Peter Kreimeier, Brunswick

Design of Outside Pens Floors in Horse Keeping

From an ethological viewpoint a horse-friendly housing system has a freely accessible pen and can be used all year round. This makes pen floor design especially important. Numerous floor design systems are available on the market. In practice, muddy paddocks are widespread, which not only worries lower water authorities. To determine possible ground water and soil contamination, the experimental horse facility of the FAL-Institute of Process Engineering and Building Research is being examined, among other things, for animal- and eco-friendly housing systems with outside pens.

Horse husbandry systems with outside pens have distinguished themselves as an income-generating, sustainable part of agricultural recreational horse husbandry farms. These housing systems are in accordance with the natural desire for movement by the horses. The need for outside pen housing forms are supported by the „Guidelines for Assessing Animal Appropriate Horse Husbandry“ from the German Ministry for Food, Agriculture and Consumer Protection. Seasonal climate stimuli by having permanent access to paddocks or to outside pens have a particularly positive impact on the health of the animals.

Conflict in the Approval Practice

The year round outside pens for horses, which are to be welcomed from the perspective of animal welfare, spark vocal concern from an environmental perspective. The lower water authorities, which are responsible for environmental protection concerns, fear that year-round access to outside pens could, in comparison to paddocks, increase pollutant inputs on small unplanted areas, which would in turn present a danger for ground water. As a consequence of these fears, broad requirements exist for prospective construction projects with paddocks or outside pens. No consistent national or state-level regulations are in effect. The decision on the extent of the regulations rests at the county level - through the responsible government official.

The type of regulations range from no regulations to tight regulations, since there have been no estimates about the possible water pollution impact until now. In the guidelines for approving construction measures, complicated requirements can emerge, such as the paving of the total open pen with impermeable cement together with a collecting basin for surface water, e.g. a liquid manure or slurry container. Most of these regulations are drawn from guidelines for building manure storage facilities and forage fermentation silos.

Research on the Year Round Outside Pen Housing of Horses

In the horse testing facility of the Institute of Production Engineering and Construction Research of the German Federal Agricultural Research Centre (FAL), animal- and environmentally-appropriate systems with outside pens are systematically studied and further developed from constructional perspectives.

At the focus of the first studies are the interactions between the needs of the animal and environmental protection.

The construction concepts of the experimental station (*Fig. 1*) make a direct compa-

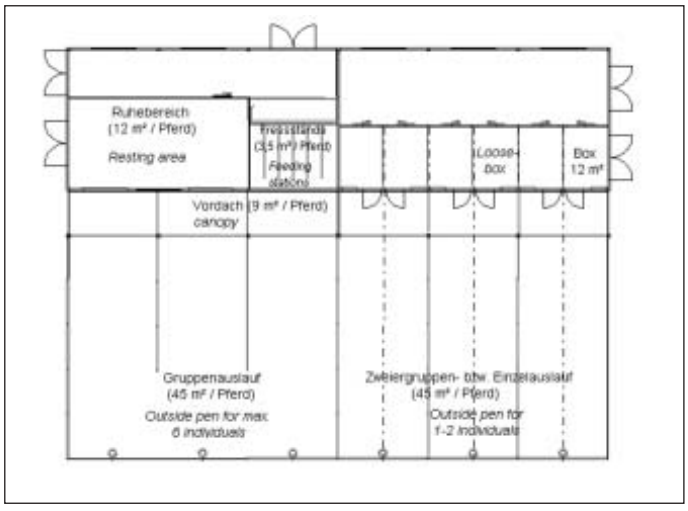

Fig. 1: Experimental stable for six horses each in single or double housing and in group housing with freely accessible outside pens

Dipl.-Ing. agr. Peter Kreimeier is a member of the scientific staff of the Institute of Production Engineering and Construction Research (director: Prof. Dr. agr. habil. Franz-Josef Bockisch) of the German Federal Agricultural Research Centre (FAL), Bundesallee 50, D-38116 Braunschweig;
e-mail: *franz.bockisch@fal.de*

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Fig. 2: Defecation behaviour in frontage of outside pen - here in front of the feeding stations

rison possible between individual and group husbandry systems in combination with outside pens for six large horses. Thus, impacts of the husbandry system or their constructional designs could simultaneously be tested for their impact on animals and environment.

The base frame of the outside pen is divided into six basins of equal size connected with the collection containers with pipes. Thus all precipitation can be stored and analysed. The water samples were examined for chemical parameters (ammonia, nitrate, phosphates, potassium, pH values) and biological parameters (total cell count, coliform bacteria, E. coli bacteria). In addition, soil samples were taken at three month intervals in the complete outside pen area. The water and soil analyses were carried out in cooperation with the Institute of Agricultural Ecology of the FAL.

