7th International Symposium on Cement Based Materials for a Sustainable Agriculture

(CIGR International Symposium)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada September 18-21st 2011

SKID RESISTANCE AND DURABILITY OF COATED AND UNCOATED CONCRETE FLOORS IN DAIRY CATTLE BUILDINGS

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CSAS11037 – Section 4: Concrete Floors for Animal Housing.

ABSTRACT Passageways in cattle buildings should provide durable and non-slippery surfaces to allow cattle an unrestrained locomotion and expression of behaviour. In order to evaluate walking areas of cattle buildings and their grip or skid resistance, measures with a Skid Resistance Tester to obtain SRT-values were performed on several dairy farms in Germany. Uncoated concrete, brushed concrete, epoxy resin coating and mastic asphalt as coating of concrete were investigated. Results demonstrated, that even high quality concrete had low SRT-values and thus low grip, whereas mastic asphalt showed high SRT-values, meaning good grip. Processing uncoated concrete surface and epoxy resin coating lead to higher SRT-values compared to mastic asphalt. Due to changes of micro-roughness of mastic asphalt, attention should be paid, to keep passageways as clean and dry as possible.
Keywords: SRT, skid resistance tester, cattle housing, floor characteristics

INTRODUCTION Interaction of bovine claws and different floor types in cattle housing is an important factor regarding claw health, lameness and locomotion behaviour of cattle. In many loose housing cattle buildings concrete flooring is widely used for passageways. But even high quality concrete is eroded after a few years chemically by faeces and mechanically by scrapers. Concrete floors become slippery and affect walking behaviour of cattle negatively. One solution to improve surface properties of concrete us in animal houses is coating by epoxy resins or a layer of mastic asphalt. To compare those solutions and to show the durability, we measured different flooring surfaces of different ages two times after 1 year. To characterize the floor properties we use the skid resistance test, a pendulum friction testing method, which was developed for measuring road surfaces. Concrete flooring skid resistance is one of the multiple choices to characterize flooring properties. The skid resistance tester was used by Nilsson et al. (1988) to measure grip of floors in dairy buildings. Franck et al. (2007) compared SRT-values of floor surfaces with different friction measurement techniques and measured the surface roughness by using a laser beam. In this study, SRT-values showed a positive correlation with dynamic coefficient of friction under wet conditions and significant correlations with roughness. Van der Tol et al (2005) considered dynamic forces when measuring the coefficient of friction. Their results proved, that friction of concrete floors is not sufficient for unrestrained cattle locomotion. The authors recommend special

attention to the design of concrete floors. Thus the aim of study was to measure SRT-values of different concrete floors under practical conditions to evaluate effects of coating and grinding compared to uncoated concrete.

MATERIAL AND METHODS SRT Measures were performed in six different cattle buildings providing floors of uncoated concrete, brushed concrete, epoxy resin coating and mastic asphalt. The cattle buildings were located in the federal state of Thuringia in Germany. Measures were done using a Skid Resistance Tester (Figure 1). The SRT value is a kind of dynamic friction measuring method. The pendulum (Figure 1 and Figure 2) is accelerated up to 2.5 ms^{-1}, a slider with a rubber block at the pendulum scratches on the watered floor for an equal distance. Depending on the floor roughness, the pendulum is de-accelerated and moves a pointer at a scale, the so called SRT - Value. A value of zero is obtained without any friction or free swinging of the pendulum arm. The surface has to be watered and cleaned before the measure. Figure 3 shows the SRT Tester in its working environment on a passageway of a cattle building.

SRT-values were obtained from 40 different points of evaluated floors. A minimum of seven repetitions per measuring point was set to achieve reliable results. In total, 320 single SRT-values were measured. Data were recorded using a data sheet and transferred to an Excel-sheet to calculate temperature adjusted SRT-values per measuring point. Mean values per floor type were calculated in the same data sheet as well as standard deviation.

