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COMPOSITION OF SIMULANT USING THE EVALUATION OF ELECTROCHEMICAL PROCESS TREATMENT FOR HIGH-LEVEL WASTE (U)

by

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**Composition of Simulants Used in the Evaluation
of Electrochemical Processes
for the Treatment of High-Level Wastes (U)**

June 27, 1994

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Prepared for the Department of Energy Office of Technology Development, Office of
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SUMMARY

Four simulants are being used in the evaluation of electrochemical processes for the treatment of high-level wastes (HLW). These simulants represent waste presently stored at the Hanford, Idaho Falls, Oak Ridge, and Savannah River sites. Three of the simulants are highly alkaline salt solutions (Hanford, Oak Ridge, and Savannah River), and one is highly acidic (Idaho Falls).

INTRODUCTION

Production of nuclear materials within the DOE complex has produced large volumes of high-level waste containing hazardous species such as nitrate, nitrite, chromium, cadmium, and mercury. The presence of organic compounds in some of the wastes also presents concerns during interim storage of the waste and during subsequent treatment for permanent disposal. Electrochemical treatment is being evaluated as a possible technology for the destruction of nitrate, nitrite and organic compounds as well as the removal of radionuclides and hazardous metals from the waste solutions. Initial evaluations will be carried out with non-radioactive solutions simulating HLW presently stored at each of the sites. This report provides the composition of the simulants being used in these evaluations.

RESULTS AND DISCUSSION

Weight percent and molar concentrations for each species for the four simulants representing Hanford Concentrated Neutralized Tank Waste, Idaho Falls Sodium-Bearing Waste, Oak Ridge Melton Valley Storage Tank Supernate Waste, and Savannah River Site Decontaminated Salt Solution Waste are provided in Tables I-IV.

The HLW stored at Hanford, Idaho Falls, Oak Ridge, and Savannah River sites represents a large majority of the HLW presently stored within the DOE complex. The HLW is stored as highly alkaline solutions at Hanford, Oak Ridge, and Savannah River, but as strongly acidic solution at Idaho Falls. The Idaho Falls waste contains high concentrations of sodium and aluminum in addition to nitrate. Because of the acidity, the waste does not contain nitrite. Minor components in the Idaho Falls waste that are hazardous and may be electrochemically active include chromium, cadmium, and nickel.

The HLW at Hanford, Oak Ridge and Savannah River are similar in that all contain high concentrations of nitrate and sodium. The Hanford and Savannah River wastes contain high concentrations of nitrite and hydroxide, whereas the Oak Ridge waste does not. The Hanford waste also contains appreciable quantities of organic complexants such as ethylenediaminetetraacetic acid, that is not present in either the Oak Ridge or the Savannah River wastes. The Oak Ridge waste contains a much higher concentration of potassium relative to sodium than either the Hanford or Savannah River wastes. Other species present in the wastes include carbonate, sulfate, chloride, fluoride, phosphate, silicate, and chromate.

During the course of the evaluations, the composition of the simulants may be changed to simplify the simulant or determine the effect of changes in one or more components on the electrochemical treatment process. The composition of all simulants used in the testing will be documented and compared with that of the reference compositions provided in Tables I-IV.

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Table I. Composition of Hanford Concentrated Neutralized Tank Waste Simulant (SY1-SIM-93A)

Density 1.2 g/mL

Component	Concentration^a	
	<u>Weight %</u>	<u>mole/L</u>
Na	7.05	3.7
Al	1.12	0.50
Cr	0.14	0.033
Ca	8.0E-03	2.4E-03
Fe	9.7E-03	2.1E-03
K	0.11	0.035
Ni	5.2E-03	1.1E-03
Zn	7.1E-04	1.3E-04
Cs	4.9E-04	4.0E-05
Sr	2.1E-05	2.9E-06
NO ₃ ⁻	4.07	0.79
NO ₂ ⁻	3.65	0.96
OH ⁻	1.02	0.72
TIC, C as Carbonate	0.22	0.22
TOC, C as EDTA	0.53	0.053
PO ₄ ³⁻	0.22	0.028
SO ₄ ²⁻	0.14	0.017
Cl ⁻	0.27	0.093
F ⁻	0.01	6.7E-03
H ₂ O	78.46	52.3

