FOAM TYPE INSULATION USED AT HETTINGER AND LANGDON STATIONS

Timothy Faller, Dexter W. Johnson, and Robert F. Nowatzki

Superintendents' residences at the Hettinger and Langdon Experiment Stations were insulated with foam type insulation. Heating degree days and fuel consumption records are being kept to determine benefits of the added insulation.

Questions and experiences continue about foam-in-place insulation. Although it is relatively new in North Dakota it has been available in the U.S. and more widely used as an insulation in Northern Europe since the 1950's. Manufacturers vary their compositions but it is basically urea-formaldehyde foam. This has a different chemical makeup compared to the urethane type or the polystyrene type plastic foam insulations which are also used for insulating buildings.

The properties and performance of urea-formaldehyde (foam) insulation was recently investigated by the U.S. Bureau of Standards (1). This report discusses the different qualities of the insulation based on four producers, some 90 reports, field experiences, limited tests by the Bureau, four European Building Research Institutes and building codes in the U.S., Europe, Canada and Alaska.

Faller is Superintendent, Hettinger Experiment Station, Johnson is Extension agricultural engineer and Nowatzki is Superintendent, Langdon Experiment Station.

As with other insulations, a proper installation by experienced contractors using good equipment is essential to have an effective foam insulation job. Shrinkage, cracks and separation of the insulation away from studs and other surfaces is a problem. Proper installation can keep the initial shrinkage to about 3 per cent, but there is evidence that shrinkage continues for at least 20 months and longer after installation. This shrinkage lowers the overall insulation value because it allows paths for air current to follow. If properly installed, an insulation "R" value of 4.17 per inch is recommended for design purposes.

The report says no safety hazards were encountered with properly installed foam nor was there an excessive risk of fire. The foam is considered combustible, however, and caution is emphasized on the use of the urea-formaldehyde insulation in buildings where foodstuffs may be stored in the open.

The foams are not recommended for attic and ceiling installations because of shrinkage, insulation breaking down at high temperature-relative humidity conditions

(122°F. and 92% relative humidity) and odor. The urea-formaldehyde foam insulation needs to be protected from light and moisture as this will cause it to break down and crumble. It is recommended to cover any type plastic foam insulation with a 15-minute time barrier material to reduce the fire hazard. The greater contact the foam insulation has with water and air the more are chances for odor problems.

The urea-formaldehyde insulation allows water vapor to pass through it. In exterior walls of homes this may lead to blistering and peeling of exterior paint and other moisture problems in the wall including a reduction in the insulation effectiveness. A vapor barrier is needed on the warm side of the insulation to prevent water vapor from getting into the insulation during cold weather.

Figure 1: The 34' x 34' x 20' high superintendents residence at the Hettinger Station after remodeling. The view is looking to the west. The heating system is an oil-fired, hot water radiator system which was overhauled in 1972.

Hettinger Branch Station superintendent's residence remodeling plans were made in 1974. It was decided to insulate the walls and ceiling (which had no insulation as such in them) to reduce heating costs. Since the interior wall sheathing would need to be removed to add conventional batt-type insulation it was decided to try the relatively new "foam-in-place" insulation which is especially adaptable for insulating existing cavity walls. The remodeling was completed during 1975.

Table 1. Heating Costs of Hettinger Station Residence

Heating Season (July 1 to June 30)	Heating Degree Days	Approximate Fuel Costs
1970-71	9,057	$600 (coal)*
1971-72	9,062	$800
1972-73	8,150	$800
1973-74	8,206	$1,600
1974-75	8,627	$2,200
1975-76	8,003	$630
1976-77	8,102	$750
1977-78	9,470	$876

**Coal furnace was changed to oil in 1972.*

About four man-days were required to cut holes, install the foam and seal the holes. Total installed insulation cost was $1,600. This included 10 inches of loose-fill, cellulose-fiber insulation installed over the second floor ceiling. The installer was Thermo-Foam Insulators, Route 1, Box 8C, Bismarck, N.D. (*2)

Removal of some inside wall sheathing showed that the foam did not get to every corner of the wall cavity. Some spaces around window corners, electrical boxes, braces, etc. were void. About 1/16 to 1/8 inch shrinkage of the insulation away from studs has been noted. Further shrinkage and crumbling of the insulation was noted in some spot checks made recently.