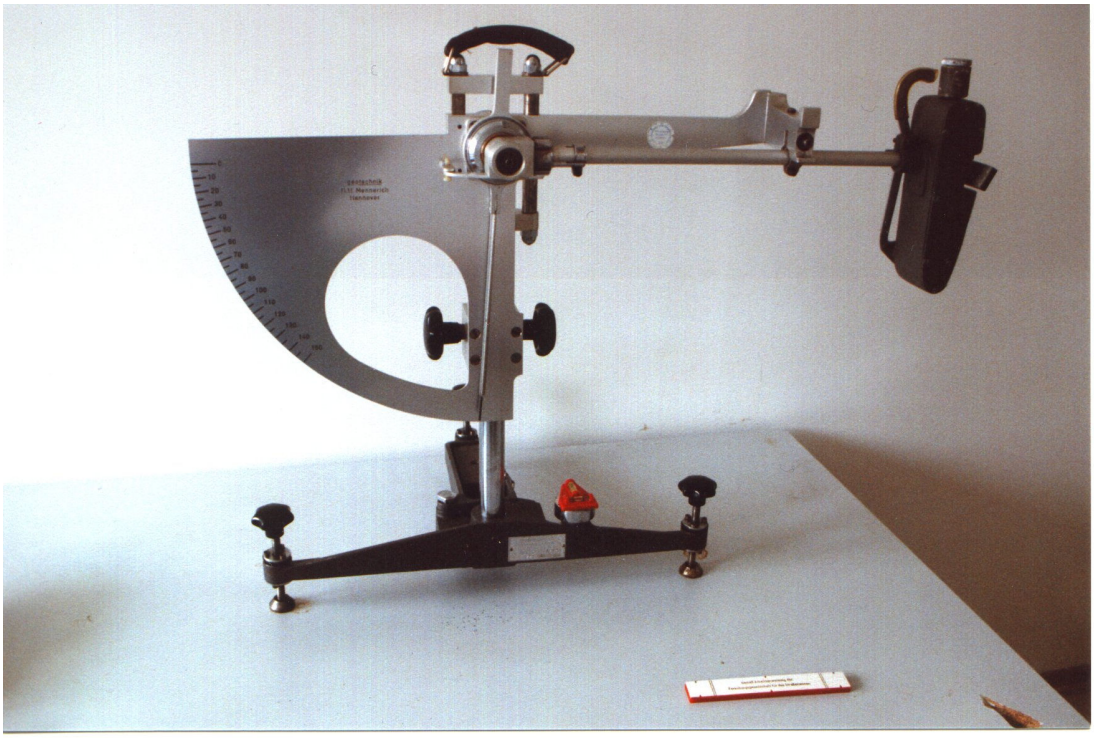

Figure 1: Pendulum tester to measure skid resistance (SRT) and tools for sliding length adjustment.

