

IMPROVING INDOOR AIR QUALITY - THE BENEFITS OF NATURAL FIBRE INSULATION

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Emerging evidence suggests that relying on ventilation strategies alone to provide healthy air inside low energy buildings is, in many cases, presenting significant risks to the health of occupants as well as the health of the building fabric.

Indoor air and occupant health

Creating and maintaining a healthy and comfortable indoor environment is a complex and difficult challenge. Temperature, humidity and carbon dioxide (CO₂) must be maintained at safe and comfortable levels. Moreover, the introduction of pollutants such as particulates and volatile organic compounds (VOCs) greatly influences indoor air quality. A robust ventilation strategy is clearly critical to CO₂ levels, but the building fabric can play an important role in helping to manage temperature, humidity and pollution levels.

Thermal comfort

Maintaining internal temperature around a comfortable mean is at the root of good fabric first low energy design. In lightweight constructions, some degree of thermal mass provided by the fabric helps to smooth out the internal temperature fluctuations which may be caused by heating systems or the opening and closing of windows and doors, for example. Natural insulations and systems tend to have



high thermal mass relative to other types of insulation. This is due to the inherent physical properties of the cellulose or protein based fibres and significantly enhanced by the presence of chemically bound water contained in these fibres. Water has a very high heat capacity which is twice that of concrete so its presence in natural fibres adds to the ability of the insulation to absorb heat energy.

Summer overheating

High internal temperatures can cause respiratory or cardiovascular problems. Work by CIBSE and Arup suggests that most people begin to feel 'warm' at 25°C and 'hot' at 28°C. Their report also defines 35°C as the internal temperature above which there is a significant danger of heat stress. In vulnerable occupant groups, the impact of overheating can take effect much sooner with potentially much poorer outcomes.

Low fabric thermal mass leaves buildings more vulnerable to uncomfortably high, and in some instances, dangerously high internal temperatures in summer. This problem of summer overheating has been identified, by the NHBC and others, as a particular problem



Woodfibre insulation and lime render installed on Houlston Manor retrofit in Shropshire. (LimeGreen and STEICO)

in buildings vulnerable to excessive heat gain with inadequate ventilation.

High internal summer temperatures are caused by heat from appliances and occupants, solar gain through windows and external heat penetrating through the fabric. It is the latter issue of penetrating heat where the thermal mass of natural insulation systems can delay the arrival of this heat energy so that it is emitted internally in the relative cool of the night. Of course, too much thermal mass will cause this heat to arrive the following day and compound the problem. Perhaps good design with natural systems can hit a ‘Goldilocks zone’ of just the right levels of thermal mass and thermal conductivity.

Healthy internal humidity

Those of us committed to the development of natural insulation products and systems view fabric breathability, or more accurately, the dry transport of moisture, as an important component in overall fabric performance. The ability of natural and hygroscopic materials to absorb and release water whilst remaining dry,

reduces the risk of interstitial condensation and ultimate fabric failure. Natural fibres constantly adjust humidity levels away from extremes of damp and dryness helping maintain air moisture at comfortable levels, reducing the risk of both surface condensation and the negative health risks from moulds, mites and viruses. Of course, fabric breathability is not an alternative to a good ventilation strategy, but should be considered as part of a robust and healthy building strategy.

Internally generated air pollution

Finally, there is a very real and growing problem of indoor air pollution. The problem of poor external air is now well documented with a recent report from the Royal College of Physicians, Every Breath We Take, indicating that air pollution is leading to an estimated 9,500 annual premature deaths in London alone. The report authors recognise the current lack of focus on indoor air. Nonetheless, clients and designers can have significant influence over VOC and particulate levels by selecting low or zero emission products and systems.

Conclusions

Buildings should be considered not as standalone discrete entities, but as part of a system in constant and dynamic interaction with people and the environment. This interconnectedness means benefits, problems, solutions and consequences cannot be effectively addressed in isolation. If we adopt this broad and holistic approach, the benefits of natural insulation products and systems will come to the fore, and we should then expect the rate of market uptake to accelerate dramatically.