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CHEMICAL BEHAVIOR OF FISSION PRODUCTS IN THE ORNL
FISSION PRODUCT RELEASE PROGRAM*

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RESULTS OF TRACER TESTS

- ~50% OF CsOH DEPOSITED ON ZrO₂ FURNACE COMPONENTS
- MOST OF CsI AND Te DEPOSITED IN THE TG TUBE
- ~0.01% OF I REACHED THE CHARCOAL; I.E., VERY LITTLE CsI DECOMPOSITION
- DISTRIBUTIONS IN TG TUBE APPEAR NORMAL:
 - Te DECLINED LOGARITHMICALLY WITH PEAKS
 - Cs AND I PEAKED ~500°C
- ALL MATERIALS EASILY LEACHED FROM STAINLESS STEEL

FISSION PRODUCT RELEASE TEST HI-4

FUEL SPECIMEN

- PEACH BOTTOM-2 (BWR) REACTOR
- IRRADIATED - JANUARY 1974-MAY 1976
- BURNUP - 10,000 MW_D/MT
- SEGMENT LENGTH - 8.0 IN. (20.3 CM)
- 1.6-MM HOLE DRILLED AT MIDLENGTH
- 10.2% KR AND 9.86% XE RELEASED DURING IRRADIATION

TEST HI-4 OPERATING CONDITIONS

- TEMPERATURE — $1800 \pm 50^{\circ}\text{C}$
- TEST TIME — 20 MIN
- CARRIER GAS — STEAM (0.32 L/MIN) — He (0.30 L/MIN)
- HEATUP RATE — $137^{\circ}\text{C}/\text{MIN}$

BASED UPON THE MEASURED AMOUNT OF HYDROGEN GENERATED,
ABOUT 54% OF THE ZIRCALOY CLADDING WAS OXIDIZED.

FRACTION OF FISSION PRODUCT INVENTORY FOUND

^{137}Cs - 31.7% (GS)

^{129}I - 24.7% (NA)

^{85}Kr - 21.1% (GS)*

^{110}mAg - >0.1% (GS)

^{125}Sb - >0.01% (GS)

*ABOUT 10.2% ^{85}Kr WAS RELEASED FROM SEGMENT
DURING IRRADIATION.

TOTAL ^{85}Kr RELEASED = 31.3%.

DISTRIBUTION OF CESIUM IN TEST HI-4*

LOCATION	TEMPERATURE (°C)	AMOUNT (mCi ¹³⁷ Cs)	PERCENT OF SPECIMEN INVENTORY	PERCENTAGE OF RELEASED
FURNACE	1850-900	1000	14.1	44.5
THERMAL GRADIENT TUBE	900-140	600	8.5	26.8
FILTER PACKAGE**	125	645	9.1	28.7
TOTAL		2245†	31.7	100

*DETERMINED BY GAMMA SPECTROMETRY.

**ABOUT 98% WAS ON GLASS WOOL FILTER.

†REPRESENTS ~65-MG TOTAL CESIUM.

