

Water bedding solutions: an innovative tool to combat heat stress

Heat stress has become a major issue in dairy cattle farming. To determine if cows are suffering from heat stress, scientists have developed a measure of the ambient temperature and the relative humidity called the Temperature Humidity Index (THI). While cows can resist relatively low temperatures (as much as -37°C), they will be negatively affected by heat stress beginning at about 23°C and further accentuated by increased humidity.

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radicals (potentially destructive chemical compositions), which can increase the risk of mastitis, permanent somatic cells in milk and reduced fertility. Indeed, it has been observed that on a medium to long term view, heat stress can cause reproduction problems such as reduced weight of newborn calves, a compromised immune system as natural immunity decreases and even a reduction of sperm quality.

Therefore, days or weeks after a heat stress period, cows are more vulnerable to illness and issues such as lameness.

A cow with high milk production having experienced a heat stress index of 80 THI will be 'internally damaged' and have irreversible consequences. Cows risk an

inability to recover their initial production rate. This problem can limit or reduce the production and genetic potential of some animals.

Bioret Agri specialise in mattresses and comfort solutions and, in collaboration with the French Livestock Institute, is doing research to reduce the impact of heat stress where cows spend over half of their time: their bed.

To investigate how mattresses can help reduce the impact of heat stress, Bioret Agri's R&D department had to understand and prove to what extent traditional bedding methods such as sand, deep bedding, straw or even regular mats and

Continued on page 9

Fig. 1 clearly shows that when the outside temperature is 24°C and the humidity is at 20%, we reach a THI of 68. This means that cows start suffering from heat stress. From this point, after only four hours, dairy cattle behaviour will start to change. To regulate temperature, they will reduce consumption in an effort to reduce metabolic heat. Also, breathing rhythm is accelerated which induces reduced rumination and loss of saliva.

Increased risk of sub-acidosis

Decreased rumination combined with altered nourishment increases the risk of sub-acidosis as the imbalance between the level of CO₂ and bicarbonates decreases the rumen PH.

Additionally, in the fight against heat stress, cows burn energy and, in doing so, generate a warming effect resulting in a vicious circle. In the battle to stay cool, energy is diverted from milk production and, even for a highly productive cow, heat stress will lead to milk production losses.

Studies conducted in Europe have shown that dairy cows suffer from heat as much as 6-15 hours per day in summer and that it can lead to losses of production of more than 3.5kg of milk per cow per day. In addition, a negative energy balance (related to the balance of thermoregulation) can affect the physical state of the animal.

From a metabolic perspective, heat stress will lead to an accumulation of cellular

Fig. 1. Heat stress diagram for dairy cows.

Temperature		Relative humidity (%)																		
°F	°C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
72	22.0	64	65	65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71
73	23.0	65	66	66	66	66	67	67	68	68	68	69	69	70	70	71	71	71	72	72
74	23.5	65	66	66	67	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73
75	24.0	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74
76	24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
77	25.0	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76
78	25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77
79	26.0	67	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78
80	26.5	68	69	69	70	70	71	72	72	73	73	74	75	75	76	76	77	78	78	79
81	27.0	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80
82	28.0	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81
83	28.5	69	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82
84	29.0	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83
85	29.5	70	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84
86	30.0	71	71	72	73	74	74	75	76	77	78	79	80	81	81	82	83	84	85	85
87	30.5	71	72	73	73	74	75	76	77	78	79	80	81	81	82	83	84	85	86	86
88	31.0	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86
89	31.5	72	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87
90	32.0	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	89
91	33.0	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
92	33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
93	34.0	74	75	76	77	78	79	80	80	81	82	83	85	85	86	87	88	89	90	91
94	34.5	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92
95	35.0	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
96	35.5	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94
97	36.0	76	77	78	79	80	81	82	83	84	85	86	87	89	90	91	92	93	94	95
98	36.5	76	77	78	80	80	82	83	83	85	86	87	88	89	91	92	92	93	94	95
99	37.0	76	78	79	80	81	82	83	84	85	87	88	89	90	91	92	93	94	95	96
100	38.0	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98
101	38.5	77	79	80	81	82	83	84	85	86	87	89	90	92	93	94	95	96	98	99
102	39.0	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100
103	39.5	78	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98	99	101
104	40.0	79	80	81	83	84	85	86	88	89	90	91	93	94	95	97	98	99	100	101
105	40.5	79	80	82	83	84	86	87	88	89	91	92	95	96	97	98	99	100	101	102
106	41.0	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103
107	41.5	80	81	83	84	85	87	88	89	91	92	94	95	96	98	99	100	102	103	104

Continued from page 7

mattresses insulate the cows. To do so, they went on farms and used infrared cameras to determine the 'hot spots' on numerous existing solutions.

On an infrared picture taken on a regular rubber mat (Fig. 2), it can be clearly seen that the retained heat under the cow just as she leaves is not far from normal body temperature.

Results with sand, straw and deep bedding were similar. They indisputably show, with the red surface following the cows' shape, that when she lies on any traditional bedding, the heat is entrapped. This means that the mattress surface will not play a role in helping the cow combat heat stress.

