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# Environmental Protection in Slurry Storage

*Building slurry stores, as well as all parts related to the runoff of animal waste, is becoming more and more difficult due to increasing restrictions. It is nearly impossible to get a building permit for a bigger unit without an appraiser's evaluation. While construction tests in the past focussed on whether the containers were tight, little attention was given to the surrounding area. A test facility of the Institute of Production Engineering and Building Research at the test station of the Federal Agricultural Research Centre (FAL) in Braunschweig delved into this question. First results are presented here.*

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The procedures to get a permit for the building of slurry stores are still to difficult, they take too much time and they become moreover difficult due to the fact, that an increasing number of different authorities is involved. In Germany and its neighbour countries the authorities focus on the term „tightness". In a wider sense the German Water Act (WHG) points out that „no disregarded materials may penetrate into the soils, which also means into the groundwater". In the USA they perform hydrological measurements concerning the load of water in the surrounding of farm steads with livestock farming [1].

### Materials and Methods

At the beginning penetration tests with different liquids into concrete of the allotted qualities B25 WU (water tight) and B35 WU (water tight) were carried out in a cooperation with the supervising authority of the Braunschweig Civil Engineering Materials Testing Institute (MPA), which is connected to the Institute for Building Materials, Concrete Structures and Fire Protection of the Technical University Braunschweig by a cooperation agreement [2]. The pressure of the liquids proved to be the most important parameter, not the duration of pressure, as many experts predicted.

The most important results are shown in *table 1*. According to these results the maximum penetration is already reached after a short period of time. This value remains constant, which can be explained by a balance of vapour pressure. In comparison to the former tests on penetration, conducted with a pressure of 10 times of the maximum natural one, according to DIN, these results are much lower. At the same time it is clear, that all penetration depths are closely related to the dry matter content of the respective liquid.

The generally accepted fist formula says

*Table 1: Maximum penetration of different liquids into concrete B25 WU*

| Liquid | Maximum penetration depths [mm] | | | | | |
|---|---|---|---|---|---|---|
| | 14 days | | 28 days | | 35 days | |
| | n | x̄ | n | x̄ | n | x̄ |
| • Water | 3, 5, 5 | 4.5 | 4, 5, 6 | 5.0 | 4, 6, 8 | 6.0 |
| • Dung water | 4, 4, 4 | 4.0 | 4, 4, 5 | 4.3 | 4, 4, 6 | 5.0 |
| • Slurry | 3, 3, 4 | 3.3 | 3, 3, 3 | 3.3 | 3, 4, 4 | 3.7 |

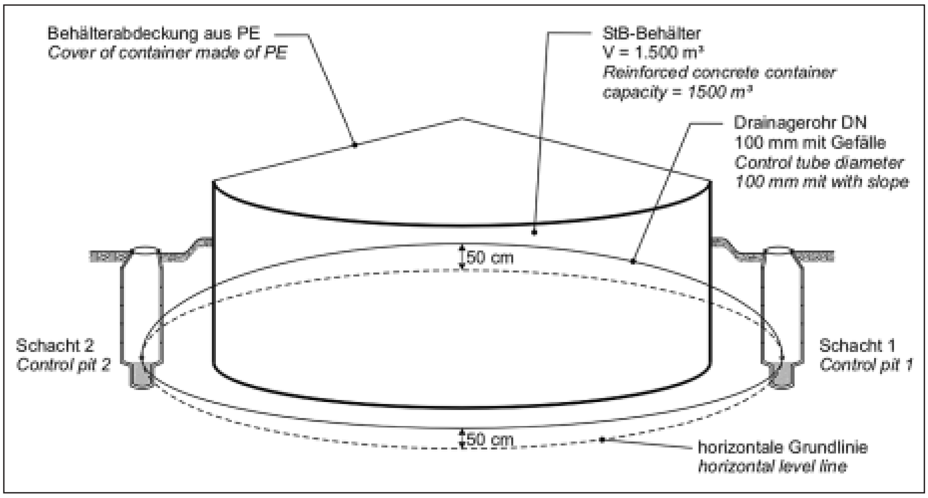


*Fig. 1: Slurry container made of reinforced concrete with leakage control (sketch)*

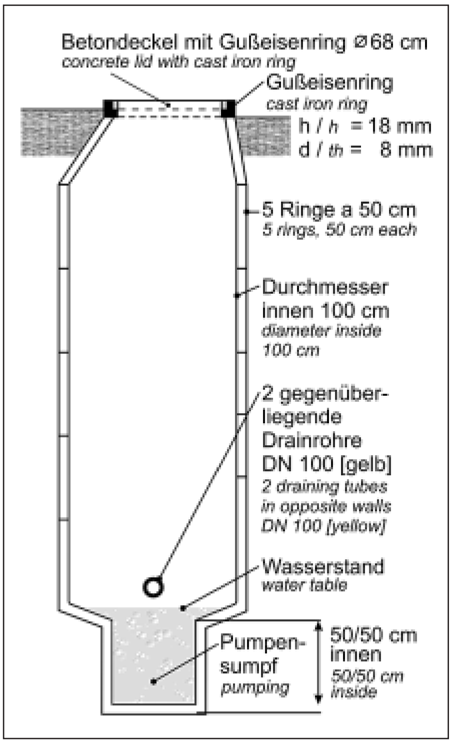


*Fig. 2: Control pit for slurry containers*

that a higher dry matter content results in a smaller penetration depth. Even dry matter contents of very tiny particles lead to a considerable self tightening of the concrete [3]. This proves, that the 80ies attempts to demand the composition of concrete used for the building of slurry containers according to the width of possible slits are no longer useful. Of course, this does not mean slits originating from construction mistakes.

