



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

SAND2013-3973P

Salt Progress 2013

**UFD Working Group Meeting
Las Vegas, NV
May 21, 2013**

**Robert J. MacKinnon for Francis D. Hansen
Sandia National Laboratories
SAND 2013-XXXX**

Salt Activities

- Reconsolidation of granular salt at elevated temperature
- Thermal conductivity $f(t, \phi)$
- Elevated temperature tests on WIPP salt
- Joint Project benchmarking
- Salt international collaboration

Reconsolidation of Granular Salt at Elevated Temperature

Level II Deliverable

COUPLED THERMAL-
HYDROLOGICAL-MECHANICAL
PROCESSES IN SALT: HOT
GRANULAR SALT
CONSOLIDATION, CONSTITUTIVE
MODEL AND MICROMECHANICS

Fuel Cycle Research & Development

Prepared for
US Department of Energy
UFD Campaign
F.D. Hansen, S.J. Bauer,
S.T. Broome
Sandia National Laboratories
G.D. Callahan
RESPEC
November 15, 2012
FCRD-UFD-2012-000422
SAND2012-9893P



SNL-FCT-TP-11-0001
Revision 1
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Sandia National Laboratories
Fuel Cycle Technology (FCT) Program

Consolidation of Crushed Salt at Temperatures up to 250°C, under
Hydrostatic and Shear Stresses, Rev. 1

Effective Date: 06/06/2012

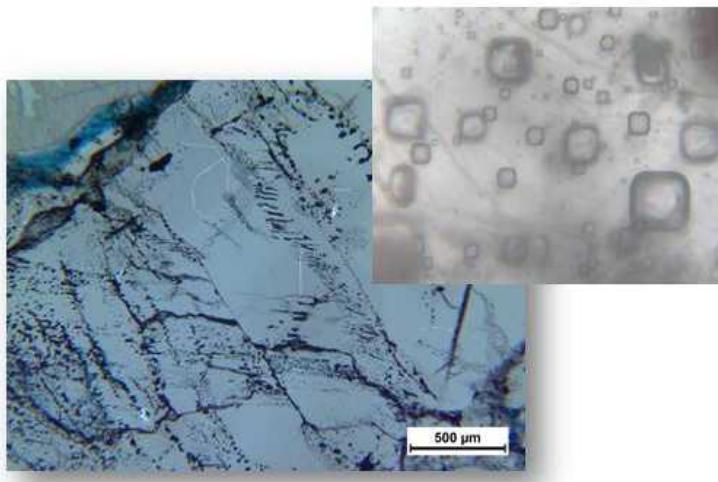
Stephen Bauer
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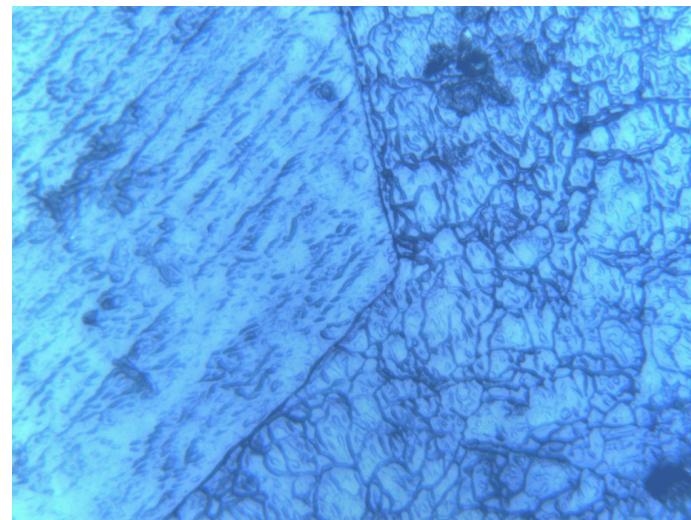
Work Underway

