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STUDY ON THE OPTIMIZATION OF CONCRETE SCREEDS IN ZOOTECHNICAL FARMS

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Abstract

Nowadays we are faced on a daily basis with the idea of being involved as much as possible in assuring the wellbeing of our planet. We are striving to implement a way of thinking that would eventually be a way of life, present in the zoo-technological farms as well. Our aim is to accomplish two main goals, firstly to have a civic contribution by strengthening the 3RE principals (Recycle - Reuse - Reduce) recycling used tires, giving them a brand-new purpose. Second, we want to improve the comfort of livestock by changing the mortar screed quality, found in cattle's stables. Optimising the Screed Mortar, we will manage to satisfy the needs of both farmers and livestock, all being an integral part of this research.

Key words: *concrete screed, recycling, waste.*

INTRODUCTION

Farmers, while trying to bring together, practicality and livestock comfort have reached the conclusion that a new way of cleaning filth is required, thus, they implemented the use of a rubber mat (Figure 1) over the 10-12 cm thick screed which had a layer of capillarity breakage of around 15 cm (Frederiksen et al., 2010). Conversely, researchers showed a spike in the number of afflictions found in bovines who were stepping and on concrete floors alone. According to Bergsten (1994), hard concrete floors increase the risk of subclinical laminitis (Figure 2) which makes young cattle limp.

Comparing a group of bovines brought up in a barnyard with rubber mat protection with another group of bovines raised in similar barnyard conditions but with a hard concrete floor, it was shown that the animals raised on the hard concrete floor had a lot more bleeding near the white line.

A fracture of the already loosened hemorrhagic wall, whilst the animal was rotating determined a fissure between the wall and hoof near the white line determining the formation of an abscess (Gîscă, 2011).

Figure 1. Concrete berth with rubber mat (Frederiksen et al., 2010)

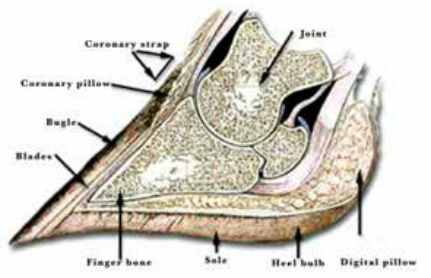

Figure 2. Section through the main tab (Gîscă, 2011)

The animal's comfort is of the highest importance, not just bovines, but of all animals. Cattle spend up to 15 hours in the resting zone, therefore their ability to relax greatly influences their behaviour and production. As it is expected discomfort in the resting zone, determines bovines to sit on all fours increasing the load, especially in the back feet, leading to bleeding of the hoofs and sever inflammation. An analogy can be made with the feeding or breeding grounds, where a lack of comfort can have similar consequences.

MATERIALS AND METHODS

The purpose of this paper is to highlight an innovative mortar recipe that intends to improve the comfort of livestock, just like the rubber mat did, focusing on eliminating the disadvantages of the rubber cover, such as slipping. According to Sârbu (2010), the surface on which the animals sleep, needs to be elastic, because a hard surface will determine not only hoof problems but also mammary afflictions. The surface also needs to be resistant to chemical agents found in animal waste and most importantly not be slippery. The rubber mat or mattresses from the shelters (https://www.rotaguido.it/dot%C4%83ri-pentru-stabula%C5%A3ie-liber%C4%83) used in the past, do not cover all the requirements highlighted above.

Proper collection of fecal materials, needs a 3% inclination (Figure 3), this has to be taken into consideration during the development of animal shelters, both in fixed and free stable (Vătămanu V., 2019).

We propose a floor mortar recipe which contains 5% natural hydraulic lime mortar NHL5 and rubber flakes in the same 5% proportion. This recipe, called MV5 5% F 5%, derived from the mortar recipe composed of Portland Cement 42.5 R, water and 5 types of sand (0.08-0.16; 0.16-0.5; 0.5-1; 1-2; 2-4), (Figures 4, 5).

