

# IMPACT OF RUBBER MAT FLOORING ON THE THERMAL COMFORT OF DAIRY CATTLE IN HOT HUMID REGIONS

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## ABSTRACT

*This study was carried out at the dairy sheds at University Livestock Farm, Kerala Veterinary and Animal Sciences University. The temperature difference between concrete and immediate rubber mat flooring was measured at 40 different points at five different times of the day for a week. The readings showed a significant difference with the rubber mat being hotter than the concrete for all times except during the morning reading. During the course of a day, the maximum temperature difference between the two surfaces was 0.95° C recorded at 11.40 AM.*

**Keywords:** rubber mat, flooring, dairy farming, thermal comfort

## INTRODUCTION

Flooring is one of the most important components of animal housing as far as animal health and welfare are concerned. Different flooring materials are being used for different types of livestock the world over. In dairy animals the most common flooring material used is cement concrete. Though concrete flooring has many advantages like durability, thermal conductivity and strength, there are some obvious disadvantages like slippery nature, hardness which reduces animal comfort, conformational defects and injuries on hoof

leading to increased incidence of laminitis. Cows on concrete has greater odds of developing or exacerbating existing heel erosion than cows on rubber flooring and the odds of becoming lame are greater for concrete-exposed cows than those on rubber (Vanegas et al., 2006).

Proper flooring management and design is critical for the effective control of production parameters, cow health, longevity and comfort. Many studies have investigated the bedding preferences of dairy cows by comparing different types of floor structures

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(Lendelova, *et al.*, 2009). Results of similar experiments indicate that cows prefer stalls with softer, elastic, dry and slip resistant floors. Due to these advantages the university farm dairy shed have installed rubber mat flooring for the past three years.

The long term effect of the use of rubber mat as flooring material in animal sheds in the hot humid tropical climate has not been scientifically proven. The lying cow is in direct body contact with the floor 12 to 14 hours per day (Lendelova and Pogran, 2003). This study was taken up to determine the temperature difference between the concrete floor and the rubber matting and to analyze its impact on thermal comfort of dairy cows.

## MATERIALS AND METHODS

The study was carried out at University Livestock Farm, Kerala Veterinary and Animal Sciences University, Thrissur, Kerala. The difference in surface temperature between the rubber mat and the immediate concrete floor was measured using an infrared thermometer at forty different points within the same shed. The temperature was recorded five times a day starting from 7.00 AM to night 10.00 PM. The readings were taken for a week during the month of April, 2012. The ambient temperature and relative humidity was also recorded. The data was statistically analyzed using SPSS.

## RESULT AND DISCUSSION

### 1. Ambient temperature and ground temperature

The ambient temperature and the floor surface temperature are the two important

thermal parameters affecting the heat load of the dairy cattle. The comparison of the two indicated that the air temperature remained higher than the ground temperature and surface temperature of rubber remained hotter than the concrete during day time and became equal by late night.

### 2. Temperature difference at different times in a day

The mean temperature that prevailed at 7.00 AM, 11.40 AM, 3.00 PM, 5.10 PM and 10.00 PM at concrete and rubber floor was  $27.11 \pm 0.08$  &  $26.96 \pm 0.08$ ,  $29.87 \pm 0.07$  &  $30.82 \pm 0.11$ ,  $30.11 \pm 0.08$  &  $30.65 \pm 0.11$ ,  $29.52 \pm 0.07$  &  $29.8 \pm 0.09$  and  $29.57 \pm 0.05$  &  $29.71 \pm 0.08$  respectively.

Except during 7.00 AM at which the concrete flooring had a significantly ( $P < 0.05$ ) higher temperature than rubber mat during all the other times viz. 11.40 AM, 3.00 PM, 5.10 PM and 10.00 PM the rubber mat flooring had significantly ( $P < 0.05$ ) higher temperature than concrete flooring.

During the course of a day, the maximum temperature difference between the two surfaces was  $0.95^\circ\text{C}$  recorded at 11.40 AM. Heat flow between two media or bodies in direct contact is described as conductive heat exchange. According to Kadzere (2002), for dairy cattle, conductive heat exchange took place between the animal and its surrounding air environment, and between the animal and any other media, solid or otherwise that the animal might be in direct contact with. When the other media with which the animal was in contact with are gases or liquid, the conductive heat exchange is further complicated by heat

exchange through convection in these media. The flow of heat by conduction depended on the temperature difference, the conductance (or inversely the resistivity) of the medium, and the area of contact (Schmidt-Nielsen, 1964). Esmay (1969) reported a proportional relationship between the bulk density of materials and their conductivity, thus the more dense the material the greater the conductivity or inversely the less the resistance to heat flow. The conductive heat transfer was described by Yousef (1985) in a simple diffusion equation as:

$K = Ah_c(t_s - t_a)$ , where  $K$  is conductive heat exchange;  $A$  is surface area;  $h_c$  is thermal conductivity of the material in contact with the skin;  $t_s$  is mean skin temperature;  $t_a$  is air temperature.