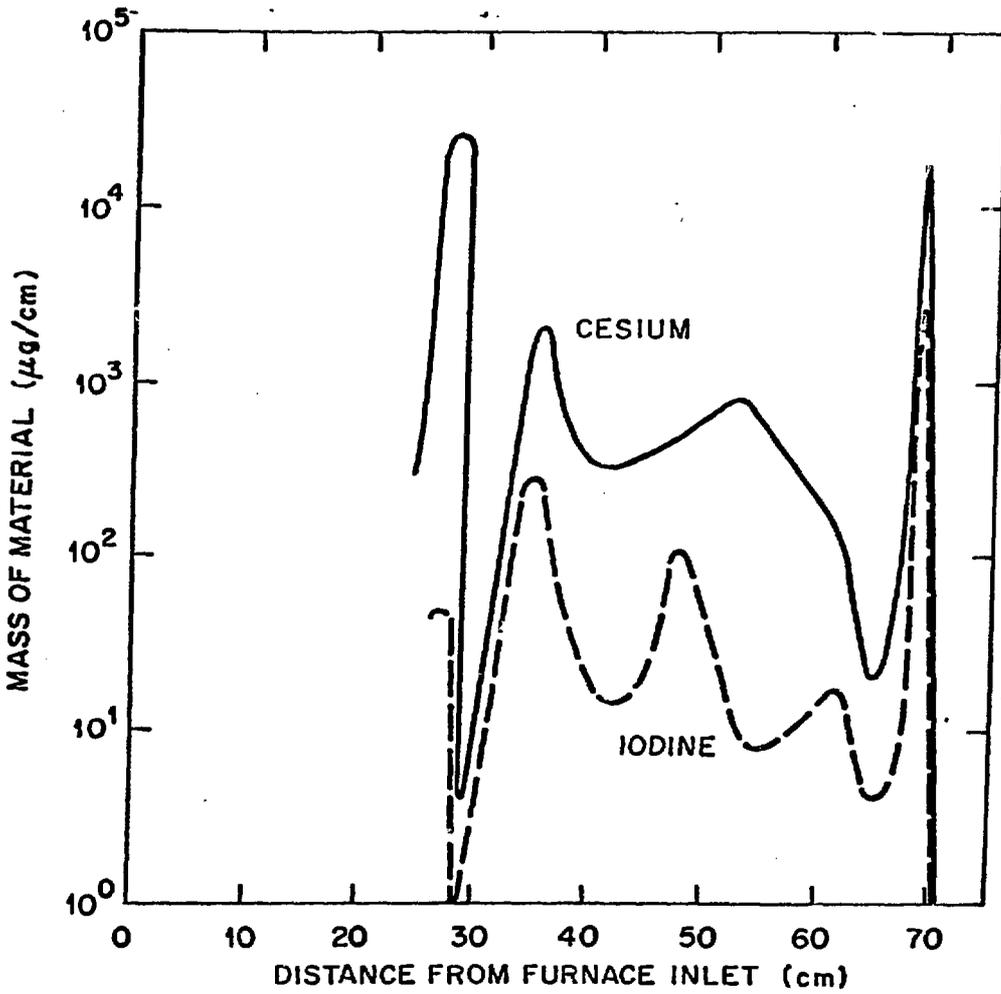
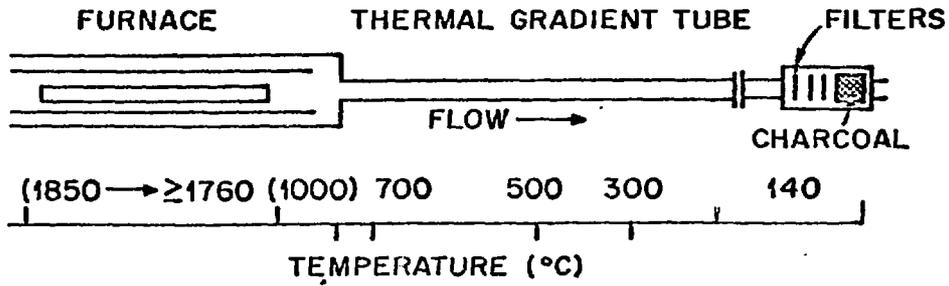
DISTRIBUTION OF IODINE IN TEST HI-4*

LOCATION	TEMPERATURE (°C)	AMOUNT (µg ¹²⁹ I)	PERCENT OF SPECIMEN INVENTORY	PERCENTAGE OF RELEASED
FURNACE	1850-900	134	0.9	3.6
THERMAL GRADIENT TUBE	900-140	1298	8.6	34.7
FILTER PACKAGE	125	2304**	15.2	61.7
TOTAL		3736†	24.7	100