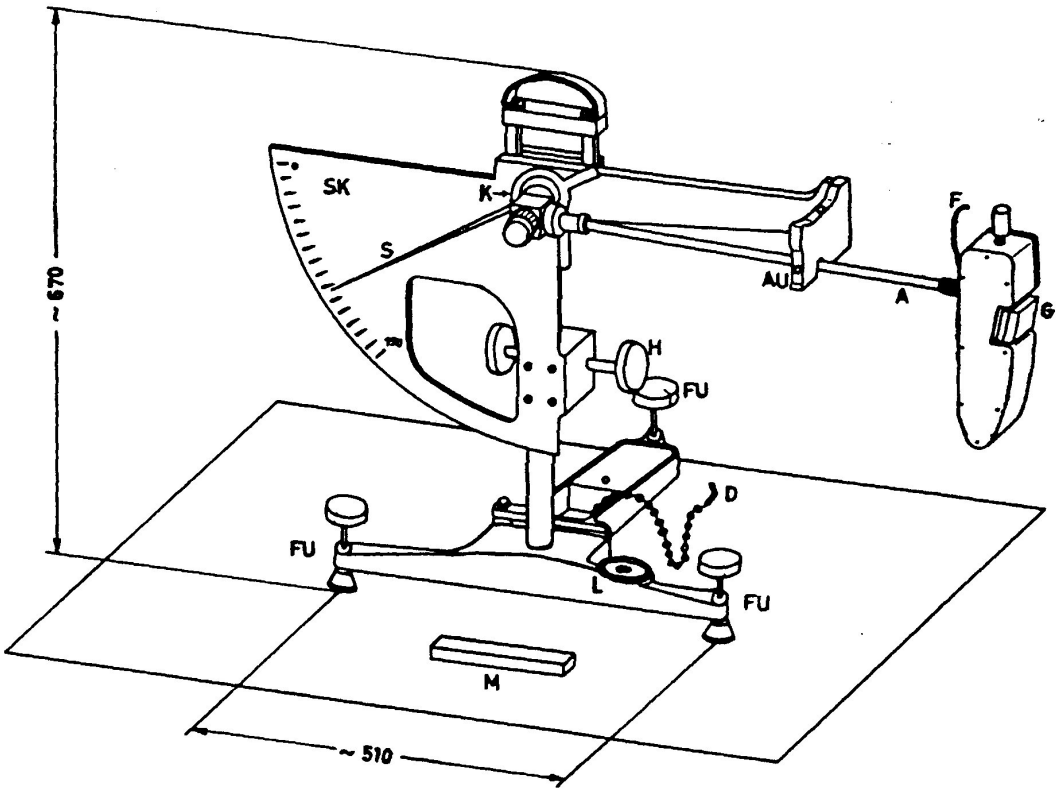

Figure 2: Scheme of Pendulum tester for skid resistance (SRT) with leveling screws (FU), spirit level (L), scale (SK), pointer (S), pendulum arm (A), release catch and release button (AU), rubber slider (G), control for vertical movement (H) and scale for sliding length adjustment (H).

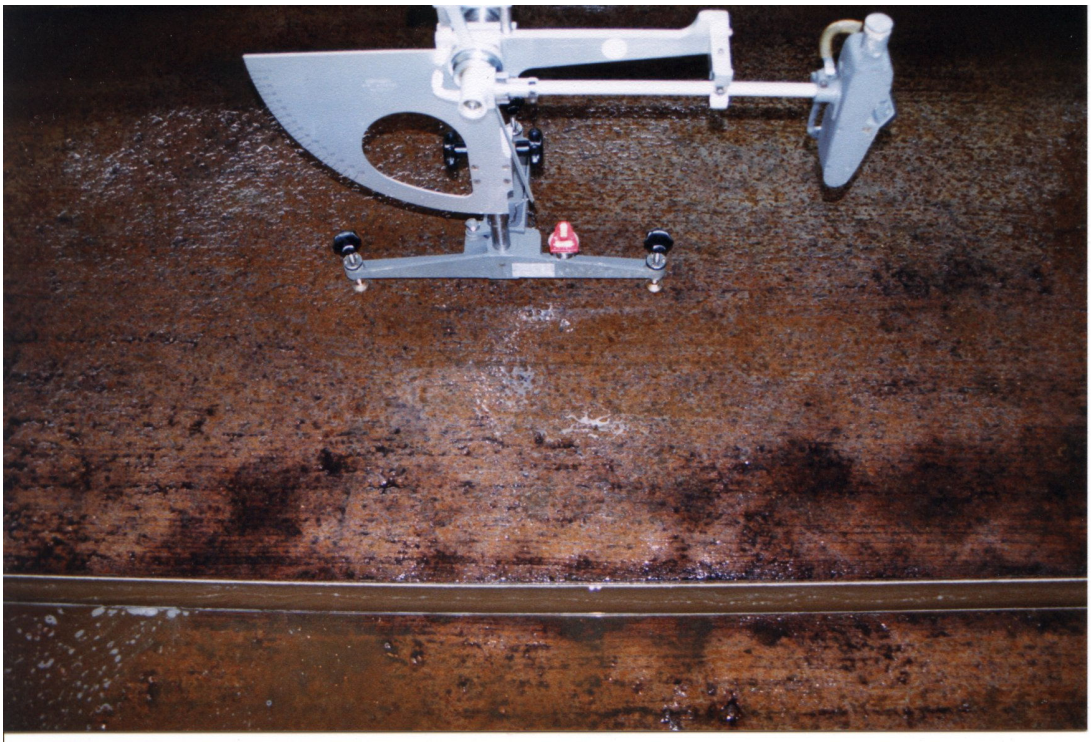

Figure 3: Pendulum tester to measure skid resistance (SRT) on a wet concrete floor of a cattle building.

