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House Mouse Damage to Insulation

Scott E. Hygnstrom
University of Nebraska-Lincoln, shygnstrom1@unl.edu

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Summary and Implications

House mice (Mus musculus) were introduced into 20, 4-inch thick insulated panels and provided unlimited food and water for six months. Mouse populations increased 3-to 4-fold inside the insulated panels. Aluminum foil vapor barriers were severely damaged by mice and in all cases, reduced to less than half of their original mass. All of the insulation materials tested (insulation board, fiberglass batt, rockwool, beadboard, and vermiculite) sustained significant levels of damage as measured by increased thermal conductance. Researchers have yet to discover an insulative material that is not susceptible to house mouse damage. Producers should use construction techniques that exclude house mice and other rodents from insulated walls. In addition, house mouse populations in and around buildings should be controlled to minimize economic damage.

Introduction

House mice are a common pest in both rural and urban areas around the world. They cause significant economic losses by consuming and contaminating livestock feed, reducing the structural integrity of buildings and equipment, and transmitting diseases to livestock and humans. In 1987, it was estimated that house mice and Norway rats (*Rattus norvegicus*) caused $8 million damage to grain and livestock feed and $8.4 million to agricultural buildings in Nebraska annually. In a 1983 survey of 275 Nebraska pork producers, 92 percent reported that house mice were present on their farms. Fifty-five percent of the producers reported having at least one insulated livestock confinement building and 67 percent experienced structural damage caused by house mice or Norway rats.

Insulation is often used in wall spaces of swine production facilities to reduce heat loss by thermal conductance and convection. When house mice gain access to insulated wall spaces, they construct tunnels and nests, resulting in the compaction, destruction, and removal of insulation. The resulting heat loss in confinement buildings can lead to higher heating costs and may necessitate costly reinstallation of insulation.

There is a continuing need to identify insulative materials that are more or less susceptible to rodent damage. Therefore, an experiment was conducted to determine the effects of house mouse activity on five different types of insulation. In addition, the changes in house mouse populations and their impact on an aluminum foil vapor barrier after they inhabited insulated panels for a 6-month period was evaluated.

Materials and Methods

The study was conducted at the University of Nebraska-Lincoln Veterinary Science Research Facility. Four rodent-proof rooms were subdivided with 22-gauge galvanized sheet metal into five, 6-foot x 3-foot x 2-foot high enclosures. Enclosures were installed to maintain 20 separate mouse populations.

One insulated wall panel (4-foot x 4-foot x 4-inches thick) was placed upright in each enclosure. The panels were built to simulate the wall of a controlled-environment livestock facility. Frames were made of 4-foot long 2-inch x 4-inch wooden studs on 16-inch centers. A 1/2-inch plywood sheet was nailed to the "inside" face of each frame and ribbed steel siding was nailed to the "outside" face of each frame. Three 3/4-inch-diameter holes were drilled through the bottom of the "inside" face of each panel to provide mice access to the panel cavities. A vapor barrier, consisting of a 2-foot x 4-foot piece of 5-mil aluminum foil weighing 40.0 g was attached to the inside of each plywood sheet. Four sets of 4 panels were each filled with one type of insulation, including: 1) Styrofoam® beadboard (Dow Chemical Co., Inc.), 2) fiberglass batt (Owens-Corning Fiberglas® Corp.), 3) rockwool (American Rockwool Corp.), and 4) vermiculite (W. R. Grace Co., Inc.). A fifth set of four panels was insulated with sheets of 1-inch Celotex® Tuff-R (Celotex® Co., Inc.), attached just inside the plywood sheet. One panel of each of the treatments was randomly assigned to an enclosure in each of the four rooms.

