Buffer swelling and homogenisation – laboratory tests

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Introduction

Swelling and homogenisation of the bentonite buffer in the Swedish KBS-3 repository for spent nuclear fuel are important functions to guarantee the requirements both during wetting and after full water saturation. Swelling at different geometries and subsequent homogenisation of compacted specimens of different bentonites are studied in a number of laboratory tests. The project consists of four parts; theoretical studies, fundamental laboratory tests, laboratory study of the influence of friction and large scale tests of the scenario involving loss of bentonite.

Examples of test results

In the series with fundamental laboratory tests the specimens are axially compacted to an initial dry density of approximately 1660 kg/m^3. Axial and radial swelling of 0% - 100% of the original volume are studied in three different test series with different types of geometries, see Figure 1. The majority of the tests are made with specimens having a diameter of 50 mm and a height between 20 and 40 mm.

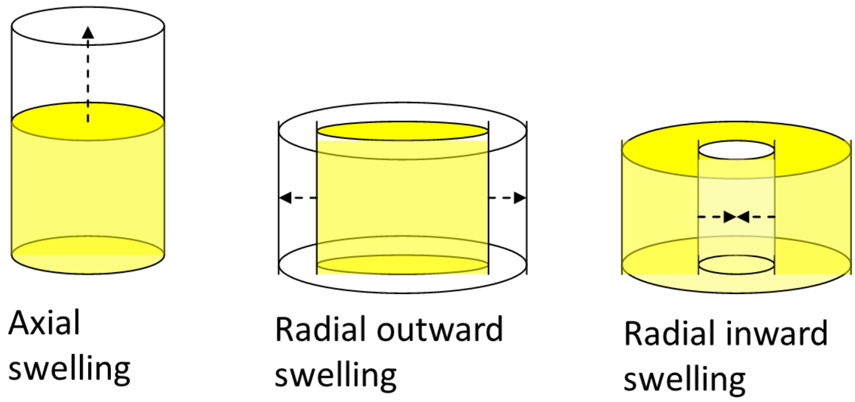

Figure 1. *Illustration of the geometry of the test types carried out.*

The development of swelling pressure, measured as stresses, is measured both in direction of swelling and in the perpendicular direction throughout the tests. After the tests the specimens are dismantled and the density and water ratio distribution are determined. Examples of test results are given in Figure 2.

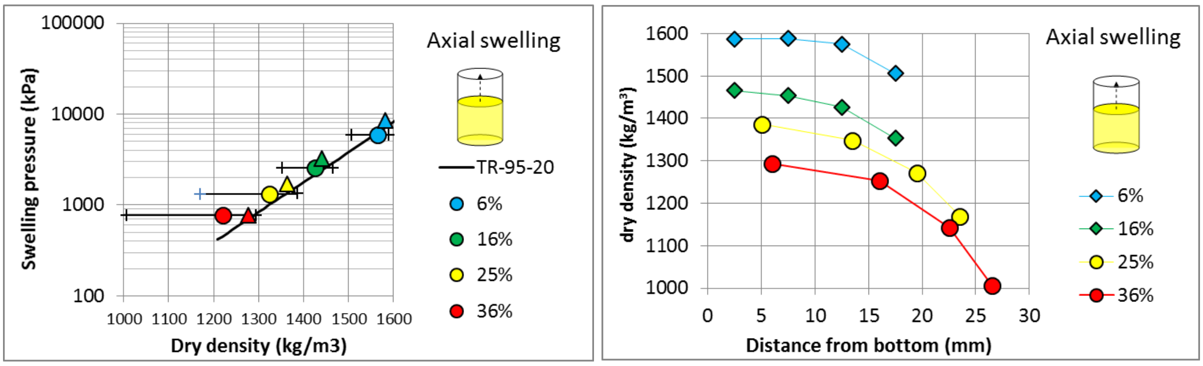

__Figure 2.__ Test results measured after axial swelling of four specimens; Swelling pressures as a function of dry density (to the left) and dry density as a function of distance from the bottom (to the right). The colours (blue, green, yellow, red) denote the size of the axial swelling (6%, 16%, 25%, 36%). The swelling pressures (to the left) were measured as stresses in the direction of swelling (circles) and perpendicular to the direction of swelling (triangles).

The swelling pressure measurements show that the swelling pressures are generally lower in the swelling direction than perpendicular to the swelling direction after completed swelling and that the average measured swelling pressures fairly well correspond to earlier measured swelling pressures from tests with no swelling involved (black solid line in Figure 2). After completed swelling and homogenisation a gradient in density that increases with increasing swelling is measured in the tests.

Tests are also made in a larger size, which give the possibility to measure gradients in radial stresses (Figure 3) and to measure density distributions in more detail.

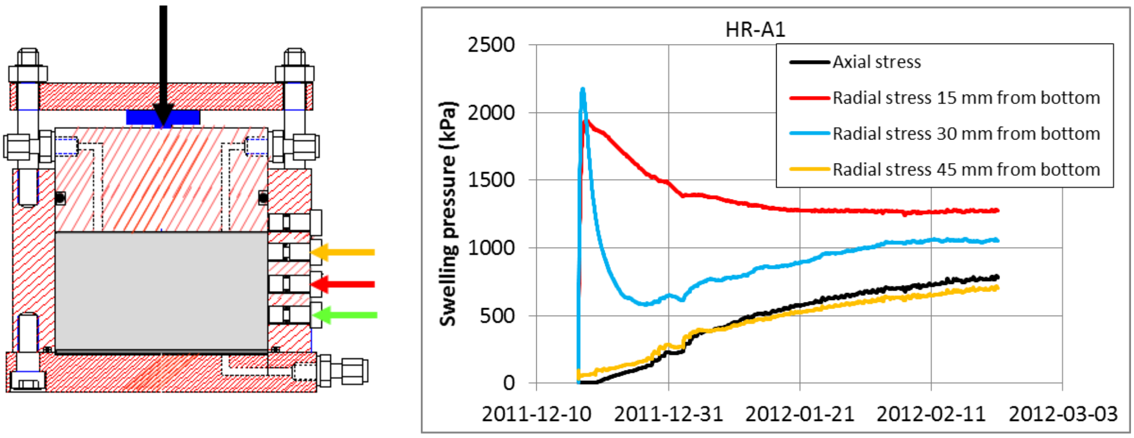

__Figure 3.__ Test set-up (to the left) and measured swelling pressure (to the right) after axial swelling. Swelling pressure measured as axial stress (black line) and radial stresses (red, blue and yellow line) measured at different distances from the bottom.

References

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