Single water pouch

To avoid this inability to dissipate heat, Bioret Agri has worked on water mattress solutions with a single water pouch that supports the entire cow's morphology and works much like a heat exchanger.

In addition to its traditional single chamber waterbed, Bioret Agri has launched the Aquatop cover, a reinforced top cover with a water pouch that better envelopes cows and increases thermal exchange by dissipating heat continually.

The company also developed the Aquastar mattress which combines all the advantages of the latex mattress with those of a waterbed.

Results demonstrate that when a cow lies down on either water solution, her heat is transmitted to the entire water pouch minimising retained heat under the cow's body with a cooling effect unlike the other traditional bedding systems.

This unique feature will maintain greater cow comfort and avoid wasted internal energy consumption that reduces milk production.

To illustrate this, the R&D department took infrared pictures of the Aquastar mattress (Fig. 3) and confirmed that the temperature is equal everywhere on the water pouch and helps to regulate the cow's temperature.

In parallel they led tests with special

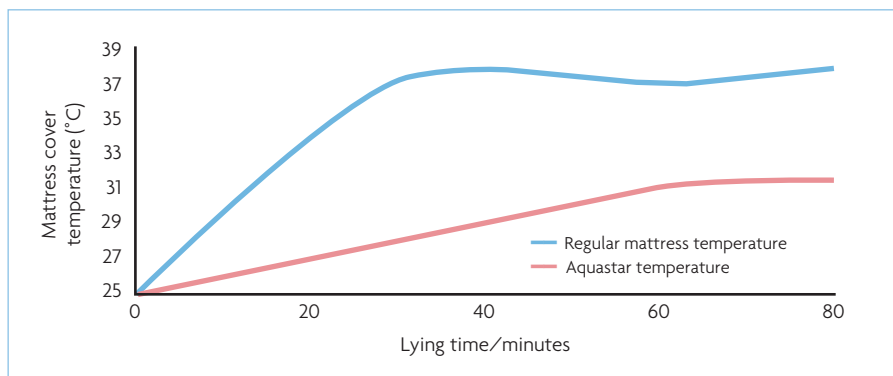


Fig. 4. Comparison with temperature sensor between rubber mats and Aquastar. Test specification (July 2016): 5 x Aquastar Bioret-Agri, 5 x rubber mattress (single plate), test period of two hours in the afternoon. Outside temperature of 28°C with a relative humidity of 65%. Value type: T sensor on mattress, FLIR gun control (Infra-red).

temperature sensors placed directly on two different types of supports: single pouch water solution and regular rubber mats.

As shown by Fig. 4, the temperature on regular mattresses approaches peak temperature after only 20 minutes, while the water solution will approach its highest temperature after about 60-80 minutes (far lower and far more progressively).

Based on their studies, the temperature is nearly 6°C lower than other comfort products. Water keeps cows cooler contributing to maintaining milk production by reducing heat stress.

Additionally, other benefits of water make such mattresses resistant to deformation and, therefore, long lasting and more hygienic thanks to the proper slope and grooved design on the surface. These innovative products can also be equipped with electronic components to measure the resting time and can fit any type of renovation of cubicles, such as individual floor mats, mattresses or linear deep bedding. For continental climate countries where hotter temperatures remain higher (day and night), the Aquaclim mattress, is an excellent option to fight against heat stress.

This innovative mattress integrates a temperature controlled channel system capable of recirculating water under the water pouch allowing a direct effect on the body temperature of the animal.

This improves animal well-being and contributes to maintaining milk production by reducing heat stress.

The water circulates in closed circuit channels in the mattress and ultimately passes through a heat exchanger to be cooled for the next passage. Thanks to a geothermal system, Bioret Agri is able to offer a cooling mattress using free energy that is good for the environment as no extra power is needed.

The optimal bedding solution

When we consider that cows spend an average of 12-14 hours lying per day and that the ideal outside temperature for a dairy cow should be between 5-15°C which, even in well insulated buildings, is difficult to preserve in some areas and some periods of time, finding the optimal bedding solution is something we should not neglect.

The test results for the single water pouch solutions such as the Aquastar and the Aquaclim mattresses respond to today's unresolved heat stress problems.

Heat stress is a complex and multi-faceted matter. Bioret Agri's water bedding solutions are new tools that can perfectly complement existing ventilation and drinkers etc. ■

Fig. 2. Infrared picture of a regular rubber mat.

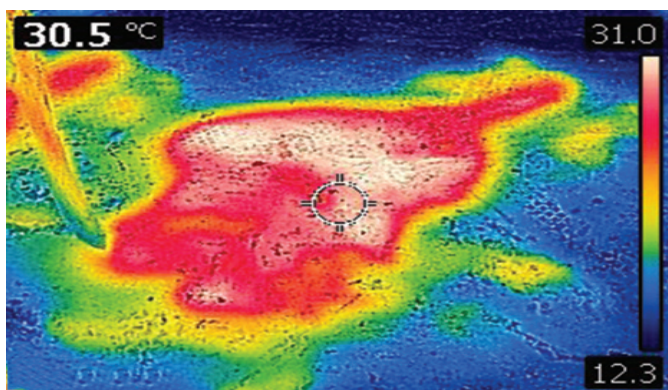


Fig. 3. Infrared picture of the Aquastar mattress.