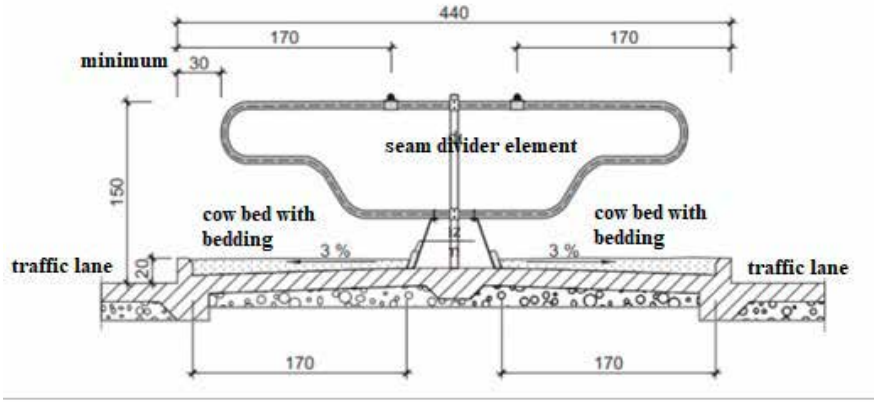

Figure 3 Detail of the cow shelter system
(Frederiksen et al., 2010)

Figure 4. Sand gauge

Figure 5. Rubber flakes recovered from the processing of used tires

Tests were performed for both recipes in order to compare bending and compression stress thus validating the difference in elasticity and resistance.
Eventually we performed an adherence (Figure 6) test as well, ever so important for the stability of the bovines on a wet surfaces (Cadar, 2022) caused by their manure.

Figure 6. Standard mortar adhesion test

Quantification methods and statistical analysis was used in interpreting the results.
The survey was another common method that we used in our research, collecting data from companies involved in the recycling of used tires.

RESULTS AND DISCUSSIONS

The results obtained are as anticipated, namely an increase in both elasticity and resistance and an improvement in regards to adherence. In the following we showcase our findings in a comparative manner for easier understanding (Table 1, Figure 7).

Table 1. Bending and compression tests for Standard Mortar (MS) and NHL5 and 5% and Rubber Flakes 5% (MV5 5% F 5%) - 3, 7 and 28 Days

Recipe	Days	Bending		Compression	
		F [kN]	R [N/mm^2]	F [kN]	R [N/mm^2]
MS	3	1570	367.97	28.42	17.01
	7	1690	401.53	29.42	18.13
	28	1790	432.81	31	19.79
MV5 5% F 5%	3	1210	310.97	16.45	10.27
	7	1296.67	349.53	21.38	13.36
	28	1810	450.81	32.66	20.41

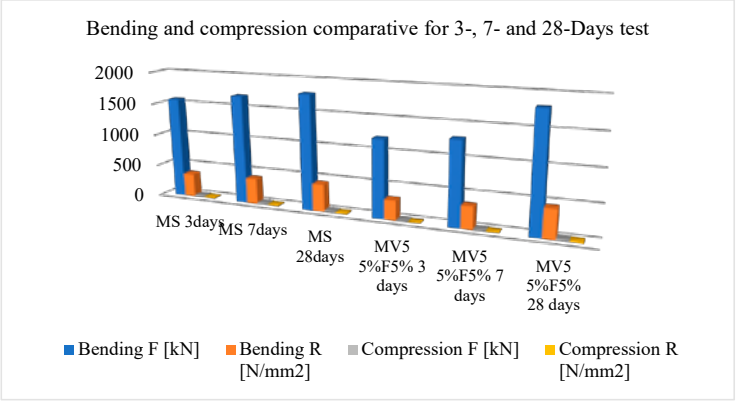

Figure 7. Bending and compression comparative for 3, 7 and 28-Days test

Comparing attempts at 3, 7 and 28 days we can observe that standard mortar shows better values, however as anticipated the most relevant tests were the ones performed at 28 days. It is well known that mortar resistance increases with the passage of time, as such 5% natural hydraulic lime mortar NHL5 with 5% rubber flakes shows the best values (Table 2 and Figure 8).