Currently, the top layer consists of washed sand. For the purpose of the experiments, this layer is between 45 and 70 cm thick. The differing depths result from the slanted base frame. Glass fleece was placed beneath this layer to prevent the sand from entering the drainage layer (20 cm) which is made of round gravel.

This simple construction was selected for the first studies, firstly, because it is inexpensive, and secondly because it provides safe footing for the animals, good shock absorbency and good water permeability. This type of floor represents the practices in actual use - topsoil removal, construction of a drainage level with a separating fleece and an upper level of sand. The danger in this type of flooring with its good water permeability is that contaminated leaching water can reach the ground water. The goal of the study is to establish the stress on soil and water in an outside pen with an artificial floor (gravel/fleece/sand) under practical conditions. The daily removal of horse manure in the outside pen is assumed under good professional practice. On the basis of these studies, measures of various nature for the protection of water and soil shall be studied.

Animal Behavior as an Influencing Factor for Possible Soil and Water Contamination

In the context of a master thesis [1], six Hanover brood mares were studied in terms of movement activity, resting behavior and excrement behavior in three husbandry systems with free outdoor access.

The first variation was carried out in single box stables with individual outside access (EH). In the second variation, called double housing (ZH) here, a dividing fence was removed so that a common outside pen was available for two horses. The individual boxes were retained, but the horses were free to visit each other. In the last variation, all six horses were kept in group housing (GH). At least one week was provided for each of the study to help the horses become accustomed to the new conditions. The study followed in the two consecutive weeks. The horses were monitored continuously by video throughout the entire time period. In each study variation, a continuous recording process was evaluated for three days. The horse could be monitored for a total of 22 of 24 hours per day. The other two hours were spent on the paddock.

The evaluation of the monitoring showed no significant differences between the different variants with regard to the excremental behaviour of the horses. When the horses were able to freely choose their location, then urination activity occurred to 90 percent in the stable on a littered lying or box area. The type, and apparently also the depth of the litter, seem to subjectively have a greater influence on urination than the husbandry system. In the figure it is clear that in an average of the study variations, about 50 percent of the defecation takes place in the roofed stable areas. In the directly connected front area of the outside pen (*Fig. 2*), in an average of the study variations, about 45% of the defecation could be observed. In contrast, the other parts of the outside pen were seldomly used for defecation by the horses.

The relative percentage of dwelling times (*Fig. 3*) in roofed areas was between 70 and 80 percent depending on the type of housing. The remaining percentage of the horse's time was spent in the outside pen. If one compares the amount of time spent in the front of the outside pen directly next to the stable and the defecation taking place in that period, then it can be concluded that horses seek particular areas to defecate.

Conclusions

In consideration of these observations, it is apparently sufficient to pave only partial areas through simple constructional measures in order to prevent leached water contamination in the outside pen. This shows that the remaining outside pen can be designed in a relatively generous manner. Numerous flooring systems are available, which differ in how they function. Some are water permeable, and others are almost impermeable. In impermeable systems, precipitation is eliminated through a slight slant in the floor. Thus for each area of use several possibilities to create the floor are available. The question remains, whether a filter effect exists in certain types of flooring. This question will be addressed in subsequent studies when this study is completed.

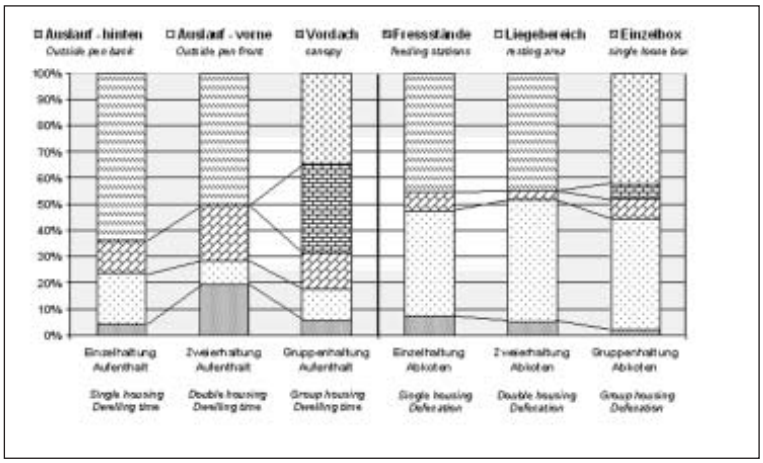

Fig. 3: Comparing dwelling times and defecation behaviour within the functional areas of the housing systems