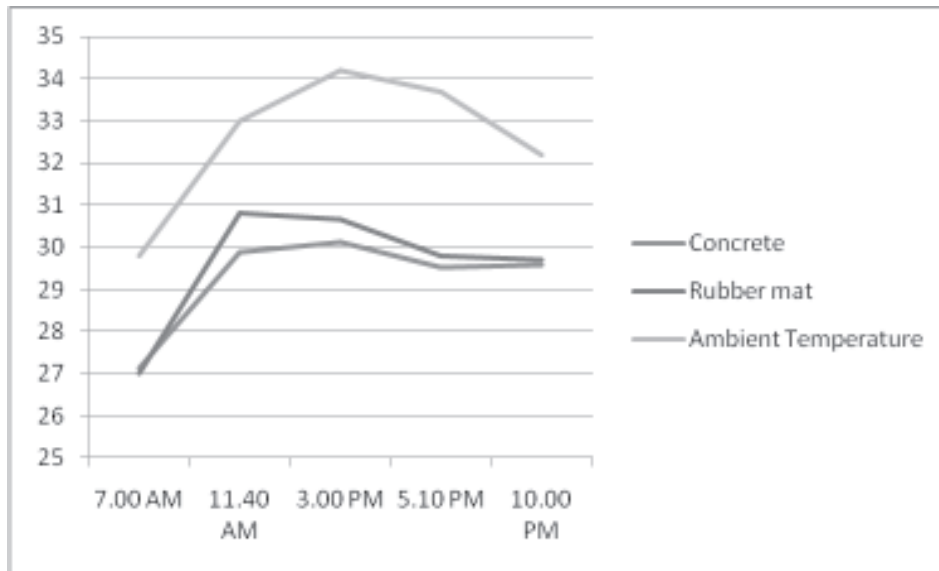
From this equation it was clear that a temperature difference between the different materials with which the animal is in contact while it is lying has a significant impact on the ability of the animal for thermolysis. The present study showed that there is significant difference between the surface temperatures of rubber mat and concrete during day time. The surface

temperatures of rubber mat were significantly higher than concrete.

For the high producing dairy cow it is important to know that the magnitude of conductive heat transfer depends on the nature of material in contact with its skin. To alleviate heat stress, utilization of bedding materials with high conductance may facilitate cooling of the animals. This underscores the importance of bedding material selection as part of heat stress abatement strategies. The present study also suggests use of materials with higher thermal conductivity to facilitate heat loss.

An animal lying on a cool wet surface will have greater conductive heat transfer depending on the thermal conductance of the substrate as well as the temperature gradient and magnitude of the area of contact relative to the total surface area. From the present study it becomes evident that the rubber floor had significantly higher temperature than concrete floor during the day time. Though rubber mat flooring has many obvious advantages, its effect on thermolysis, animal comfort and physiological significance in hot humid conditions has to be explored by further research.