Table 2. Bending and compression tests for Standard Mortar (MS) and NHL5 5% and Rubber Flakes 5% (MV5 5% F 5%) - 28 Days

No.	Bending	Compression			
	F [kN]	F [kN]	R [N/mm^2]	F [kN]	R [N/mm^2]
MS	1790	31	19.79	30.58	18.79
MV5 5% F 5%	1810	32.66	20.41	30.59	19.34

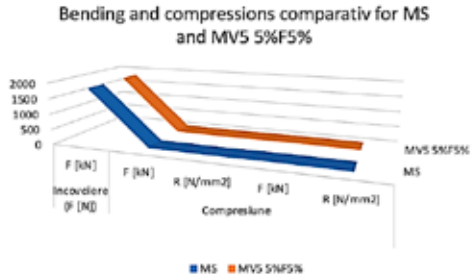

Figure 8. Bending and compression comparative for MS and MV5 5% F 5% at 28 Days

A slight increase of both bending and compression resistance can be seen for the MV5 5% F 5%, at the 28 days mark. Valuable information was also obtained in terms of adhesion tests at the 28 days mark (Table 3 and Figure 9).

Table 3. Adhesion tests for Standard Mortar (MS) and NHL5 5% and Rubber Flakes 5% (MV5 5% F 5%) - 3 and 28 Days

Adhesion	Compression	
	3 days	28 days
MS	2	119
MV5 5% F 5%	8	81

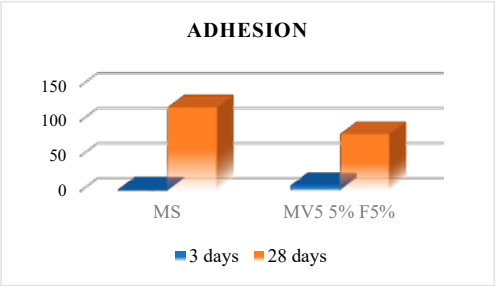

Figure 9. Adhesion test for MS and MV5 5% F 5% - 3 and 28 Days

CONCLUSIONS

The results of our research showed that the improved recipe had better result for both compressions and bending ((SR) EN 196). The mortar screed had higher elasticity and bigger load potential throughout the tests performed ((SR) EN 1015-11:2002/A1:2007).
Adherence was also showed to be better. The fact that we can now use an anti-slip surface will greatly improve the wellbeing of cattle. Another satisfactory conclusion is that the principal of the 3 RE (Recycle - Reuse - Reduce) can be uphold with ease, we can recycle and reuse rubber materials contributing to a cleaner environment.

We have taken steps towards improving our recipe by adding natural latex, enhancing the connection between components and yielding better overall results. Using latex will not only provide us with a more elastic material, but will also enable us to maintain the eco path on which we set out, giving bio-constructions a great alternative to traditional materials.

We are keen on employing only natural additives and natural coupling agents in order to improve the lifespan of animals breed in zoo-technological farms. Natural polymers are present in many of the articles published in the last couple of years, following a steady trend of returning to ecological materials (Aciu C. et al., 2018; Jumate E. et al., 2017). This has to do with both economic factors and planet saving concerns.

Why both factors are so important? In addition to the ecological aspect, we consider that the economic aspect is also very important, because the elaboration of a new material with the presented benefits must be cost efficient, otherwise it will not be sold in the market, which makes our product unfeasible. Thus, the price / benefit ratio must be a winning one. Following this situation, we can discuss profit and capital for permanent improvements, regarding the new patented ecological material.

For a large-scale use of the optimized recipe, we consider it appropriate because any additional resistance to both bending and compression, as well as adhesion.

The cost incurred by our recipe and mortar quantities are not so different but the overall result is way better. We can only recommend it due to the multiple advantages it has over the classical format.

There is more and more talk about green houses and passive houses, which represent a clear future direction towards our return to nature.

One cannot sufficiently emphasis how important it is to go back to traditional construction materials, optimized for bio-constructions which permits ecological building projects that in turn improve our ecosystem.

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