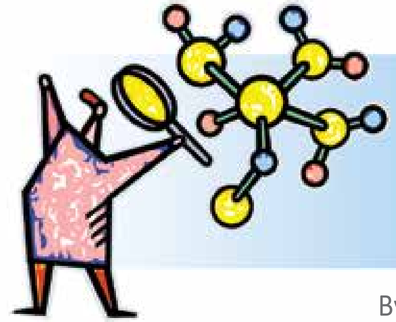
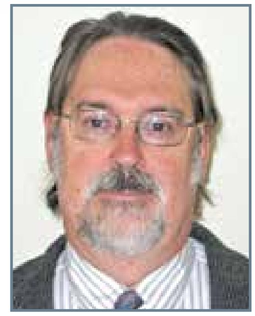
Pushing The Envelope



Basic Research NEEDED

By Dr. Richard E. Norris, RRC, PE



Basic research is essential to our success as building envelope consultants. The requirements for our materials and systems are changing, and we must understand the new materials in order to use them intelligently.

Our ability to determine which roofing and waterproofing materials will work reliably for the decades for which we design our roofing and waterproofing systems depends upon knowing the basic physical and chemical properties of the materials and how they perform in service. What do we know about them? In recent years, there has been almost no basic research on the materials we use.

We are asking more of building envelope materials and systems than we did just a few years ago. We expect them to last longer, and we employ them such that there is less air movement across the assembly. How do we know that all of the materials will last under these conditions? What changes do we make to building physics to meet today's design requirements, and how do these changes affect the performance of the building envelope systems?

The accumulation of condensed moisture under cool roofs is one such issue. To understand it, we need to know some basic physical properties of the materials in the roof assembly: density, porosity, thermal conductivity, permeability, etc. If we understand these properties, we can model the systems and predict whether they will cause the building to "self compost." This is particularly crucial when we replace a "hot" roof with a new "cool" roof.

Researchers at Oak Ridge National Laboratory (ORNL) are building an extensive database of materials for the WUFI (Wärme und Feuchte instationär, translated as transient heat and moisture) program. This will allow us to analyze the system at the design stage, before installation. It will help us to know how much insulation to install, where to install it, and whether or not to ventilate. The airflow in the attic space is not yet well understood. Researchers are working on this. Forced ventilation can be modeled in WUFI, but passive ventilation modeling is difficult, at best.

The best way to know how long a material will last in a particular assembly, in a particular environment, and at a particular location is to build it and watch it. But we seldom can wait 15 years or longer to see if the new material will actually last in service. So we must make some assumptions based upon our experience with similar materials in past assemblies. Unfortunately for us, this offers only limited assurance of a new product's performance; and every time the manufacturer changes the formula, we have a new product.

Some changes in products are forced upon the manufacturers by government and/or environmental legislation. The reduction in volatile organic compounds (VOCs) is one example. Another is the trend to utilize reflective (cool) roof surface materials. Still another is the change to alternative pressure-preservative chemicals for wood. When the new pressure-preservative chemicals first came on the market, we did not know that they would cause rapid corrosion of the fasteners we use to secure the wood to the framing. We are starting to see similar failures due to the accumulation of condensation.

What are we to do? Not every consultant has a chemist and an engineer on staff, as well as a testing laboratory. If we did, we would have difficulty convincing our clients to pay for the time and expertise to test and analyze the new materials.

Can we rely upon the manufacturers of the new materials to tell us what their materials can do? My experience is that they either do not know the material properties we need in order to run WUFI, or they will not share them with designers if they do know them. I am sure that they do not know how long their new materials will last in service, either. We do not have a reliable, generally accepted accelerated weathering test for building envelope materials.

When I entered academia, this was to have been my life's work. Unfortunately, I was unable to find funding for my research and lost my faculty job for lack of research publications. The basic research in this area would include development of test methods to quantify and model the mechanical behavior of materials. Then, the change in mechanical behavior (and chemical composition!) during aging could be measured. This would allow comparison of changes in service with those in accelerated weathering tests, permitting us to predict how long new materials should last in service.

We need an investment in basic research to enable us to analyze new materials and make informed decisions about their probable performance and durability in service.

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