur where heating is intermittent, the wall *surface* temperature rising and falling relatively rapidly with changing temperature. So, for example, on entering a house in the evening the heating comes on, the wall *surface* temperatures increase and water is produced by cooking, bathing, and general occupation activities, etc leading to an increase in internal water vapour. This is not a problem in that wall surface temperatures have also increased to prevent an excessively high relative humidity developing in the boundary layer of air. Later, however, the heat goes off, the room and walls cool but water vapour levels often only very slowly decline. Thus the relative humidity in the boundary layer of air increases as the wall surface cools and condensate may form usually sometime after the heat has switched off.

It is also important to appreciate that moulds can develop in some materials without condensation occurring. Some mould will readily developed on some cloths, leather, cardboard at relative humidities of 75-80%; this can lead to clothes and shoes in cupboards going mouldy without condensation occurring. Indeed, the musty odour that sometimes encountered is frequently mould growing in such situations but most not actually readily visible. What mould grows where and when depends on the material (and finish), relative humidity and probably air flow across a particular surface.

So to improve/maintain a suitable internal environment we must ensure that the internal relative humidity does not ideally *persistently* maintain an average much above 65%, preferably lower, during the winter months; this will reduce the risk of mould growth, dust mites and other biological agents developing. Such conditions can be achieved by:

1. maintaining a suitable temperature, or
2. improving ventilation, or
3. a combination of both.

But it must be appreciated that even under such conditions there may be particular cold areas such as missing insulation in roof, cold lintels, etc which will need special attention if condensation/mould growth is to be avoided.