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Super Hutches for Calves

How do Material Properties affect the Climate?

The goal in this investigation was to combine the new positive super hutch housing form with new materials, in order to improve the interior climate under higher solar radiation. Two different super hutch construction forms were compared, one hutch made of fibre-glass reinforced plastics (GRP) and an own development of light-natural sandwich (LNS). The temperatures for the LNS-hutches were 5°K lower than in the GRP-huts; the LNS temperatures were almost the same as the ambient temperatures in the shade.

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Keywords

Calves, group housing, super hutches, heat stress

The impact of plywood hutches compared to polyethylene (PE) hutches regarding heat stress of calves has been shown by [1]. Referred to indoor temperature during summer, plywood is the better building material for calf hutches. Hutches made of PE heat up much stronger and cause heat stress of calves in summer. Measures from different studies show differences in temperature between 10 am and 4 pm of 2.5 up to 5° C, depending on the building material being either wood or PE [2].

Material and Methods

A study of the Institute of Production Engineering and Building Science of the FAL Braunschweig was made to find alternative material for super hutches promising a better micro climate with same basic functions. Thus, a super hutch from renewable raw materials was developed, as easy to set aside as super hutches made of fibreglass reinforced plastic (GRP). The building material of the new hutch was light natural sandwich (LNS), a light panel material from renewable raw materials. The LNS-Panels were used to form a load-bearing super hutch of 16 m^2 area without framework but moveable with a tractor [3]. To achieve an additional effect on the climate, the LNS-super hutch was covered with a green roof mat consisting of moss and sedum.

For a comparison, two LNS and two GRP-hutches with same size (16 m^2) were investigated (experiment 1). The experiment was conducted on a meadow with shading trees for each hutch. Groups of six calves (3 months old) each were housed till an age of 6 months in the period from February 2003 to February 2004 in the hutches. In total, 96 calves were housed in the hutches. Temperature and relative humidity was recorded in every hutch as well as reference value for both parameters outside in the shade. To complete the measures of building material properties the same hutches were tested in a further experiment during summer 2005. A LNS-hutch with green roof (LNS-1), a GRP without shade (GRP-2), a LNS-hutch without green roof (LNS-3) and a GRP-hutch (GRP-4) with shade were placed on a meadow. Thermal distribution on the inner surface was measured in a 2 h interval from 8 a. m. till 10 p. m. with an infrared camera in every hutch on six days.

Results

The distribution of temperature values in experiment 1 (*Fig. 1*) was even, thus a significant difference could not be assessed. A significant difference existed between outdoor temperature (shade) and indoor temperature measures of GRP-1 and GRP-2. Focusing on day time temperatures between 8 a.m. and 10 p.m., leads to significant differences in mean temperature between LNS-based and GRP-hutches. A 24 h value includes the cooling during night time, which is the reason why there is no difference.

During summer 2003 mean indoor air temperature in LNS hutches was 5 to 6 °C lower than the value in the plastic hutches (measured between 10 a.m. and 4 p.m.). The temperature in LNS-hutches was close to the

Table 1: Correlation between air- and inner surface temperature and temperature in sunlight and shaded temperature

Hutch	point of measurement	temperature in sunlight	temperature shaded
		r	r
LNS-1	air	0,59	0,91
	inner surface	0,64	0,94
LNS-3	air	0,86	0,90
	inner surface	0,80	0,95
GFK-2	air	0,73	0,64
	inner surface	0,92	0,65
GFK-4	air	0,66	0,75
	inner surface	0,63	0,38