**Fig. 1. Ambient temperature and ground temperature at different times of the day**



**Fig.2. Temperature difference at 7.00 AM**

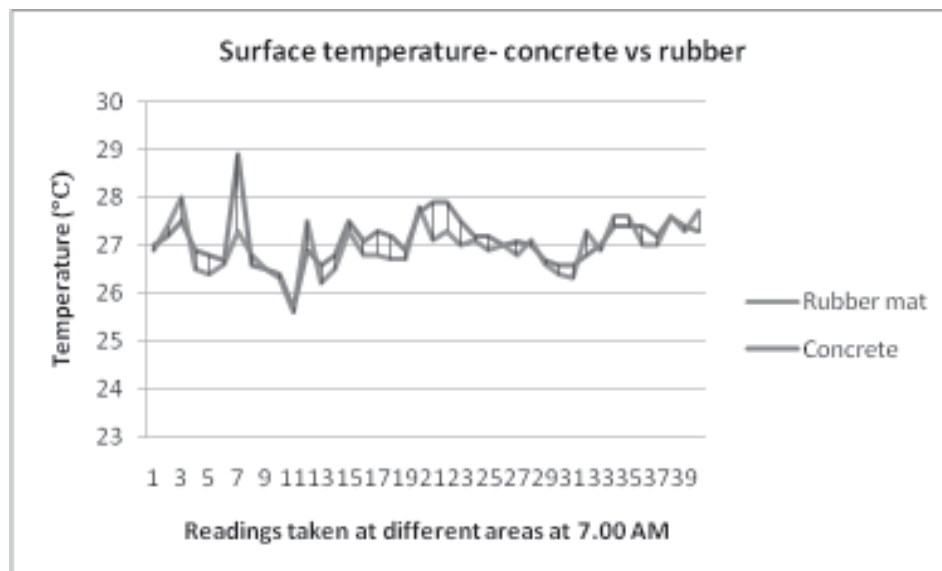


Fig.3. Temperature difference at 11.40 AM

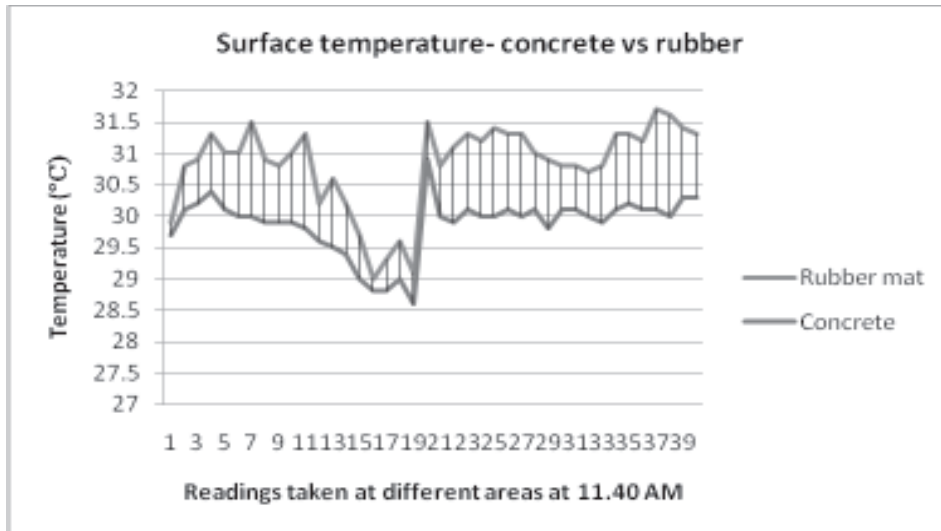


Fig.4. Temperature difference at 3.00 PM

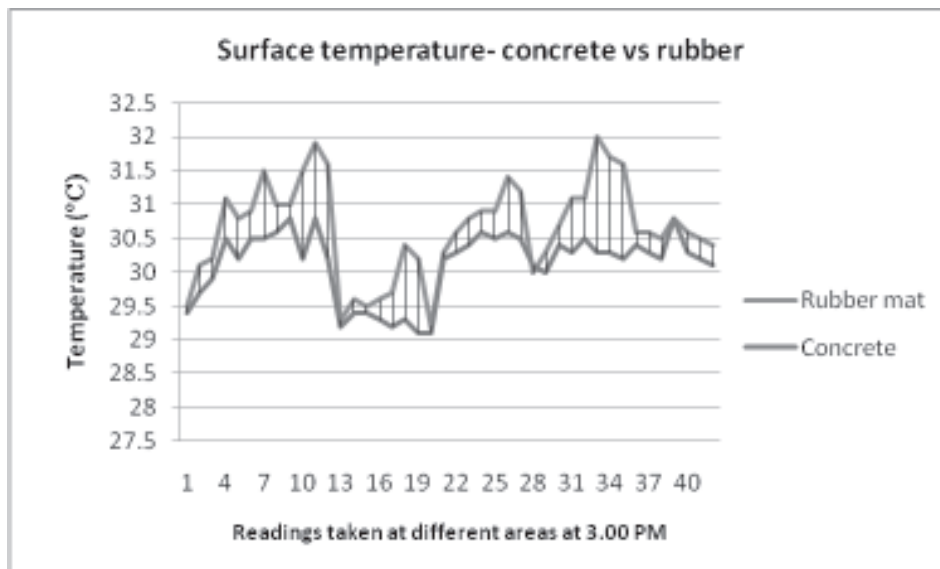