Reconsolidation of Granular Salt at Elevated Temperature

Natural Fluid
Inclusions



Migrating Inclusions
during Consolidation



Recrystallization during
Reconsolidation

Thermal Conductivity as a Function of Temperature and Porosity

SNL-FCT-TP-12-0001
Revision 0
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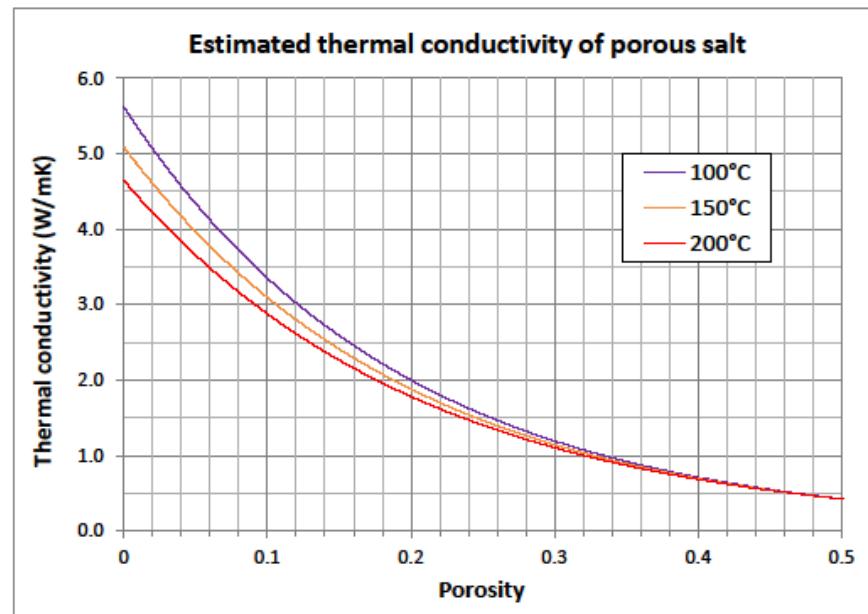
Sandia National Laboratories
Fuel Cycle Technology (FCT) Program

Thermal Conductivity of Crushed Salt
Rev. 0

Effective Date: _____

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Elevated Temperature Tests on WIPP Salt

SNL-FCT-TP-xx-000x
Initial Issue
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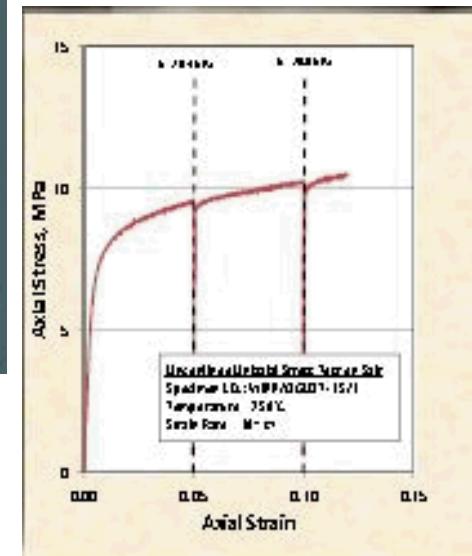
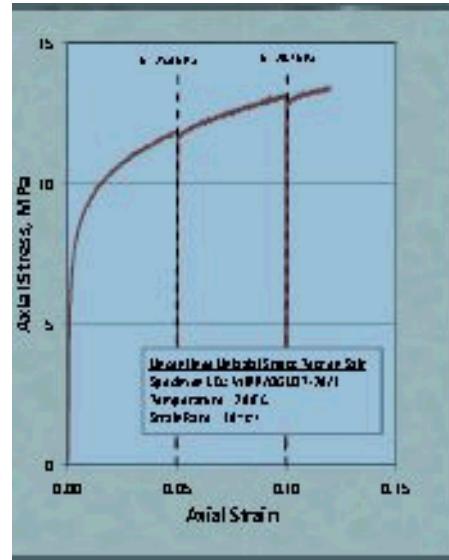
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Sandia National Laboratories
Fuel Cycle Technology (FCT) Program

Elevated Temperature Unconfined Compression Tests on Salt

Effective Date: February 14, 2013

Kirby D. Mellegard, Principal Investigator
Manager, Materials Testing
RESPEC
P.O. Box 725
Rapid City, SD 57709



Work Underway

Typical Test Results

Elevated Temperature Tests on WIPP Salt



Decrepitation at 275C



Plastic flow at 250C

10/2010 Start of Joint Project III

- Asse Benchmark Study on Temperature Influence and Healing

10/2012 Today

- Simulations of a Drift with a Bulkhead in the Asse Mine
- German Testing of WIPP Salt

9/2013 Current End of Subprojects

10/2013 Intended Start of Extension

- WIPP Benchmark Study

WIPP Salt Sent to Germany Researchers



Sieved Run-of-Mine WIPP Salt used in Testing.



300 mm Diameter WIPP Core.

