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Energy saving through piglet creep heating

The longer nursing piglets lie in their creep, the more is reduced the electrical input and work of a regulated underfloor heating (proved through field investigations and laboratory simulation). Through using a waterbed with controlled underfloor electrical heating the average power input can be reduced by 10%. If gel is added into the water, a surface temperature of substantially over 30 °C can be achieved with a 140/150 W heat lamp or with underfloor heating.

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Keywords

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Creep heating is necessary to create an optimum microclimate for piglets, reduce piglet losses and allow high weight gain performances. However, the energy costs involved are comparatively high and lie [1] between 4 and 10 DM per litter, depending on the heating system.

In laboratory and practical investigations, the possibilities for savings in electrical energy through a regulated electrical underfloor heating or through the application of a gel cushion in association with an interval switch for the electric heating, were investigated.

Laboratory investigation

If piglets lie on the creep floor heating they thus cover the floor surface with their bodies. Where a regulated underfloor heating is used, it can be seen that less energy has to be supplied for heating during the lying periods in that the piglets represent an insulation layer against the cooler surroundings and thus less convection heat losses take place. This situation was simulated in the laboratory with a warm water bed [2] placed on a regulated 140 W warm plastic and this covered 100%, 50% or 0% with a styropor insulation plate. The thermostat had three heat stages for the achieving of a required temperature on the waterbed surface: 37 °C, 34 °C or 30 °C. With the help of an electricity meter (Power Monitor), the power requirement for the heating of the waterbed in association with the degree of cover was measured over 72 hour periods by an approximately constant room temperature of 23 °C. In a second investigation, different gel cushions and waterbeds were investigated regarding some thermodynamic properties (homogeneity of surface temperature, time span for cooling after switching-off heating, dynamics of the surface temperature with interval application of the heating) in association with heat sources (heat lamps, underfloor heating), heat input (140, 150, 250 W) and insulation layer (with or without 1 cm thick styropor plate) under the mats [2].

Practical investigations

At the Education and Research Station Oberer Hardthof various farrowing pens were equipped with adjustable electrical underfloor heating (A = 300 W, B = 65 W per plate) and on each a waterbed placed. Using performance data analysis (Ledan) the actual power input of the heating was recorded at 15 minute intervals and stored on memory cards. For this, optical sensors for scanning the running discs were attached to electricity meters and with every revolution these gave an impulse to the recording equipment [3]. The transference of the stored data took place through a special software.

Parallel to this, the lying behaviour of the piglets were recorded over 24 hours on chosen days with an infrared camera and delayed-action video [4]. Within the same 15 minute intervals used in the Ledan measurements, the lying behaviour of the piglets was recorded and divided into two classes:

- < 20% of piglets lying in the creep simultaneously
- ≥ 80% of piglets simultaneously lying in the creep

Additionally through each of the four production cycles the heating B was run with and without warm water beds and the elec-

Table 1: Mean power input of a controlled 140 Watt heating foil at three different heating levels in dependence on plane of cover (0%, 50%, 100%)

Warm waterbed on the heated plastic, measurements in each case over 72 hours.

Heat setting	Styropor-covering %	Average surface temperature (°C)	Average air temperature (°C)	Average power input (W)
6	0	31,4	23,1	137,9
6	50	30,9	23,2	134,3
6	100	37,1	23,3	112,7
5	0	30,8	23,1	124,3
5	50	31,4	24,8	99,4
5	100	34,3	23,6	77,6
4	0	27,9	23,0	82,3
4	50	29,3	23,4	73,0
4	100	30,7	23,8	51,3

Waterbed/ gel cushion	Heat lamp/height Warm plastic	Temperatur x̄(°C)	s % (%)
WWB 8 L	250 W / 50 cm	38,5	1,4
WWB 8 L	250 W / 60 cm	35,8	1,4
WWB 8 L	250 W / 70 cm	35,0	1,0
WWB 8 L	250 W / 40 cm	31,3	1,4
WWB 8 L	250 W / 50 cm	29,8	1,0
gel cushion	150 W / 50 cm	33,6	23,2
gel cushion	150 W / 60 cm	33,7	18,8
gel cushion	150 W / 65 cm	34,4	16,4
gel cushion	140 W Warm plastic	35,5	12,2
WWB 15 L	140 W Warm plastic	32,5	1,0