RESULTS For a comparison of SRT Values it is necessary to know how to interpret them. In Table 1 a characterization of SRT-values shows, that acceptable flooring for cattle starts with SRT-values of 50 to 60.

Table 1. Interpretation of SRT-Values.

SRT-Value	Grip
> 70	excellent, maybe abrasive
60 - 70	good
50 - 60	sufficient
40 - 50	not sufficient
< 40	slippery

The results from our Skid Resistance Tester are shown in Figure 4. Six years old concrete and concrete with epoxy resin coating (1 year old) with SRT <= 40 showed poor grip values. The floors were suitable as walking surfaces in cattle buildings. A recently installed brushed concrete had acceptable grip at SRT of 49, whereas mastic asphalt coating resulted in excellent good and sufficient grip. Mastic asphalt has even if it is 5 years old good grip properties.

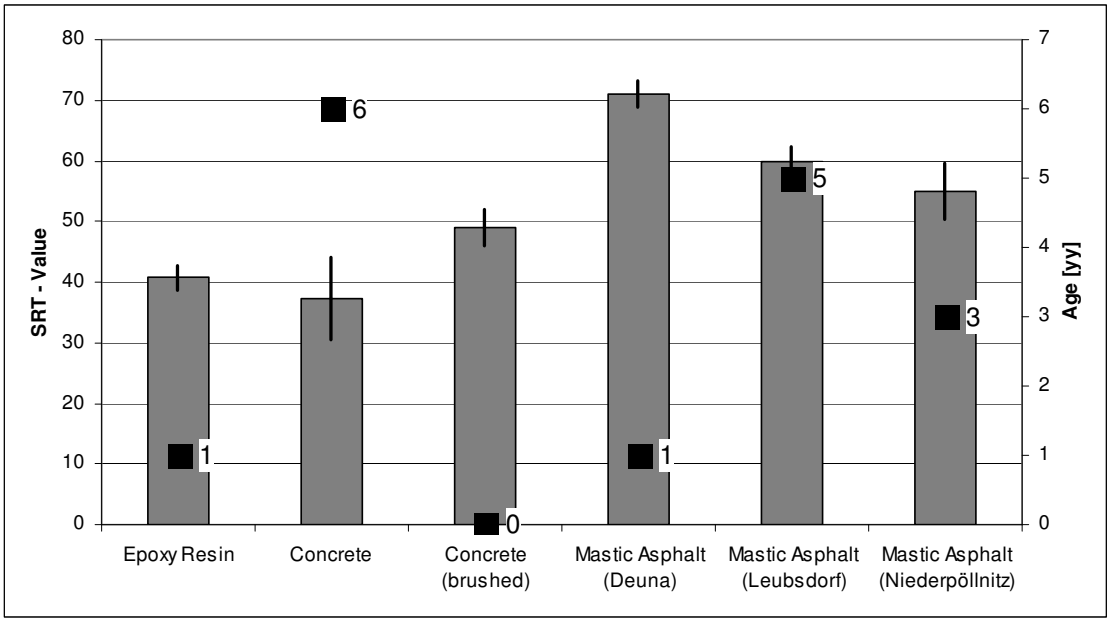

Figure 4. SRT-values for 6 different floor types (grey column) and age in years (black square).

In order to show how farmers could improve a poor grip of concrete floors, we measured concrete floors and epoxy coated floors before and after renovation. The results are shown in Figure 5. Grinding of poor screeded concrete resulted in good grip of SRT = 55. An epoxy resin coated floor with slippery properties was sandblasted to improve grip. The sandblasted epoxy floor had increased SRT-values of 44 which maybe sufficient.

