



Research & Development Highlights

Technical Series
90-240

Wet-Sprayed Cellulose Insulation in Wood-Frame Construction

Introduction

Cellulose insulation is usually installed dry in horizontal cavities such as attics. Manufacturers claim it can be used in vertical cavities with an adhesive binder if water is added as it is blown into the cavity. The water activates the binder, which sets the cellulose.

Manufacturers claim wet-sprayed cellulose insulation is cheaper to install and works better than glass-fibre baus because it leaks less air, transmits less noise and does not absorb as much moisture. They also claim that the water will not damage wood framing and sheathing.

CMHC commissioned a test project to evaluate these claims. The project's objectives were to determine:

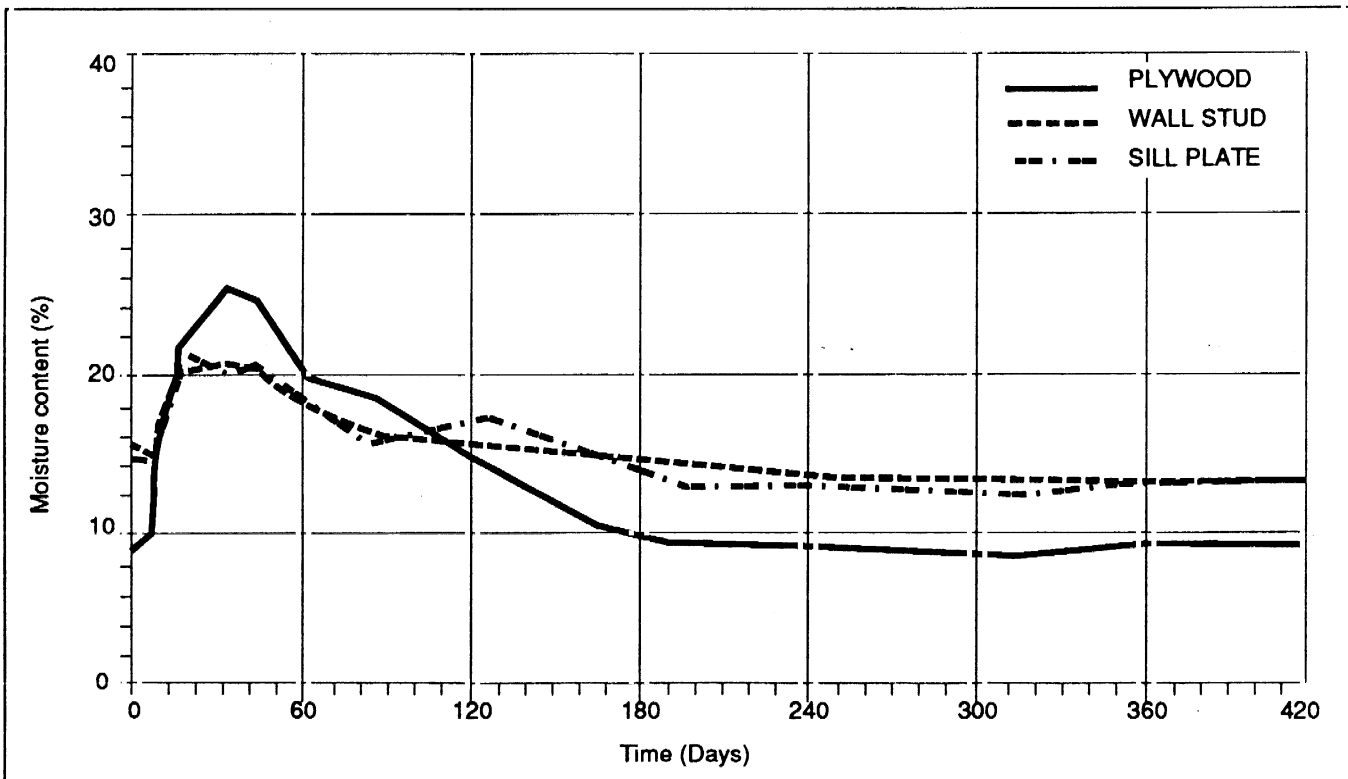
the drying rates of building materials surrounding the cellulose insulation;

- whether building materials would suffer moisture damage; and
- whether cellulose insulation would be an effective air barrier

The Test House

Testing took place in a two-storey, detached wood-frame house in Alberta. The house was built to R-2000 airtightness standards. Its attic and subfloor rim joist junctions were not gasketed and its electrical outlets were left unsealed so that the tests would show how airtight the cellulose alone would make the house.

