

Recent Progress in the DEOX Process

2006 ANS Annual Meeting

B.R. Westphal

K.J. Bateman

R.P. Lind

D.L. Wahlquist

June 2006

The INL is a
U.S. Department of Energy
National Laboratory
operated by
Battelle Energy Alliance



This is a preprint of a paper intended for publication in a journal or proceedings. Since changes may be made before publication, this preprint should not be cited or reproduced without permission of the author. This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, or any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any information, apparatus, product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights. The views expressed in this paper are not necessarily those of the United States Government or the sponsoring agency.

Recent Progress in the DEOX Process

B.R. Westphal, K.J. Bateman, R.P. Lind, and D.L. Wahlquist

Idaho National Laboratory: P.O. Box 1625, Idaho Falls, ID, 83415, and brian.westphal@inl.gov

INTRODUCTION

A head-end processing step is being developed for the treatment of spent oxide fuel by either aqueous or pyrochemical technologies. The head-end step, termed DEOX for its emphasis on decladding via oxidation, employs high temperatures to promote the oxidation of UO_2 to U_3O_8 via an oxygen carrier gas. During oxidation, the spent fuel experiences a 30% increase in lattice structure volume resulting in the separation of fuel from cladding. An added benefit of the head-end step is the removal of fission products, either via direct release from the broken fuel structure or via oxidation and volatilization by the high temperature process.

The DEOX program at the Idaho National Laboratory has progressed from an initial exploratory phase, where the objective was the optimization of particle size and fuel-clad separation [1], to a phase more applicable to current flowsheet development, i.e. the removal and collection of targeted fission products [2]. The behavior of fission products has been investigated via testing with irradiated spent fuel to determine the effects of temperature, pressure, oxidative gas, and cladding on the removal efficiencies of targeted fission products. In addition, a preliminary design for the retention of fission products in an off-gas treatment system has been initiated as part of a collaborative effort with Korea Atomic Energy Research Institute through an International Nuclear Energy Research Initiative (I-NERI).

RECENT PROGRESS

Using a set low temperature oxidation cycle near 500°C , additional conditions have been applied to distinguish their effects on the removal of targeted fission products. Both oxygen and air have been utilized during the oxidation portion followed by vacuum conditions to temperatures as high as 1050°C . In addition, the effects of cladding on fission product removal have also been investigated with released fuel to temperatures greater than 500°C . Results from these experiments as well as those from on-going tests will be presented.

Shown in Fig. 1 is the conceptual design for a vertical split tube furnace which includes four separately controlled heating zones. The lowest zone contains the spent oxide fuel while the upper three zones are for the collection of specific off-gassed fission products. The sealed inner assembly will have the ability to be remotely disassembled so that the trapping units with filter media

can be individually analyzed. Design and fabrication efforts for this furnace are currently being performed.

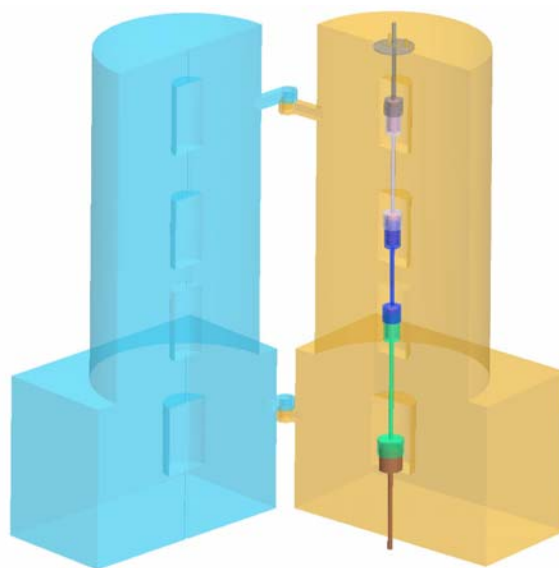


Fig. 1. DEOX Furnace with Off-Gas Treatment System Assembly.

REFERENCES

1. B.R. WESTPHAL et al., "Results of Phase I Testing for the DEOX Process," *Trans. Am. Nucl. Soc.*, **91**, pp. 519-20 (2004).
2. B.R. WESTPHAL, K.J. BATEMAN, R.P. LIND, K.L. HOWDEN, and G.D. DEL CUL, "Fission Product Removal from Spent Oxide Fuel by Head-End Processing", *Proc. Global 2005*, AESJ, Tsukuba, Japan (2005).