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Mobile Warm Water Mat Heating for Piglet Rearing

Warm water mats are widely used as heat sources in piglet rearing. MIK International AG has developed a mobile zonal floor heating system called 'Thermo M'. The heat distribution across its elastic surface is very homogeneous, and the system is readily accepted by piglets as a lying area. The surface temperature of the heating elements, which are supplied with warm water by means of a closed circular pipeline and a circulation pump, can be set very precisely, and the amount of heat continuously released by the system is determined by temperature difference to the room temperature. Thanks to a specially developed service trolley, the working time required for installation, removal, cleaning and disinfection of the warm water mats has been considerably reduced.

Piglets in rearing pens start soiling the warm water mats after only a few weeks, i.e. when there is no further need for a constant heat supply or when ambient temperatures increase as a result of weather changes. In the context of research for a diploma thesis, a series of tests were performed with a mobile warm water mat system that can be removed from the pen anytime as soon as soiling occurs.

The system can be described as a 'waterbed' that is connected with a continuously adjustable heater by means of a closed circular pipeline installed in the rearing compartment. The circulation pump of the heating installation continuously circulates warm water through the heating elements. The 1.6 m • 0.7 m mat elements consist of several components that can be assembled in the rearing pens. Two elements can be combined to form a 'piglet nest' (*Fig. 1*). The elements are fastened to the floor slats by means of cable ties.

As soon as the piglets in one rearing pen no longer need the waterbed as a heat source, it can be removed, cleaned, disinfected and used in the next rearing compartment. This lowers the acquisition costs per piglet place. Of course, all rearing compartments should be equipped with a permanently installed warm water supply circuit. Heating units and circulation pumps should be installed in the feeding passage.

Fig 1: Ideal resting behaviour – relaxed lateral position

Practical investigation

Animal behaviour, technical parameters and the working time requirement of the system were monitored over a period of nine months. The measurements were carried out under controlled practical conditions in four identical rearing compartments at the Frankenforst Research and Training Station of Bonn University. Thermotechnical short-term tests were performed in parallel in the environmental chamber of the Institute for Agricultural Engineering.

The mobile warm water mats can easily be installed by two people. The working time input was regarded as 'acceptable' because

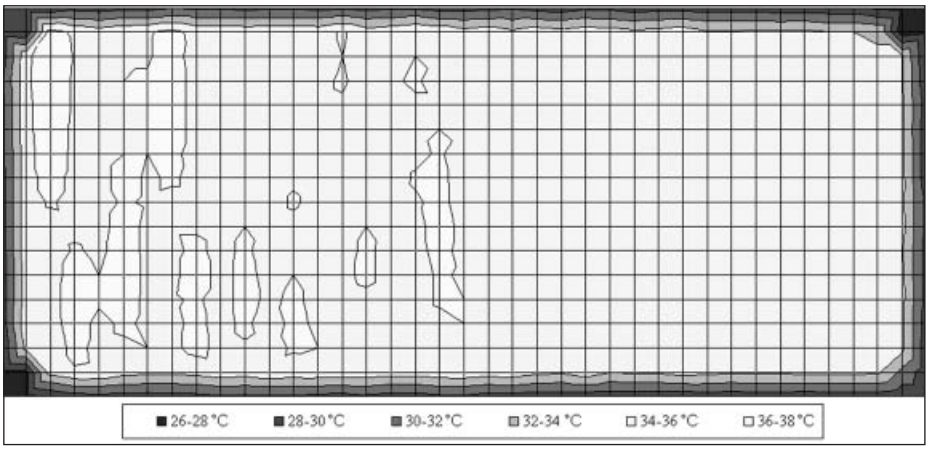

Fig. 2: Heat distribution on the surface of the warm water mat, with the water entering at the top left and leaving at the bottom right (to the next element or back to heater)

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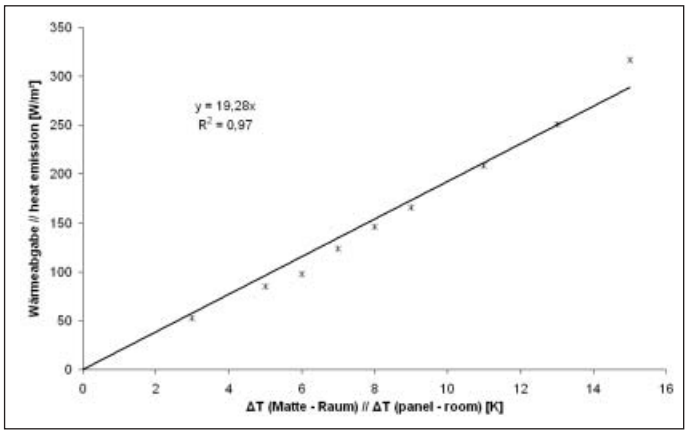

