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Power (SNAP)-Isotopic SNAP Program
M-3679 (52nd ed.)

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COMPATIBILITY DATA SHEETS FOR CERIUM-144,
CESIUM-137, CURIUM, AND STRONTIUM-90

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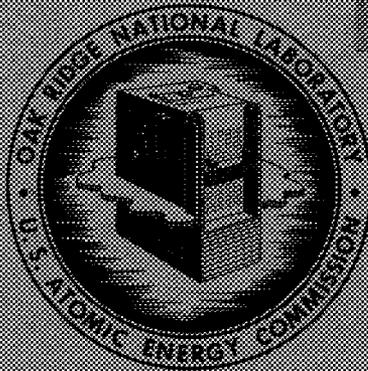
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CRNL-4189

Contract No. W-7405-eng-26

ISOTOPES DEVELOPMENT CENTER

COMPATIBILITY DATA SHEETS FOR CERIUM-144,
CESIUM-137, CURIUM, AND STRONTIUM-90

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E. E. Ketchen

Isotopes Division

NOVEMBER 1967

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
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CONTENTS

	<u>Page</u>
CERIUM-144	1
CERIUM OXYSULFIDE (Ce_2O_2S)	1
CERIUM SULFIDE (Ce_2S_3)	1
CEROUS FLUORIDE (CeF_3)	1
CESIUM-137	2
CESIUM CHLORIDE ($CsCl$)	2
CURIUM	2
CURIUM-244 SESQUIOXIDE (Cm_2O_3)	2
CURIUM-242 OXIDE CERMET	2
STRONTIUM-90	3
STRONTIUM-90 METAL	3
STRONTIUM TITANATE ($SrTiO_3$)	3
STRONTIUM OXIDE (SrO)	3
STRONTIUM FLUORIDE (SrF_2)	4

COMPATIBILITY DATA SHEETS FOR CERIUM-144,
CESIUM-137, CURIUM, AND STRONTIUM-90

CERIUM-144

CERIUM OXYSULFIDE (Ce₂O₂S)

REFERENCE COLUMN

The compatibility of Ce₂O₂S with various containment materials at 1000°C and at 1850°C is summarized as follows. 1

<u>Container material</u>	<u>Maximum penetration observed, mils</u>		
	<u>168 hr</u>	<u>500 hr</u>	<u>1000 hr</u>
<u>1000°C</u>			
Hastelloy X	No attack	Traces	Traces
Tungsten	No attack	No attack	2.0
N-155	2.5	—	—
Nionel	2.0	—	—
<u>1850°C</u>			
Molybdenum	No attack	No attack	Traces
Tantalum	Traces	Traces	Traces
Tungsten	Traces	Traces	Traces

CERIUM SULFIDE (Ce₂S₃)

The compatibility of Ce₂S₃ with various containment materials at 1000°C is summarized as follows. 2, 3

<u>Container material</u>	<u>Maximum penetration observed, mils</u>		
	<u>168 hr</u>	<u>500 hr</u>	<u>1000 hr</u>
Haynes 25	1.5	1.5	2.0
Molybdenum	0.1	0.1	1.0
Tantalum	No attack	Traces	0.5-1.0
Tungsten	No attack	No attack	No attack
TZM	0.1	0.2-1.0	1.0
Hastelloy X	No attack	No attack	Traces
Nionel	No attack	6	6
N-155	Traces	Traces	Traces

CEROUS FLUORIDE (CeF₃)

The compatibility of CeF₃ with various containment materials at 1000°C for 1000 hr is as follows. 4

<u>Container material</u>	<u>Remarks</u>
Hastelloy X	Slight reaction
Haynes 25	Slight reaction
Molybdenum	No visible reaction
Niobium	No visible reaction
Nionel	No visible reaction
N-155	No visible reaction
Tantalum	Slight reaction
Tungsten	Some reaction

CESIUM-137

REFERENCE COLUMNCESIUM CHLORIDE (CsCl)

A CsCl source which was encapsulated in stainless steel and contained 1540 curies of ^{137}Cs showed no signs of reaction after being opened nine years later. The source operated at slightly above ambient room temperature.

5

CURIUM

CURIUM-244 SESQUIOXIDE (Cm_2O_3)

A molybdenum alloy containing 0.5% titanium and 0.1% zirconium (TZM) was contacted with an oxide mixture containing 29 wt % $^{244}\text{Cm}_2\text{O}_3$, 57 wt % $^{241}\text{AmO}_2$, and 14 wt % $^{239}\text{PuO}_2$. Static capsule tests at 1100°C for periods of 250 and 1000 hr and at 2000°C for 25 hr showed no reaction with molybdenum, even though the oxide fuel was molten at 2000°C.

