

Cs-135 Content of Cesium Capsules and Strontium/Cesium Heat Sources

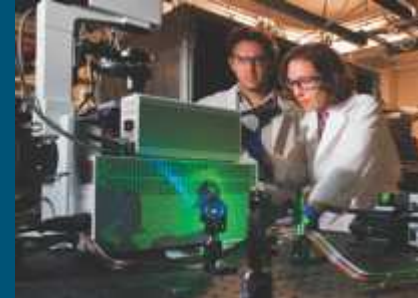
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- Background
- Waste Characteristics
- Quantity of ^{135}Cs in cesium capsules
- Quantity of ^{135}Cs in strontium and cesium heat sources
- Conclusion

- The U.S. Department of Energy manages 1,335 cesium capsules and 34 strontium and cesium heat sources at the Hanford Site
- Multiple cesium isotopes are present in the capsules
- Multiple strontium and cesium isotopes are present in the heat sources
- Of the multiple isotopes, ^{90}Sr and ^{137}Cs are of concern for storage, transfers, transportation, and preclosure and handling phases of disposal
- Of the cesium isotopes, ^{135}Cs is of concern for postclosure performance assessment of the repository in which the wastes are eventually disposed of
- The ^{135}Cs content of these wastes is not reported
- Purpose of this study is to estimate the quantity of ^{135}Cs present in these wastes

Waste Characteristics

■ Cesium Capsules

- Cesium extracted from liquid waste in tanks at Hanford between 1974 and 1983 as CsCl
- 1,335 capsules are double-walled cylinders 21 inches tall, 3 inches in diameter
- Stored in pools at Hanford
- Cesium inventory information from Hanford tank inventory information and destructive testing of capsules.
- Currently managed as high level waste

■ Strontium and cesium heat sources

- Cesium and strontium extracted from B-Plant complex at Hanford in 1986 and 1987
- Formed into 34 glass logs 4 feet tall, 1 foot in diameter
- Stored in six CASTOR and two GNS casks at Hanford
- Cesium inventory information from Hanford tank inventory for B-Plant
- Currently managed as transuranic waste

Quantity of ^{135}Cs in Cesium Capsules

- Cesium in capsules came from four reprocessing plants
 - T-plant (1956)
 - B-plant (1956)
 - REDOX (1967)
 - PUREX (1988)
- Wootan and Finfrock (2002) calculated radionuclide inventories (curies) in tanks using ORIGEN2 and DKPRO
 - Fuel type
 - Fuel burnup
 - Reactor type
 - Decay
 - Method of reprocessing
 - Decay date of January 1, 2001
- Calculated activity ratio and mass ratio of ^{135}Cs to ^{137}Cs from the averaged tank data

Quantity of ^{135}Cs in Cesium Capsules (cont'd)

- Sasmor et al. (1988) destructively tested seven cesium capsules
- They measured atom percents of the cesium isotopes in each capsule
- Derived activity ratio and mass ratio of ^{135}Cs to ^{137}Cs from the data
- Calculated activity ratio and mass ratio of ^{135}Cs to ^{137}Cs in 2016 and found the average from all eight data points
 - Activity ratio: $1.2\text{E-}5$
 - Mass Ratio: $8.7\text{E-}1$
- Multiplied ratios by reported total curies and mass of ^{137}Cs in the capsules as of 2016
- Result
 - 388 Curies of ^{135}Cs in the capsules
 - 337 kg of ^{135}Cs in the capsules

Quantity of ^{135}Cs in Strontium/Cesium Heat Sources

- Cesium in heat sources came from the B-Plant
- Used B-plant inventory data from Wootan and Finfrock (2002) for ^{135}Cs and ^{137}Cs
- Calculated activity and mass ratio of ^{135}Cs to ^{137}Cs from B-plant data as of 2001, then adjusted ratios to 1987, the year ^{137}Cs inventory is reported
 - Activity ratio: $9.7\text{E-}6$
 - Mass ratio: $7.3\text{E-}1$
- Multiplied ratios by reported total curies of ^{137}Cs in heat sources as of 1987
- Results
 - 49 Curies of ^{135}Cs in the heat sources
 - 43 kg of ^{135}Cs in the heat sources

- Two wastes that DOE manages contain unreported quantities of ^{135}Cs
- Quantities of ^{135}Cs need to be known for postclosure performance assessment calculations
- It is possible to estimate the quantity of ^{135}Cs in these wastes
- Quantity in capsules: 388 Curies (337 kg)
- Quantity in strontium and cesium heat sources: 49 Curies (43 kg)

- Wootan, D.W. and S.F. Finfrock, 2002. "Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989," RPP-13489, Rev. 0, Fluor Hanford, Richland, WA.
- Sasmor, D. J., J. D. Pierce, G. L. Tingey, H. E. Kjarmo, J. Tillis, and D. C. McKeon, 1988. "Characterization of Two WESF Capsules After Five Years of Service," SAND86-2808, Sandia National Laboratories, Albuquerque, NM.