Fig.5. Temperature difference at 5.10 PM

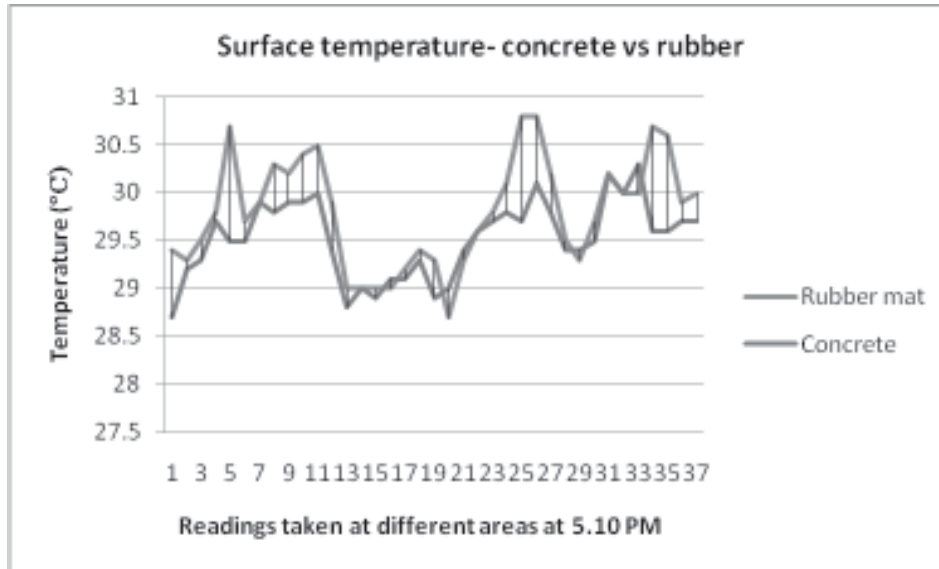
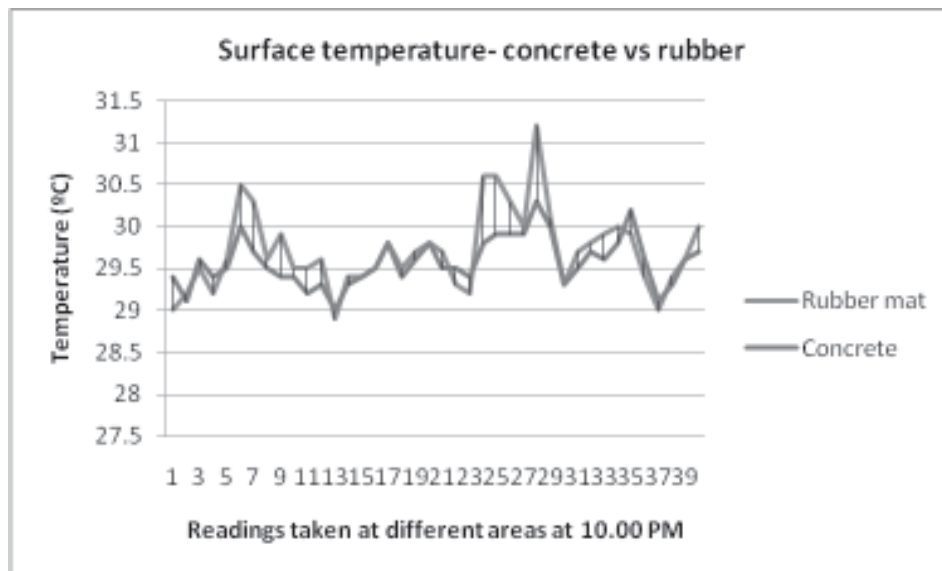
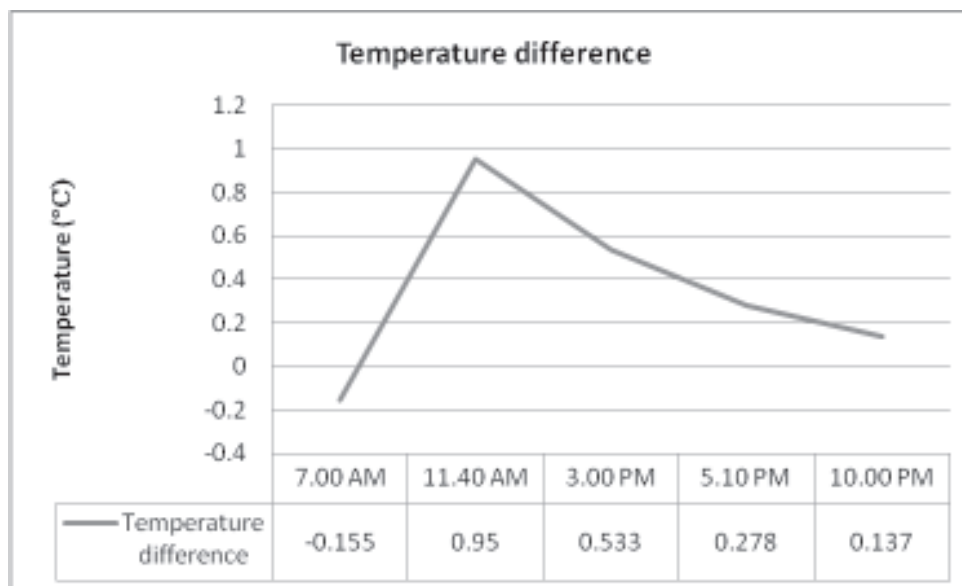


Fig.6. Temperature difference at 10.00 PM



**Fig.7. Temperature difference between the two surfaces****REFERENCES**

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