

Table of Content

Abstract.....	I
Kurzfassung.....	II
Acknowledgement.....	III
1 Introduction.....	1
2 Basics for the investigation of crushed salt compaction	5
2.1 The rock salt barrier - form of occurrence	5
2.2 Functions of crushed salt backfill	8
2.3 Some remarks on quality assurance of crushed salt backfill during emplacement	12
3 Natural and technical analogues and microstructural relevance.....	15
3.1 Importance of natural and technical analogues.....	15
3.1.1 Natural analogues – primary genesis of salt rocks	15
3.1.2 Natural analogues – diagenetic changes of petrophysical properties	17
3.1.3 Technical analogues.....	20
3.2 Microstructural processes and hydromechanical interactions	23
3.2.1 Overview of experimental methods.....	23
3.2.2 Optical microscopy	23
3.2.3 Fundamentals: Deformation mechanisms – dry/wet conditions.....	25
3.2.4 Synoptic view of hydro-mechanical interactions and microstructure.....	29
4 Experimental work.....	33
4.1 Overview and discussion of existing experimental database.....	33
4.2 Material selection.....	35
4.2.1 Synthetic crushed salt mixture /lithological reference parameters	35
4.2.2 Porosity	38
4.3 Microstructural analysis of loose crushed salt material.....	39

4.4	Oedometric tests on two crushed salt samples from bedded salt layers in Teutschenthal, Germany	42
4.4.1	Introduction.....	42
4.4.2	Material and methodology.....	42
4.4.3	Results and discussion	46
4.4.4	Conclusion on crushed salt tests from the bedded salt deposits Teutschenthal	51
4.5	Pre-compaction tests	51
4.5.1	Plain strain compaction by TUC.....	53
4.5.2	Pre-tests by IfG – Small compaction cell.....	66
4.5.3	Big-compaction cell by IfG	68
4.5.4	BGR pre-compaction	75
4.6	Long-term triaxial tests.....	76
4.6.1	Triaxial compaction tests TK-031 and TK-033	78
4.6.2	Isostatic long-term compaction test by IfG	83
4.7	Microstructural analysis of experimental compacted crushed salt	92
4.7.1	Microstructures in pre-compacted samples.....	92
4.7.2	Microstructures in long-term compacted samples	103
4.8	New experimental methods for the determination of THM-coupled long-term behaviour	108
4.8.1	Design and construction of the new compaction cell.....	108
4.8.2	Two pilot tests from the laboratory program approach with innovative operational modes TUC-V2 and TUC-V3.....	115
5	Modelling work.....	123
5.1	Requirements	123
5.1.1	Requirements from repository layout	123
5.1.2	Requirements for the numerical model	126
5.2	Existing constitutive models for crushed salt.....	141
5.2.1	BGR-CS3 model.....	141
5.2.2	Callahan model.....	146
5.2.3	CODE_BRIGHT model	155

5.2.4	C-WIPP model.....	159
5.2.5	C-WIPP modified by BGE-TEC.....	160
5.2.6	C-WIPP modified by the IfG.....	162
5.2.7	C-WIPP modified by TUC	164
5.2.8	Modified Hein model	177
5.3	Analysis of the existing constitutive model approaches.....	183
5.3.1	Methodological approach for comparative constitutive model analysis...	183
5.3.2	Overview of the existing constitutive model approaches for crushed salt: similarities, differences and need for validation	185
5.4	Benchmarking tests	189
5.4.1	Approaches of the individual modelling groups	190
5.4.2	Evaluation of modelling results	255
6	Conclusion and future recommendations	261
6.1	Summary	261
6.2	Future recommendations	263
6.2.1	Microstructure investigations	263
6.2.2	Laboratory plans for the next project phase: plane strain pre-compaction by TUC	264
6.2.3	Laboratory plans for the next project phase: long-term compaction behaviour.....	266
6.2.4	Numerical modelling	287
	References	293
	List of figures.....	307
	List of tables	319