The foam insulation is permeable and will allow water vapor to move into and through it from the inside, warm-room space. No polyethylene vapor barrier could be installed on the walls or ceiling, however, without replacing the interior sheathing. The several coats of paint on the interior surfaces plus the addition of wall paneling were thought to provide some vapor barrier protection.

Figure 2. Foam-in-place insulation was installed through two inch diameter holes cut through the outside sheathing at the remodeled Hettinger residence. Holes were made between each set of studs about seven and fourteen feet above the ground, and above and below windows. The insulation was "foamed" into each hole until it ran out as shown.

The Hettinger residence after remodeling has been quite comfortable although there seems to be a slight increase in cold spots and drafts in some rooms. The house has been much quieter since it was insulated and there has not been one incidence of mice. Records will continue to be kept and heating costs compared to earlier records.

Langdon Superintendent's Residence Now Remodeled

The 34' x 34' x 20' superintendent's residence at the Langdon Branch Experiment Station (built in 1908) is identical construction to the Hettinger Branch Station residence. Like the Hettinger house, it has 2 x 4 inch, back-plastered, double walls with two air spaces. Aluminum frame windows were installed in 1950. The walls of this residence were insulated with foam-in-place insulation in December 1977. The interior was remodeled and the second floor 2 x 10 inch joisted ceiling was insulated in 1974 with blown-in, glass-fiber insulation. Cost for the foam insulation job was $1,083 for the main house plus $214 for insulating the 12' x 14' x 10' kitchen addition to the main floor. The work was done by Insulate, Inc., Walhalla, N.D. (2)

Figure 3: The residence at the Langdon Branch Experiment Station. The view is looking Northwest. The tree windbreak would have a beneficial effect on heating costs.

The insulating procedure followed involved removing the lapsiding from four levels up the exterior walls of the house; (1) midway between first floor windows (2) above first floor windows but below first floor ceiling (3) below second floor windows but above first floor ceiling and (4) midway on second floor windows. In some small areas where siding was difficult to remove (i.e. around front porch door and below windows, etc.) holes were drilled through the siding and later plugged.

Holes were then drilled through the exposed tongue-groove sheathing. The insulating hose was inserted in the lower holes and insulation foamed in at 60 to 80 lbs. pressure until it oozed out the upper holes (for each floor). After insulating the siding was renailed using larger nails.

Observations and records will also be compared for heating degree-days and costs at Langdon. These figures and those for the Hettinger Station will provide useful information for the different winter climates of these two Stations.

The home at the Langdon Station was noticeably more comfortable during the remainder of the 1977-78 winter after insulating. Much of the floor draft previously experienced was eliminated.

The 1977-78 winter at Langdon was colder than normal. A total of 11,177 heating degree days were recorded at Langdon during the 1977-78 year (July 1-June 30). This was 696 degree days above normal, indicating cooler weather. In this regard the 1977-78 winter was somewhat colder than the 1973-74 winter (see Table 2). However, the fuel consumption in 1977-78 was about 800 gallons less than in 1973-74. A large factor contributing to the reduced fuel consumption was the fiberglass insulation installed in the second floor ceiling late in 1974. Cost of heating the Langdon home has increased because of the increased unit cost of Number 2 burner fuel used.

Table 2. Heating Degree Days, Fuel Consumption & Cost; Langdon Experiment Station

Heating Season	— Heating Degree Days* —			— Fuel Consumption & Cost** —		
July 1-June 30	Actual	Normal	Depar.	Gallons	(Approx)	Cost
1970-71	10,444	10,481	− 37	2510		$456
1971-72	10,735	10,481	+254	3063		$572
1972-73	10,156	10,481	−325	2782		$490
1973-74	11,100	10,481	+619	2755		$738
1974-75	10,588	10,481	+107	1756		$592
1975-76	10,159	10,481	−322	1935		$746
1976-77	10,015	10,481	−466	1780		$745
1977-78***	11,117	10,481	+696	1953		$904

**Heating degree days, computed from official daily weather records, Langdon Experiment Station, Base 65 degree F.*
***Number two burner fuel, approximate amounts (not adjusted for carry-over year to year)*
****Foam insulation "Arctic Foam" (urea formaldehyde) installed in the walls, December 11, 1977.*