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Materials impact air quality

By Deborah Singerman

O SAY that a building makes you sick does not raise eyebrows anymore. Employers increasingly realise that productivity improves if workers are neither too hot, nor too cold, can breathe easily and see well without glare or frown.

Potential productivity gains in Australia from improved indoor environments include $1-2 billion for reduced respiratory illness and up to $15 billion for better work performance from improved thermal comfort, lighting and acoustics.

Indoor air quality (IAQ) has become a public health issue and a growing commercial and legal liability for building owners and managers who fail to provide a safe working environment including control of air to occupants of commercial buildings, says the Cooperative Research Centre (CRC) for Construction Innovation, whose website charts the issue (www.construction-innovation.info).

Currently, designers try to minimise potential IAQ impacts of new building materials and contents by selecting low-emission materials. These materials are not always available, however, and even when used their aggregated pollutant concentrations are generally overlooked.

Equally, the supply air may be contaminated with fine particles and toxics in city centre buildings or from formaldehyde and volatile organic compounds (VOCs) from building materials, contents and appliances during and after construction or renovations.

All of these factors have different impacts on IAQ according to construction cycle time, building site and design, building operation and different players throughout construction work.

The CRC's new prototype office design tool, IAQ Estimator, begins to address the long-term implications of indoor air pollutants by estimating their concentrations at the design stage, based on emissions over time from large area building materials, furniture and office equipment.

The prototype software combines existing indoor air quality measurements, product emission and ventilation/filtration data into a practical model for estimating the indoor air quality of indoor spaces, again over time. It allows control of indoor air pollutants from new materials aimed at the first six months of construction, documented at one day, three days, seven days, 14 days, 28 days and six months.

IAQ Estimator has a database of air pollutant emission rates for common, fixed, large surface area building materials and contents such as paints, adhesives, floor coverings, plasterboard and reconstituted wood-based panels and office furniture. It considers some 20 VOCs including formaldehyde, and airborne particles from these materials and from office equipment such as computers and copiers/printers, and the contribution of outdoor urban air pollutants – air intakes from outside a building – by location and ventilation system filtration.

Estimated pollutants are for a single, mixed, mechanically ventilated zone in an office building with acceptable pollutant levels derived from Australian and international health-based standards; pollutants were not included if such standards were not available.

It uses this database to estimate the effects of different ventilation scenarios on indoor air quality for the office zone in a 3D CAD model. (The IAQ Estimator acquires its dimensional data for the indoor spaces from the CAD model via industry standard Industry Foundation Class files.)

IAQ Estimator will also estimate submicroclimate particle levels and urban air toxics in mechanically ventilated office buildings for different levels of urban air pollution, particle emissions from copiers/printers, and ventilation/filtration systems. It integrates these factors for estimating indoor air pollutant levels within a building zone directly from materials information available in a 3D CAD model or from information input manually.

With the emphasis on measuring construction materials used over large areas and over time, construction work is going to be affected by the specification and final selection of these materials, says the CRC's Chief Operating Officer, Research and Commercialisation Peter Scuderi. "It will impact on how a building is built and used."

As with all CRC research projects, partners are from academia, government and industry, in this case: CSIRO, Queensland University of Technology (QUT), Queensland Department of Public Works, Woods Bagot and Brisbane City Council.

Specific data was collected for one test building and, as currently available, the IAQ Estimator is considered a proven concept tool and a significant step towards a commercial product.

A background paper from CSIRO Sustainable Ecosystems (Selwyn Tucker, Stephen Brown, Stephen Egan and Fanny Boulaire) and Lidia Morawska and Congrong He from QUT's International Laboratory for Air Quality and Health reveals IAQ Estimator's potential scope.

"A method for predicting optimised indoor air quality and the use of appropriate performance measures are key prerequisites for developing a building code for indoor air quality, and to provide estimates of indoor quality from which environmental and occupant health consequences can be minimised."

The paper also indicates areas for further product emission testing that could be expected to have implications for commercial fitout and construction work. These include water-based and low-emission paint on plasterboard; carpet adhesive emissions as part of a carpet/underlay/adhesive system; and long-term emission data for MDF and particleboard.

Scuderi says a plasterboard manufacturer has already


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expressed interest in looking at the tool to see how it might measure the impact of its product on IAQ, but "we still want to improve the tool and it is early days yet".

Council House 2 has received 18 awards since opening. (© City of Melbourne)