Fig. 3: In the climate chamber experiment heat emission was clearly a function of the temperature difference between the heating mat and room temperature

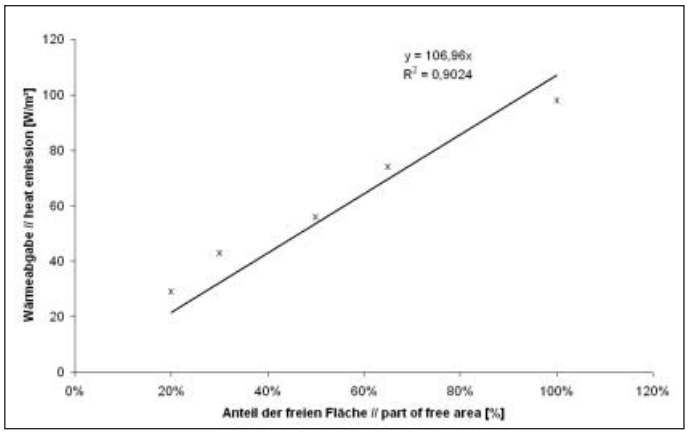

Fig. 4: Heat emission as a function of the free convective area/ the degree of coverage by resting animals (at a temperature difference of 6 Kelvin)

the mats have to be installed only once per rearing period.

The mats were cleaned, disinfected and temporarily stored on a service trolley developed especially for this new system. The trolley is equipped with swivel arms on which the mats are hung, and all accessories are stored on the trolley as well. The complete system is cleaned and disinfected on the service trolley outside of the rearing compartment. With the time spent for cleaning reduced considerably, thanks to the service trolley, the additional time required for cleaning and installing this system as compared to other systems can now be calculated to be 3.4 minutes per piglet.

With the ideal temperature of 34 to 36°C being reached on 71 % of the mat surface, the heat distribution over the warm water mats was very good (*Fig. 2*). The average temperature difference between two mats combined to form a 'piglet nest' was 2.6 K. Thus, in terms of heat distribution the mats meet the requirements of piglets [1].

The resting behaviour of the piglets was analysed by means of video recordings and classified into the following categories: sternal, lateral, piling, on the edge of the 'piglet nest'. The proportion of piglets lying in an ideal or good position (lateral or sternal) was higher on the mat than in the control group. As regards the proportion of piglets lying in an ideal position (lateral position), the mat had a highly significant statistical advantage over the control group.

The acceptance behaviour of the piglets varied considerably, which can be attributed to their 'prior experience' of flooring conditions in farrowing pens. Some of the piglets were from farrowing pens with concrete slatted floors, whereas others were from pens with plastic slats. Piglets familiar with plastic flooring were faster to accept the heating mats. All in all, the piglets readily accepted the heating system; after no more than 4 and 7.5 hours respectively, 70 % and more than 95 % of the piglets were lying on the mats.

In contrast to what the literature on piglet production says about the implications for animal performance [2], there was no statistically significant difference between both groups.

The cleanness of the mats was graded according to a scale ranging from 1 to 5, where 1 stands for 'clean' and 5 for 'completely soiled'. After three weeks of rearing, the mats forming a 'piglet nest' as shown in *Figure 1* received a grade of 2.4 on this scale. Mats used on concrete slats were soiled more heavily because on this type of flooring the hoof contact area is larger than on plastic floors. Accordingly, they received a grade of 3.2 after three weeks of use.

Climate chamber tests

In the climate chamber (without animals) the heat emission of the heating mat was determined to be 124 W/m^2 at a typical difference of 7 K between room and mat temperature (*Fig. 3*). The power consumption of the system, which was determined according to the method described in [3], was 6.6 kWh per piglet place during the three summer months in which it was used. Measurements are currently being performed to verify this value under winter conditions.

Depending on mat occupancy, the mat heating releases different amounts of heat into the room. *Figure 4* clearly shows a linear relationship between the degree of coverage / the size of the free area and the heat release of the heating element. The full heating capacity is achieved if the pen is empty (i.e. before animals are moved in); with the mat occupied by piglets weighing 6 kg (coverage about 40 %), only 60 % of the maximum heating capacity is achieved.

Conclusion

The technology under study here has advantages in that it supplies constant warmth, thus ensuring a high degree of animal comfort. Another advantage is the low degree of soiling of the lying areas. The flexible supply of thermal energy at low acquisition costs per animal place is another argument in favour of the system presented here. In a comparison of technologies, the working time required for assembling and disassembling is a clear disadvantage, but in terms of animal hygiene the system provides perfect starting conditions for piglets.

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