Dry-blown cellulose was installed in the ceilings and wet-sprayed cellulose in the walls and rim joists. To evaluate the effects of different construction techniques, the south wall of the house included four sections:



Average wall moisture contents

- standard construction;
- standard construction without a polyethylene vapour barrier;
- standard construction without a polyethylene vapour barrier, and with several 25 mm vent holes through the exterior wall (maximum ventilation through the wall); and
- standard construction with a tightly sealed cavity (minimum ventilation through the wall).

Moisture and temperature sensors were inserted in sections of the north, south and east walls.

Findings

Wood Moisture

Sections of the frame adjacent to the dry insulation showed normal absorption and drying rates. After the wet-sprayed cellulose was installed, the plywood's sheathing moisture level increased to 26% after 30 days, decreased to near original levels (15%) after 160 days, and dried 1% more by the end of the test (420 days).

The framing timbers' moisture level increased to 22% in the first 10 days, dried to slightly over original levels (9%) after 80 days, and then dried 3% more by the end of the test (420 days). From these observations, the study concluded:

- plywood absorbed more moisture and dried out more quickly than framing timbers; and
- wall and sill timbers had similar absorption and drying rates.

Moisture Damage

The study looked for four kinds of moisture damage:

Corroded metal fasteners

Siding nails tend to corrode, so galvanized nails were used and the siding was made as watertight as possible. About 30% of the siding nails examined were at least partly corroded, especially where they penetrated wood, because both the nails' protective coating and the amount of moisture varied.

Wood fungi

The cellulose insulation contained a wood fungicide, but traces of fungi were found in the north wall between the plywood and the framing timber. The fungicide probably did not reach this location because it had no direct contact with the cellulose.

Shrinking and Warping

Saturated wood usually returns to its normal dimensions when it dries. The wall timbers did not shrink or warp abnormally.

Deteriorated bonding in plywood

A year after the insulation was installed, the plywood panels were firmly bonded and apparently unaffected by moisture.

Airtightness

When the house was fully constructed and still very wet, researchers measured a rate of 1.58 air changes per hour (ac/h) at 50 Pa

During the year, tests found air change rates of 1.95, 2.01 and 2.00 ac/h, at 50 Pa. Where rim joist cavities were completely filled with cellulose, very little air leaked from the duct openings. In the walls, only electrical outlets showed any trace of air leaks.

Pressure drop tests were used to determine which wall components blocked the most air.

The plywood exterior sheathing was the principal air barrier, followed by the gypsum board, polyethylene and cellulose. The joints in the sheathing, originally 3 mm wide, had swollen almost tight; this increased the plywood's airtightness. Wing holes in the interior gypsum board interconnected many cavities and reduced its airtightness. If the electrical outlets had been sealed or the plywood joints made a little looser, the results of these tests might have been different. The cellulose was not very effective in reducing air flow.

Occupants' Comments

The occupants of the house made three major comments:

- Heating costs were low during the year of the test.
- The house was quieter than any other they had lived in.
- The cellulose insulation in the basement should have been covered to protect it and prevent the release of cellulose fibres into the air. Cellulose fibre is not known to be harmful, but the insulation binder could contain chemicals which might be.

Conclusions

- Wet-sprayed cellulose insulation nearly saturates wood framing, but within six months the framing will dry almost to the level before installation, even during winter.

- **Sill** plates and wall studs gained and lost moisture at about the same rate. This suggests that most of the sprayed moisture did not drain through the sill plates.
- The insulation dried faster in the wall sections where there was high ventilation and no polyethylene. Insulation exposed to the indoors dried faster than insulation in closed-in cavities.
- The drying rate was affected by air temperatures, humidity, ventilation of the insulated cavity, orientation, time allowed before installing gypsum board and other construction conditions.
- One year after construction, the house had deteriorated little. Some nails were slightly corroded and a few fungi were found in one wall.
- Cellulose insulation is not an effective air barrier.

Project Manager: Norbert Koeck

Research Report: Field Monitoring of Cellulose in Walls—Edmonton

Research Consultant: Building Envelope Engineering

A full report on this research project is available from the Canadian Housing Information Centre at the address below.

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