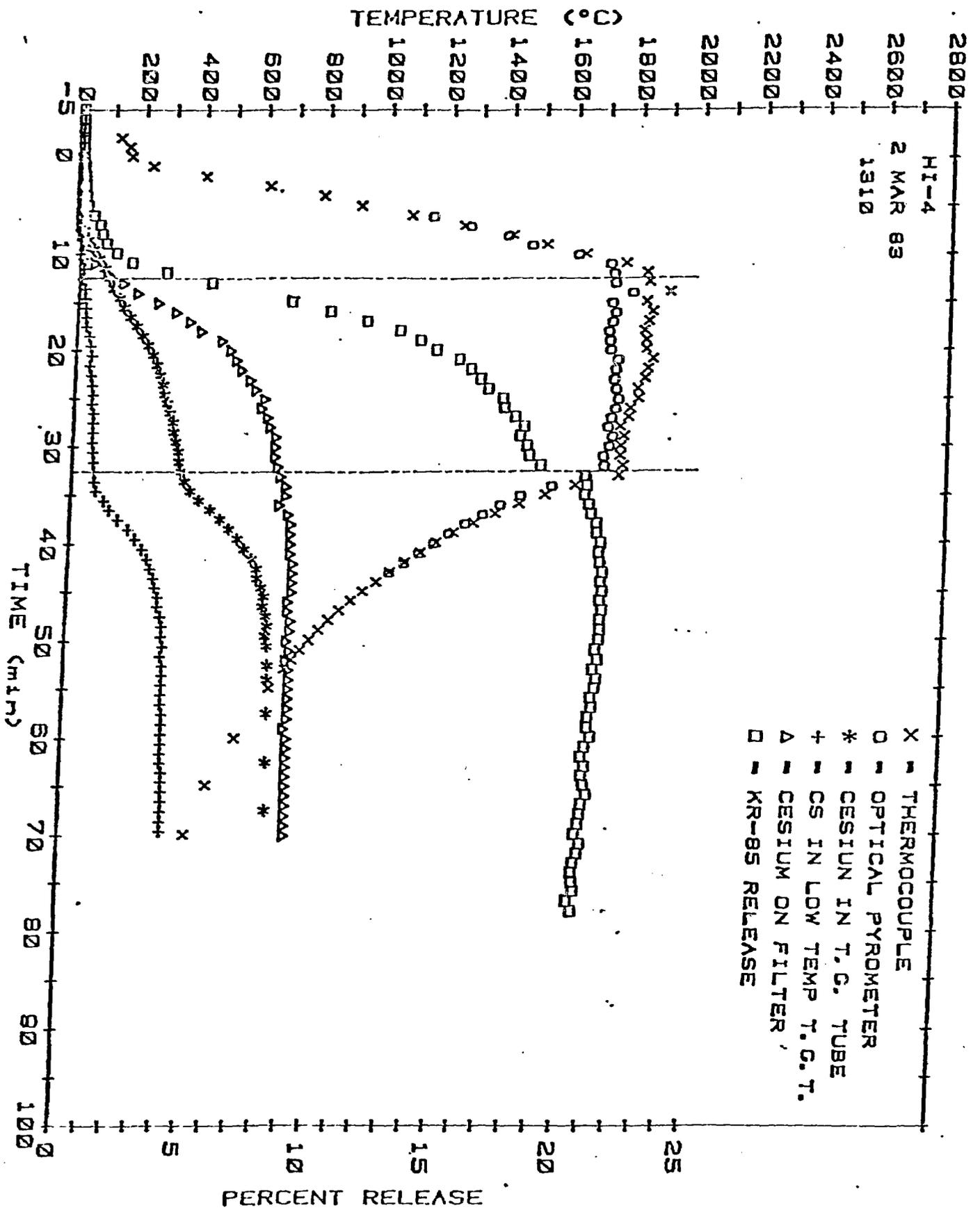
*BASED ON ACTIVATION ANALYSIS FOR ¹²⁹I IN LEACH SAMPLES.

**ONLY ABOUT 0.01% WAS COLLECTED ON THE CHARCOAL.

†REPRESENTS ABOUT 4929-µg IODINE.