4th US/German Workshop on Salt Repository Research, Design and Operations

Suggested Topics

- German Program (VSG, DAEF)
- Salt Club Meeting Report
- FEP-Catalogue
- Uncertainties in Safety Case
- Scenario Development
- Contributions of Analogues
- Operational Phase Safety
- Plugging and Sealing
- Rock/Salt Mechanics (THM-Modelling)
- Geochemical Issues
- Repository Design and Operations
- Miscellaneous Topics
- Technical Tours: ERAM, ASSE, Staßfurt
- Sept 2013 Berlin

*Proceedings of 3rd
US/German Workshop
on Salt Repository
Research, Design and
Operation*

Fuel Cycle Research & Development

Prepared for
U.S. Department of Energy
Used Fuel Disposition Campaign
Francis D. Hansen, Kristopher L. Kuhlman
Sandia National Laboratories
Walter Stelninger
Karlsruhe Institute of Technology
Enrique Biurrun
DBE Technology
February 14, 2013
FCRD-UFD-2013-000100
SAND 2013-1231P



Level II Milestone

- Safety Case
- Benchmarking
- Reconsolidation

A core group (Steering Committee) was nominated for the member nations of the Salt Club:

- Germany (E. Biurrun/DBE TEC and J. Mönig/GRS/Chair)
- United States (F. Hansen/Sandia/Co-Chair and A. van Luik/DOE)
- Poland (Andrzej Chwas)
- Netherlands (Erika Neeft, Jacques Grupa, Ewoud Verhoef)

Salt Club undertakings are responsive to the NEA/IGSC goals and therefore reach a wider distribution and more extensive applicability.

3rd US/German Workshop on Salt Repository Research, Design and Operations



	Name	Org		Name	Org		Name	Org		Name	Org		Name	Org	
21	Arguello, J. Guadalupe	SNL	22	Fahlund, Sandra	SGR	30	Jobmann, Michael	DBETEC	3	Nair, Prasad	DOE-NE	20	Stahmann, Joachim	TUFS	
4	Bauer, Steve	SNL	24	Freeze, Geoff	SNL	31	Klein, Tom	URS-RES	8	Orrell, Andrew	SNL	44	Staudtmeister, Kurt	IUB Hannover	
23	Bean, Jim	SNL	25	Gährken, Andreas	TUBS	32	Lax, Kar-Heinz	TUC	36	Pilzschke, Elmar	TUC	11	Steininger, Werner	KIT-PTKA	
38	Becker, Dirk-Alexander	GRS	26	Gardner, W. Peyton	CNWR/NSWR	33	Kuhmann, Kris	SNL	49	Popp, Till	IFG	61	Thompson, Bill	Golden	
10	Bilurun, Enrique	DBETEC	27	Ghosh, Amitava	GRS	34	Lee, Joon	SNL	50	Pudewillis, Alexandra	KIT-INE	Missing	Wang, Yifeng	SNL	
46	Bollingerer, Wilhelm	DBETEC	28	Grisie, Werner	IRG	35	Leigh, Christi	SNL	41	Robinson, Bruce	LANL	28	Wieczorek, Klaus	GRS	
14	Broom, Scott	SNL	29	Guerin, David	LANL	36	Leugier, Bastian	IUB Hannover	23	Rosell, Gregory	SNL	47	Wolf, Jens	GRS	
34	Büner, Michael	KIT-PTKA	30	Günther, Ralf-Michael	IRG	37	Levitt, Christian	SNL	52	Sallaberry, Cedric	SNL	56	Yildirim, Savaş	IUB Hannover	
2	Bushman, Nancy	US DOE-EM	31	Gunter, Tim	DOE-NE	38	McKinnon, Robert	SNL	5	Sambeek, Leo Van	RESPEC	55	Zepf, Dirk	IUB Hannover	
1	Callahan, Gary	RESPEC	42	Hampel, Andreas	Hampel Consulting	39	Mauke, Ralf	EFS	48	Schuhm, Michael	SNL				
Missing	Camphouse, Chris	SNL	9	Hansen, Frank	SNL	40	Mellegard, Kirby	RESPEC	29	Selz, Stephen	USHRC				
Missing	Colon, Carlos F. Jove	SNL	52	Hardin, Ernest	TUC	41	Miller, Andy	SNL	6	Seyoumian, S. David	SNL				
43	Dunigan, Sean	SNL	31	Herchen, Kai	TUC	42	Missel, Christian	TUBS	Missing	Shotemaker, Paul E.	SNL				
12	Düsterloch, Uwe	TUC	60	Houseworth, James	BNL	43	Müller, Christian	DBETEC	15	Sobolik, Steven	SNL				