^a reference [1]

TIC=Total Inorganic Carbon, TOC = Total Organic Carbon

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Table II. Composition of Idaho Falls Sodium-Bearing Waste Simulant

Density 1.2 g/mL

<u>Component</u>	<u>Concentration^a</u>	
	<u>Weight %</u>	<u>mole/L</u>
HNO ₃	7.88	1.5
Al	1.23	0.545
Na	2.54	1.33
NO ₃	22.1	4.27
Cr	2.49E-02	5.74E-03
Cd	1.72E-02	1.84E-03
Ni	1.07E-02	2.19E-03

^a references [2-5]**Table III. Composition of Oak Ridge Melton Valley Storage Tank Supernate Waste**

Density 1.242 g/mL

<u>Component</u>	<u>Concentration^a</u>	
	<u>Weight %</u>	<u>mole/L</u>
NaNO ₃	26.7	3.9
NaOH	0.77	0.24
Na ₂ CO ₃	1.2	0.14
CaCO ₃	8.1E-04	1.0E-04
Al(NO ₃) ₃	0.086	5.0E-03
KNO ₃	1.6	0.2
NaCl	0.47	0.1
Zn(NO ₃) ₂	0.020	0.001

^a references [6,7]

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Table IV. Composition of SRS Decontaminated Salt Solution Waste

Density 1.21 g/mL

Component	Concentration^a	
	Weight %	mole/L
NaNO ₃	13.7	1.95
NaNO ₂	3.40	0.60
NaOH	4.42	1.33
NaAl(OH) ₄	3.0	0.31
Na ₂ CO ₃	1.4	0.16
Na ₂ SO ₄	1.6	0.14
NaCl	0.10	0.22
NaF	0.052	0.015
KNO ₃	0.13	0.015
Na ₂ SiO ₃	0.038	0.0038
Na ₃ PO ₄	0.12	0.0085
Na ₂ CrO ₄	0.044	0.0033
NaB(C ₆ H ₅) ₄	0.072	0.0026
Na ₂ [Ru(NO)(NO ₂) ₄ (OH)] ^b	1.4E-03	4.5E-05
HgCl ₂	4.9E-05	2.2E-06

^a reference [8]^b model compound for family of nitrosyl ruthenium compounds that may be present in the waste [9,10]**ACKNOWLEDGEMENTS**

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REFERENCES

1. T. M. Hohl, "Synthetic Waste Formulations for Representing Hanford Tank Waste," WHC-SD-WM-TI-549, Rev. 0, April 23, 1993.
2. B. L. Bergeson and R. D. Boardman, "Update of Sodium-Bearing Waste Tanks Composition and Volume," Letter Memorandum to Distribution, September 24, 1993.
3. R. I. Donovan, RID-08-89, to A. P. Hoskins, "1989 Tank Farm Inventory," dated August 14, 1989.

4. K. J. Rebish, KJR-06-93, J. M. Roberts, "Tank Farm Composition History," dated August 2, 1993.
5. R. K. Hague, RKH-18-89, to R. I. Donovan, "Actinide Analysis Results," dated July 7, 1989.
6. T. E. Kent, W. D. Arnold, W. D. Bond, J. L. Collins, P. A. Taylor, and D. F. Williams, "Overview of Laboratory Treatment Studies for Decontamination of Liquid Low-Level Waste Oak Ridge National Laboratory," Proceedings of the Conference Waste Management '93, Volume 2, Tucson, AZ, 1993.
7. J. L. Collins, D. J. Davidson, C. W. Chase, B. Z. Egan, D. D. Ensor, R. M. Bright, D. C. Glasgow, "Development and Testing of Ion Exchangers for Treatment of Liquid Wastes at Oak Ridge National Laboratory," ORNL/TM-12315, March, 1993.
8. Basic Data Report, Defense Waste Processing Facility Sludge Plant, DPSP-80-1033, Rev. 90, Volume 2, Appendix G, April 1985.
9. H. Pollack and R. M. Wallace, "Behavior and Identification of Extractable Ruthenium," DP-344, March, 1959.
10. J. M. Fletcher, I. L. Jenkins, F. M. Lever, F. S. Martin, A. R. Powell, and R. Todd, L. Inorg. and Nucl. Chem., 1 (1955), 378-401.

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