### Analysis of soluble entries in a drainage control system

When a new slurry container with a capacity of 1.500 m$^3$ was built in the Test Station of the Federal Research Centre, a drainage control system was implemented. This system consists of two drainage control tubes (diameter 100 mm), both of them going into a control pit via a slope of 50 cm of height each, which are situated on the opposite side of the container (*Fig. 1*). This slope makes sure that a liquid which may originate in the surrounding of the slurry container will flow into one of these control pits.

By principle the control pits are built the same way as those made for underground building from rings of concrete; but additionally they contain a pump sump with 50 by 50 by 50 cm each. This size is big enough for a normal water pump as can be bought from dealers (*Fig. 2*). The ground plate of the control pits can easily be reached by a ladder of cast iron steps, which are mounted to the wall (for clarity they are not shown). Above the pump sump the ends of the drainage tubes are situated (diameter 100 mm, yellow).

When building the control pits, the possible mistake must be eliminated that rain water or horizontally flowing water above impenetrable ground layers flows into the system. This was managed by implementation of a plastic layer above the control pits, which was put on drainage grave (*Fig. 3*).

Several extreme rainfalls at the end of summer 2004 lead to a considerable rise of the groundwater table within few days. This made soil particles, solved into water, penetrate into the control drainage system. The procedure could be confirmed by a camera, which moved into both directions from the control pits. The liquid ran into the pump sump of the control pits and was taken there for analysis. The analysis was carried out by the Institute of Technology and Biosystems Engineering of the FAL immediately and showed the results to be seen in *table 2*.

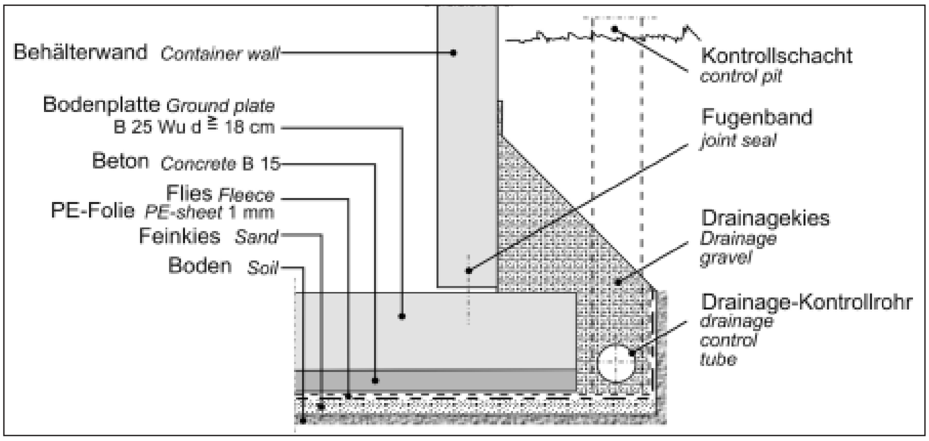


*Fig. 3: Positioning of a drainage control tube*

As can be seen, the liquid of the control pits did not show any traces of slurry. The $NH_4$-content could nearly not be proved; the $NH_3$-content equals that of rain water.

This allows to state that the technical construction of the reservoir as well as its connection to the runoff-system does not harm the environment. If the construction is done according to the „accepted rules of art“ (anerkannte Regeln der Baukunst), no further measures are necessary. This is also true for the leakage control system described before, for common building practice it is not necessary.

## Literature


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[2] *Krentler, J.-G., A.W. Gutsch und D. Weiß*: Güllebehälter aus Stahlbeton: Untersuchungen zur technischen Sicherheit. Landtechnik 56 (2001), H. 1, S. 46-47

[3] *Krentler, J.-G.*: Gülle lagern: Was wird wirklich gebraucht? Eilbote (Sonderteil Landtechnik) 52 (2004), H. 25, S. 11-13


| | pit west pump sump without sediment | pit east pump sump with sediment | pit east pump sump without sediment |
|---|---|---|---|
| pH | 9.36 | 8.5 | 8.55 |
| $NH_4$ [mg/g] | 0.02 | 0.02 | 0.02 |
| CSB [mg/l] | 149 | 337 | 258 |
| $NO_2$-N [mg/l] | n.n. | n.n. | n.n |
| $NO_3$-N [mg/l] | 1.4 | 0.74 | 1.4 |

*Table 2: Analyses in the bottom of a control pit for slurry containers*