Cellulose Insulation

We studied the moisture performance of cellulose insulation to see how it compared to fiberglass and rigid foam, other common types of insulation.

Our main question was how it would handle moisture in the extreme climate of Interior Alaska. First, a quick refresher on the moisture behavior of walls. A conventional wood-framed wall consists of 2x6 or 2x4 studs with an interior vapor barrier. This system has historically worked in the Interior because the vapor barrier limits the amount of moisture allowed into the walls, and moisture that does sneak in remains frozen through most of the winter. During the spring, the walls thaw and dry to the outside.

But when you add exterior foam insulation to a house, a common technique used to save energy, you block the drying path to the outside. Is this good or bad for the wall? Depends on how much you add.

If you add enough exterior insulation (for example, six inches of EPS foam for a 2x4 wall) the wall framing and sheathing will stay warm enough to avoid condensation, improving your overall moisture control. If you don't add enough, however, you move your wall sheathing into the danger zone—above freezing and very humid.

We know how fiberglass and rigid foam perform in various wall designs, and how to avoid moisture problems when building or retrofitting (http://www.cchrc.org/safe-effective-exterior-insulation-retrofits).

This latest study looked at the performance of cellulose in different wall scenarios over an 18-month period. These were not standard walls—we intentionally left out a vapor barrier because we wanted to force moisture into the walls.

Cellulose insulation is made primarily of recycled paper. A locally made, rather inexpensive product, it has recently become more popular in the Interior. "Dense-pack" cellulose is blown into a wall to a density of 3.2 pounds force per cubic foot, which is designed to prevent the insulation from settling over time. Dense-pack cellulose has an R-value of 3.7 per inch—slightly higher than fiberglass batts and slightly lower than EPS foam.

Our study shows that cellulose can handle moisture better than fiberglass or EPS insulation, when used properly. The test wall that used cellulose as both interior and exterior insulation maintained lower humidity levels (and was less likely to condense or grow mold) than the test wall that used interior fiberglass and exterior foam.

That can be partly attributed to the material properties of cellulose. Dense-pack cellulose is actually less permeable to airflow than fiberglass batts. So when used as interior insulation, it reduces the amount of moisture that migrates into the stud cavity.

Cellulose also has the ability to absorb and release water vapor, allowing it to moderate moisture levels within a wall and prevent the large spikes in relative humidity that cause moisture damage.

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It's also more permeable to water vapor than EPS or XPS. The test wall with exterior cellulose had lower humidity levels than the wall with exterior foam, because it allows faster drying to the outside.

Based on this study, dense-pack cellulose can provide a good option for exterior insulation beyond rigid foam board. In future studies we plan to look at the minimum amount of exterior cellulose needed to keep the sheathing warm and dry.

Read the report at http://www.cchrc.org/sites/default/files/docs/CelluloseSnapshotFinal.pdf