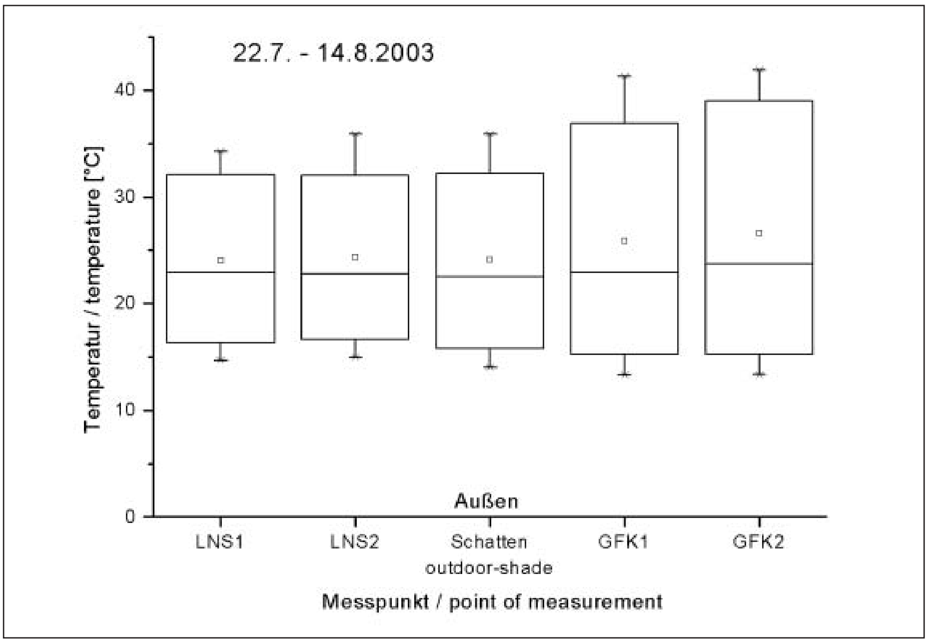

Fig. 1: Box–whisker-plot of air temperature and shaded outdoor temperature experiment 2 summer 2003

outdoor temperature in the shade, whereas the indoor temperature of GRP-hutches was higher than 30°C for several hours. To interpret the results, one has to consider the effect of the green roof. To achieve a measurement of the pure effect of building material, one LNS-hutch in experiment 2 was used without green roof. The temperature measures in the super hutches compared to the outdoor air temperature in the shade (*Fig. 2*) indicate differences regarding LNS-3 and GRP-2 (without shade). The indoor temperature of LNS-1 and GRP-4 was nearly the same as the outdoor shade temperature. Regarding outdoor air, LNS-1 and GRP-4 temperature, 95 % of all values were below 30 °C. The effect could be seen as well in the correlation between shaded and unshaded outdoor temperature together with hutch temperature (*Table 1*). Air- and inner-surface temperature of the LNS-hutches was close to the outdoor air temperature in the shade. The temperature (inner-surface) of the shaded GRP-hutch were a bit higher, because complete shading could not be achieved, thus a partly heating by solar radiation occurred. The temperature of the GRP-2 hutch without shade was highly correlated with the outdoor temperature without shade. The significance of correlation of the LNS-3 hutch was higher as well when compared to the outdoor temperature without shade.

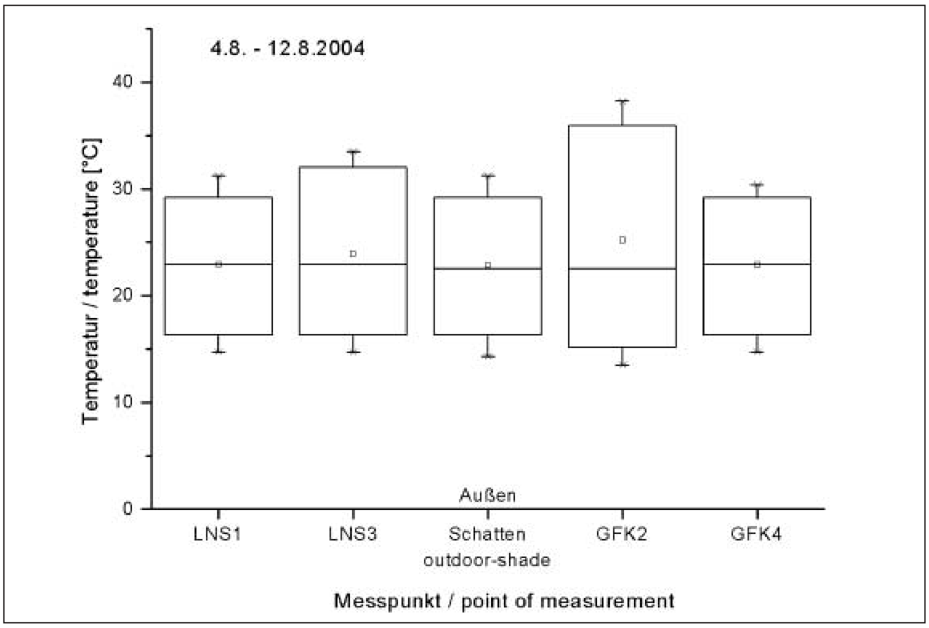

Fig. 2: Box–whisker-plot of air temperature and shaded outdoor temperature experiment 2 summer 2004

Conclusions

Using sandwich panels as building materials may improve the indoor micro climate of super hutches for calves. The temperature in insulated (sandwich) hutches was close to the outdoor temperature measured in the shade. Similar results could be achieved with a complete shading of the hutches (90 %), but this is not possible for every farm yard.

Literature

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