Table 2: Results of 3 lab measurements at different warm water beds and gel pillows – means of 12 measuring points at the surface after 8 hours of heating

Heating	Proportion of lying piglets (%)	Number 15 min-intervals	Average power input (W)
A (300 W)	< 20	360	83,2
	> 80	298	52,4
B[1)] (2 x 195 W)	< 20	188	264,7
	~ 50	129	253,3
	> 80	19	231,6

Table 3: Mean power input of a controlled electrical underground heater in dependence on laying behaviour of piglets

trical work, and average electrical consumption, recorded by electrical meter.

Laboratory investigation results

With increasing degrees of water bed cover with an insulation sheet (0%, 50% and 100%) the average electricity input was reduced – and this occurred in all three heating settings (*table 1*). Thus, with the highest heating setting and without cover the average energy input was 137.9 W whilst the average of three days with 100% cover showed a reduced power consumption of 112.7 W. In this simulation the average energy savings with the individual heating settings were nevertheless from 18.2 to 37.7%.

With a 250 W infrared lamp, a warm water bed with 8 l content can, in relationship with the height of the heat lamp, be warmed to an upper surface temperature of 35 °C to 38.5 °C. On the other hand, where a 150 W heat lamp is applied the height above the water bed must be reduced to 40 cm in order to achieve or exceed the temperature ordained by the Pig Production Act in the lying area for 10 day old piglets (30 °C) at a room temperature of 20 °C. If the house temperature sinks below 20 °C, a drop in the creep temperature has to be expected. Even where the 150 W lamp is at a height of 50 cm above the creep surface a creep temperature of 30 °C cannot be guaranteed (*table 2*).

When a gel is used as bed additive instead of water – such as, e.g., found in human water beds – a 150 W heat lamp, and also a 140 W underfloor heating, can achieve an upper surface temperature of from 33.6 °C to 35.5 °C on average (table 2) after eight hours heating. However, the gel cushion results in a much less homogenous surface temperature (s% = 12.2 to 23.2%) compared with a water bed (s% = 1.0 to 1.4%). The medium water gave a very even heat distribution over the total area of the heated creep, whilst with gel the temperature in the centre (especially with a heat lamp) was clearly higher as in the surroundings.

The better heat absorption capacity of the gel cushion can be used together with an interval switch for the electric heating. After an eight hour heat-up period, different intervals of on/off switching for heat lamp or underfloor heating were analysed (30 min with, 30 min without heating; 60 min with , 30 min without heating; 30 min with, 15 min without heating) [2]. Contrary to the warm water bed where the heating cooled down in interval operation, the gel cushion in laboratory conditions with a room temperature of around 20 °C maintained an almost constant surface temperature, even with a heating programme timing of 50% respectively with and without heating in half-hourly changes over 24 hours. A complete presentation of the entire recording programme can be seen in [2].

Results of practical investigations

For both regulated underfloor heating systems it was demonstrated that in phases where less than 20% of the piglets were lying in the creep, the power consumption rose by around 30 W compared with comparable periods with more than 80% of piglets lying on the creep surface (*table 3*). Recorded for this evaluation were 994 quarter-hour values for behaviour and electrical power in several production cycles under different in-house climate conditions [3].

In a total 28 cycles, each of 28 day suckling, with the regulated electrical underfloor heating B it was determined that with a waterbed on the heated floor the average electrical input was 72.8 W, but without a water bed 81.4 W (per four production cycles). The ground for the energy saving was the proven fact that the piglets lay on the water bed in large numbers and over longer periods. The lying area is thus for a great period of time covered by the young pigs. The contact area between water bed surface and the cooler surrounding air is thus smaller and so the heat loss is also smaller. The heating must warm-up less often in order to keep the temperature at the desired level.

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