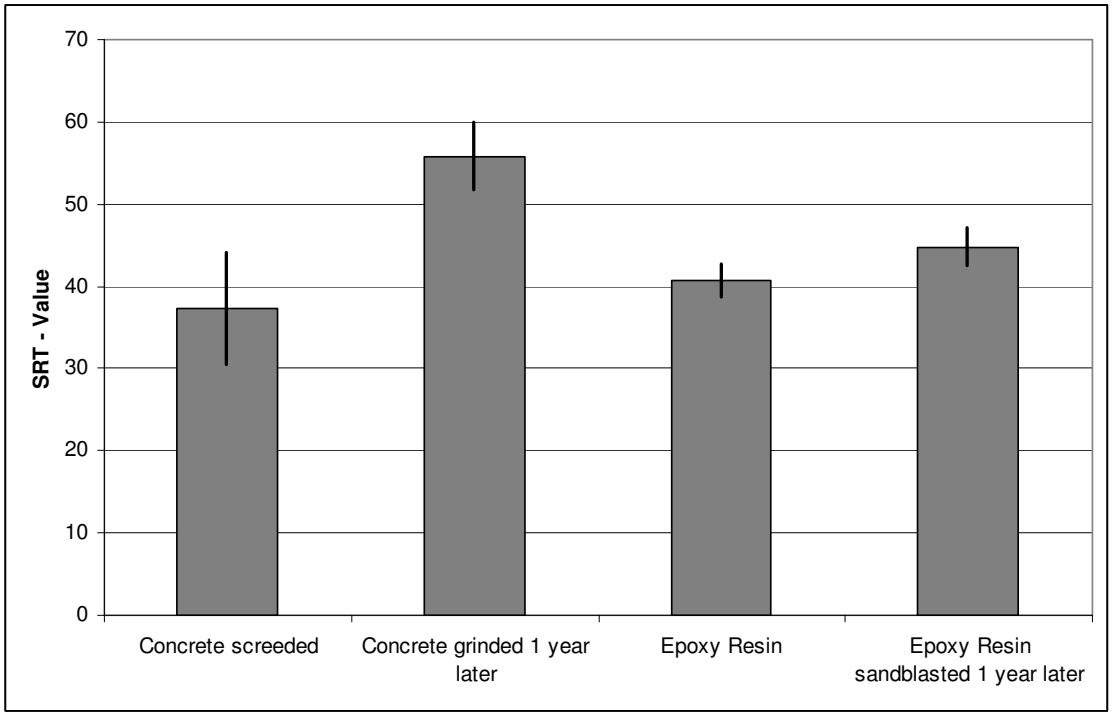

Figure 5: Concrete and epoxy resin coated concrete before and after processing.

DISCUSSION Results of SRT-values indicate that uncoated concrete should either be coated with mastic asphalt in order to get durable grip or – if left uncoated – finished by using a brush. Considering results of Franck et al. (2007) mastic asphalt can maintain grip for a long time. The reason can be a changed micro-roughness, even mastic asphalt gets eroded by cleaning device and faeces. As a result, "peaks" of rigid components remain within the surface and thus lead to constantly high SRT-values. Concrete will remain or erode to a slippery surface within the same time. Our results seem to be in line with those of Van der Tol et al. (2005), who stated, that the dynamic coefficient of friction of concrete, which is highly correlated with SRT-values, is not suitable for an unrestrained cattle locomotion. Epoxy resin as coating remained even after sandblasting relatively slippery and had lower SRT-values compared to grinded concrete surface.

CONCLUSION Mastic asphalt seems to be a durable coating with high grip for a period of 8 to 10 years, even if the micro-roughness will be changed. Due to possibly higher abrasiveness of older mastic asphalt, wet passageways for cattle should be avoided in order to keep the claw dry and more resistant against erosion. Especially feeding passageways, where cows spend 5 – 6 hours per day, should be cleaned more frequently when using mastic asphalt. Even high quality concrete is eroded after a short period of 2 – 3 years and will be no longer a suitable surface for passageways in cattle buildings. Grinding may be an option to improve grip of uncoated concrete but can become costly. Epoxy coating in our case showed poor SRT results.

Acknowledgements The author wishes to thank Peter Kreimeier and Thilo Georg for their help to measure SRT-values under practical conditions.

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