6

<u>System</u>	<u>Temp, °C</u>	<u>Time, hr</u>	<u>Atm</u>	<u>Extent of reaction</u>	
Cm_2O_3 powder in W crucible	1800	8	Vacuum	None detected visually	7
Cm_2O_3 powder on W filament	2150 (melted)	1	4% H_2 - 96% He	No reaction, wetting, or penetration detected by metallography or by fission fragment autoradiography	7
Cm_2O_3 powder on Ir filament	2150 (melted)	1	He	Curium penetration and surface reaction	7
Cm_2O_3 powder on Pt-50% Rh filament	1700	10	O_2	No curium penetration but possible surface reaction	7
13 vol % B-type Cm_2O_3 in a Ta matrix	1400	12	10^{-6} torr	An unidentified reaction product was observed by metallography and X-ray diffraction	8

CURIUM-242 OXIDE CERMET

Tests at 1100°C for 1000 hr and at 2000°C for 24 hr with an oxide mixture containing 29 wt % Cm_2O_3 , 57 wt % AmO_2 , and 14 wt % PuO_2 showed that this oxide mixture was compatible with the alloy Mo-0.5% Ti-0.1% Zr (TZM).

6

With the use of iridium in a metal-metal oxide cermet, alloying of iridium with molybdenum was observed at 2000°C. Also the molten oxide mix appeared to react with iridium to form a lower melting alloy. At 1000°C the reaction between iridium and molybdenum was too slow to be observed, at least over a period of time of 1000 hr.

STRONTIUM-90

REFERENCE COLUMNSTRONTIUM-90 METAL

After exposure of 2036 hr at 925°C to liquid strontium metal, it was found that molybdenum and stainless steel 321 showed good compatibility with liquid strontium metal; that wrought iron and Haynes 25 were worthy of further study; and that Hastelloy C, Hastelloy N, Hastelloy X, and titanium had dissolved and were incompatible with strontium metal. 9

No attack on molybdenum was observed after 5000-hr contact with liquid strontium metal at 1000°C. 10

STRONTIUM TITANATE (SrTiO₃)

The following results were obtained on stable SrTiO₃. 2

Container material	Maximum penetration observed, mils		
	168 hr	500 hr	1000 hr
<u>1000°C</u>			
Haynes 25	Traces	0.1	0.2
Molybdenum	No attack	No attack	No attack
Nionel	1.5	1.7	2.0
Tungsten	Traces	0.2	1.5
TZM	No attack	No attack	No attack
<u>1850°C</u>			
Molybdenum	No attack	No attack	No attack
Niobium	No attack	-	No attack
Tantalum	No attack	Traces	3.0
Tungsten	No attack	-	No attack
TZM	No attack	Traces	5.0

STRONTIUM OXIDE (SrO)

The following results were obtained with SrO-7% BeO material at 1000°C. 2

Container material	Maximum penetration observed, mils		
	168 hr	500 hr	1000 hr
Haynes 25	2.0	2.0	4.0
Molybdenum	-	No attack	No attack
Nionel	-	4.0	4.0-8.0
N-155	1.0	1.5	2.0-4.0
Tungsten	No attack	No attack	No attack
TZM	No attack	No attack	No attack

STRONTIUM FLUORIDE (SrF₂)REFERENCE COLUMN

Metallographic examination of test specimens exposed for 19 months at 925°C gave the following results.

11

<u>Encapsulating material</u>	<u>Penetration, in.</u>	
	<u>Maximum</u>	<u>Average</u>
<u>Simulated SrF₂ fuel</u> <u>(1 wt % Ca, 0.5 wt % Fe)</u>		
Haynes 25	0.0006	nil
Ta liner in Haynes 25	Complete penetration of Ta liner	
Hastelloy C	0.001	0.0004
Hastelloy N	0.002	0.001
Hastelloy X	0.0075	0.0014
<u>Simulated aged feed material</u> <u>(SrF₂ + 2-1/2 wt % Zr as ZrO₂)</u>		
Haynes 25	0.0015	0.0008
Ta liner in Haynes 25	Complete penetration of Ta liner	
Hastelloy C	0.0007	0.0003
Hastelloy N	0.0028	0.0011
Hastelloy X	0.0055	0.0011

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