**Errata** 2011-12

# SKB TR-10-15

# Design, production and initial state of the buffer

In the earlier distributed report, there are errors that have now been corrected. The corrected pages 50, 51, 80, are enclosed. The changed text is marked with a vertical line in the page margin. An updated pdf version of the report, dated 2011-12, can be found at www.skb.se/publications.

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### 5.1.5 The design parameters and production-inspection schemes

The design parameters are the parameters that in Section 3.1 (Table 3-1, Table 3-3, Table 3-4, Figure 3-1, Figure 3-2 and Figure 3-3) were used to specify the reference design of the buffer. These parameters shall, directly or indirectly, be inspected during the production of the buffer to verify that the produced buffer conform to the reference design. The outcome of the design parameters need to be known for the initial state. The properties required with respect to the long-term safety and the production (Section 2.3), the design parameters and the parameters inspected in the production and their relations are presented in Table 5-2.

To give an overview of the production, *production-inspection schemes* illustrating the main parts of the production and their included stages are established. For each illustrated stage the design parameters and the processes performed to alter and/or inspect them are presented. Details about the production processes are given in the text about each stage. The text about each stage also includes a presentation of the inspections performed within the stage. The methods for test and inspection are presented separately for each main part of the production. The production-inspection schemes for the excavation and delivery and manufacturing of blocks and pellets are shown in Figure 5-2 and the production-inspection scheme for the handling and installation of the buffer is given in Figure 5-3.

**Table 5-2. Buffer – required properties and related design parameters and parameters inspected in the production.**

| Required property | Design parameter | Parameter inspected in the production |
|---|---|---|
| Material composition | Montmorillonite content | X-ray diffraction pattern |
| | Sulphide content | Combustion gases |
| | Total sulphur content (including the sulphide) | Combustion gases |
| | Organic carbon | Combustion gases |
| Compaction properties of material ready for compaction | Granule size distribution | Sieving curve |
| | Water content | Weight before and after drying |
| Density and dimensions of blocks | Bulk density | Weight and dimensions |
| | Dimensions | Height<br>Diameter (outer)<br>Hole diameter (ring shaped blocks)<br>Details according to Figure 3-2 |
| Density and dimensions of pellets | Dimensions | Thickness of individual pellet<br>Width of individual pellet<br>Length of individual pellet |
| | Bulk density loose filling | Weight and volume of loose material |
| Installed density | Bulk density of blocks | Weight and dimensions of installed blocks |
| | Bulk density of pellet filling | Weight and volume of installed pellets |
| | Width of pellet filled gap | Geometry of deposition hole[1]<br>Position of installed blocks in the deposition hole |
| Installed geometry | Buffer thickness | Dimensions of deposition hole[1]<br>Dimensions of installed blocks<br>Positions of installed blocks in the deposition hole |
| | Width of pellet filled gap | Dimensions of deposition hole[1]<br>Dimensions of installed blocks<br>Positions of installed blocks in the deposition hole |
| | Diameter of hole within the installed blocks | Dimensions of installed blocks<br>Positions of installed blocks in the deposition hole |

[1] From the **Underground openings construction report**.

In the production-inspection schemes stages where the design parameters are processed are marked with blue colour. Light blue is used for any processing of design parameters and darker blue is used for processes that finally determine one or several design parameters. Determining a parameter means that the parameter is determined within the stage and that no active efforts are, or can be, made to alter it in the following stages of the production.

For the tests and inspections orange colour is used. Lighter colour is used for any inspections of the design parameters during the production and darker orange is used for final test and inspections. After final inspection no further inspections are possible to perform.

Stages where the design parameters are not processed but can be affected are marked with grey colour. Grey colour is also used for inspections of conditions that may impact the design parameters.

| | | 4.2 Excavation and delivery | | | 4.3 Manufacturing of blocks and pellets | | |
|---|---|---|---|---|---|---|---|
| **Property** | **Design parameter** | **Excavation and delivery for shipment** | **Material delivery and intermediate storage** | **Transport to and storage at production plant** | **Conditioning of the bentonite** | **Pressing of blocks / Pressing of pellets** | **Machining of blocks** |
| Material composition | Montmorillonite | Excavation | | | | | |
| | | (By supplier) | X-ray diffractation | – | – | X-ray diffractation | |
| | Organic carbon | Excavation | | | | | |
| | | (By supplier) | Heating in furnace | – | – | Heating in furnace | |
| | Sulphide | Excavation | | | | | |
| | | (By supplier) | Heating in furnace | – | – | Heating in furnace | |
| | Total sulphur | Excavation | | | | | |
| | | (By supplier) | Heating in furnace | – | – | Heating in furnace | |
| Compaction properties | Granule size distribution | Grinding | – | – | Grinding | | |
| | | (By supplier) | Sieving | – | Sieving | | |
| | Water content | Drying | Storage | Transport and storage | Mixing | | |
| | | (By supplier) | Drying in micro wave oven | – | Drying in oven | Drying in micro wave oven | |
| Density and dimensions of blocks | Bulk density | – | – | – | – | Pressing | |
| | | – | – | – | – | Weighing and calliper | Weighing |
| | Dimensions | – | – | – | – | Pressing | Machining |
| | | – | – | – | – | Calliper | Calliper |
| Density and dimensions of pellets | Dimensions | – | – | – | – | Pressing | |
| | | – | – | – | – | Calliper | |
| | Bulk density loose filling | – | – | – | – | Pressing | |
| | | – | – | – | – | Weighing of defined volume | – |