Two adult male and three adult female house mice were released into each enclosure and maintained for six months. All released mice were ear-tagged for individual identification. During the first 14 days, 15 dead mice were replaced with live mice of the same sex. After day 14, each population was allowed to fluctuate without additions, other than births, and without removal, other than deaths or escapes. Mice were provided unlimited

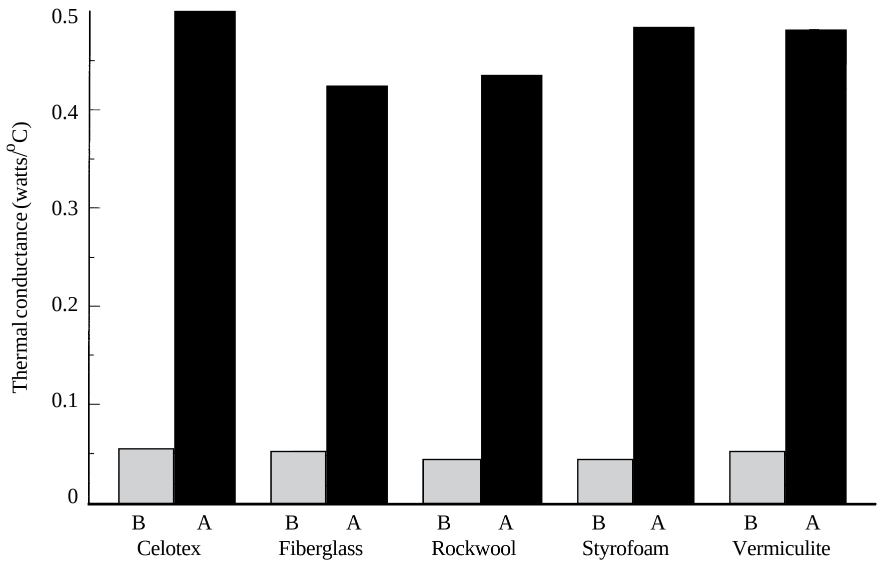

Figure 1. Mean thermal conductance (watts/°C) of insulated wall panels (n = 20) before (B) and after (A) a 6-month occupation by house mice.

Figure 2. House mouse damage to a panel insulated with fiberglass batt after 6 months of exposure.

food (Wayne Rodent Lab-blocks) and water throughout the experiment. Enclosures were vacuumed two times per week to remove discarded insulation, waste food, excrement, and dead mice. Dead mice were identified and recorded throughout the 6-month period.

All mice were removed from the enclosures using live-traps at the end of the 6-month period. Mice were identified as tagged or untagged, counted, and euthanized with carbon dioxide gas. The remaining aluminum vapor barriers were removed and weighed at the end of the 6-month period. A heat flow probe (HFP-20, Concept Engineering) was used to measure the heat flow through the panels before and after they were subjected to house mouse activity. A temperature gradient was established “inside” and “outside” of each panel using an air conditioned cooling chamber. Temperatures ranged from 35 to 70°F.

Results and Discussion

House mouse populations

The number of house mice in all panels combined increased from 100 to 399 during the 6-month period. During the study 172 dead mice were found and 227 mice were live-trapped at the end of the study. No significant differences were observed in the mean numbers of house mice found among the five types of insulation tested.

Vapor barrier damage

The integrity and function of the vapor barriers were significantly impaired by the house mice during the occupation period. The aluminum foil sheets were severely torn, shredded, and gnawed upon. Entire sections were missing in several cases. Mean weights of the vapor barriers that remained after the 6-month period were similar among treatments, but were dramatically less than the original 40.0 g vapor barriers that were installed. The damaged vapor barriers would be ineffective at inhibiting movement of moisture from the interior plywood wall to the insulation.

Insulation damage

House mouse activity during the 6-month period caused an increase ($P<.01$) in the heat flow and resultant thermal conductance through all five insulation types (Figure 1). The damage was quite obvious (Figure 2) and equally severe among the insulation types as there were no significant differences in thermal conductance.

To date, all insulation materials tested at the University of Nebraska and elsewhere have been susceptible to damage by house mice. Research should be conducted to develop and test insulative materials that are less attractive to house mice or less susceptible to house mouse activity.

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[1]Scott E. Hygnstrom is an Associate Professor and Extension Wildlife Damage Specialist, Department of Forestry, Fisheries and Wildlife.