***Figure 5-2.*** *Production-inspection scheme for the excavation and delivery and manufacturing of blocks and pellets. Blue colour is used for processing of the design parameter and orange for inspection, darker colour illustrate final processing or inspection. Grey colour show stages where the design parameters may be affected but no processing occurs (also see explanation to the colours is given in text above).*

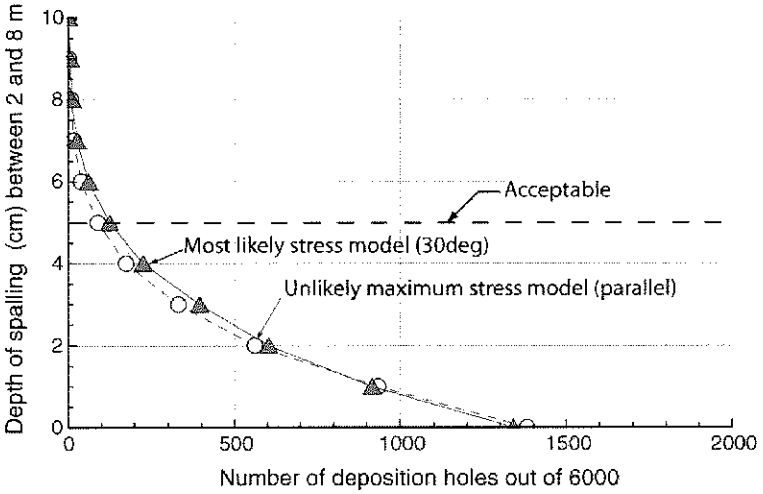


*Figure 6-4. The number of deposition holes where the spalling reaches different depths for the "most likely" stress model with the deposition tunnel at 30 degrees to the maximum horizontal stress and the "Unlikely maximum" stress model with the deposition tunnel parallel to the maximum horizontal stress, see Section 4.3 in the* ***Underground openings construction report.***

Based on the distribution in block densities given in Table 6-3 the variation in saturated density can be calculated for accepted increases in width of the pellet filled gap, or deposition hole radius, from the nominal. Results from such calculations are given in Table 6-6. For a straight deposition hole with nominal diameter the increase in width of the pellet filled gap corresponds to the maximum accepted depth of spalling. The number of deposition holes where this depth of spalling may occur according to Section 4.3 in the **Underground openings construction report** is also given in Table 6-6. If the diameter deviates from the nominal the accepted depth of spalling is altered accordingly. If the deposition hole is not straight the accepted spalling decreases accordingly.

### 6.1.5 Buffer geometry

#### *Thickness around the canister*

The thickness around the canister will for the installed buffer deviate from the nominal thickness, i.e. 35 cm. The installed buffer thickness will depend on the diameter of the deposition hole and its variation along the hole and on the position of the ring shaped blocks within it. The buffer thickness will also be affected by the position of the canister within the ring shaped blocks and the diameter of the canister. The canister will be guided so it is placed centred within the buffer rings. The impact of the variation in canister placement and canister diameter on the buffer thickness can be neglected. The variation in buffer thickness will, in similarity to the installed density, mainly depend on:

- variations of the diameter of the deposition hole,
- the placement of the buffer blocks with respect to the centre line of the deposition hole,
- the occurrence of spalling.

**Table 6-6. Results of calculations of the saturated buffer density at the canister sections for accepted increases in width of the pellet filled gap from the nominal.**

| Allowed increase in widht of pellet filled gap (m) | Number of deposition holes out of 6,000 with corresponding depth of spalling | 99.9% confidence interval for the buffer density at saturation (kg/m³) | (kg/m³) |
|---|---|---|---|
| 0.050 | 150 | 1,933 | 1,948 |
| 0.040 | 200 | 1,946 | 1,961 |
| 0.030 | 400 | 1,959 | 1,974 |
| 0.020 | 600 | 1,972 | 1,988 |
| 0.010 | 950 | 1,986 | 2,003 |