**DISTRIBUTION OF CESIUM AND IODINE
IN TEST HI-4**

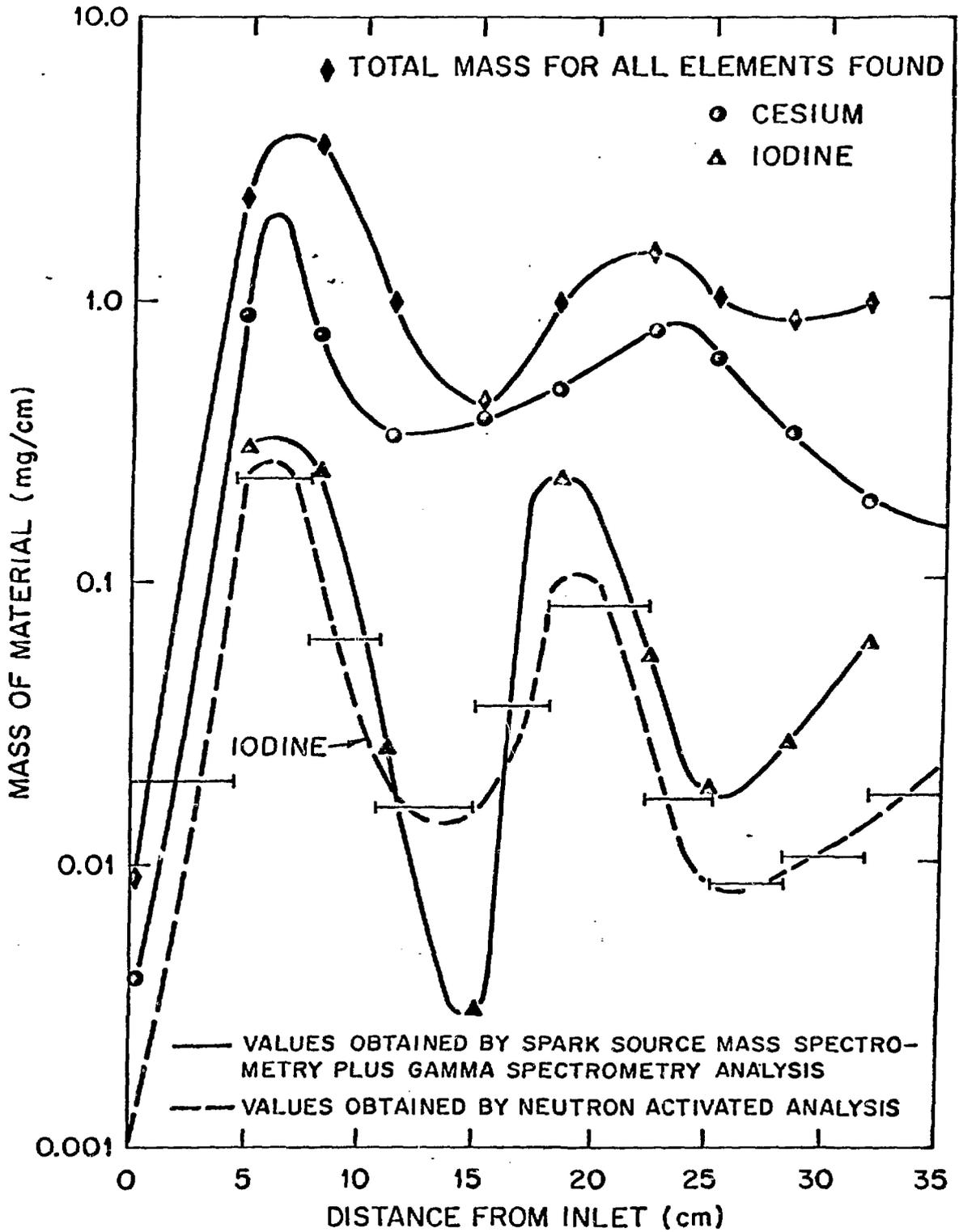


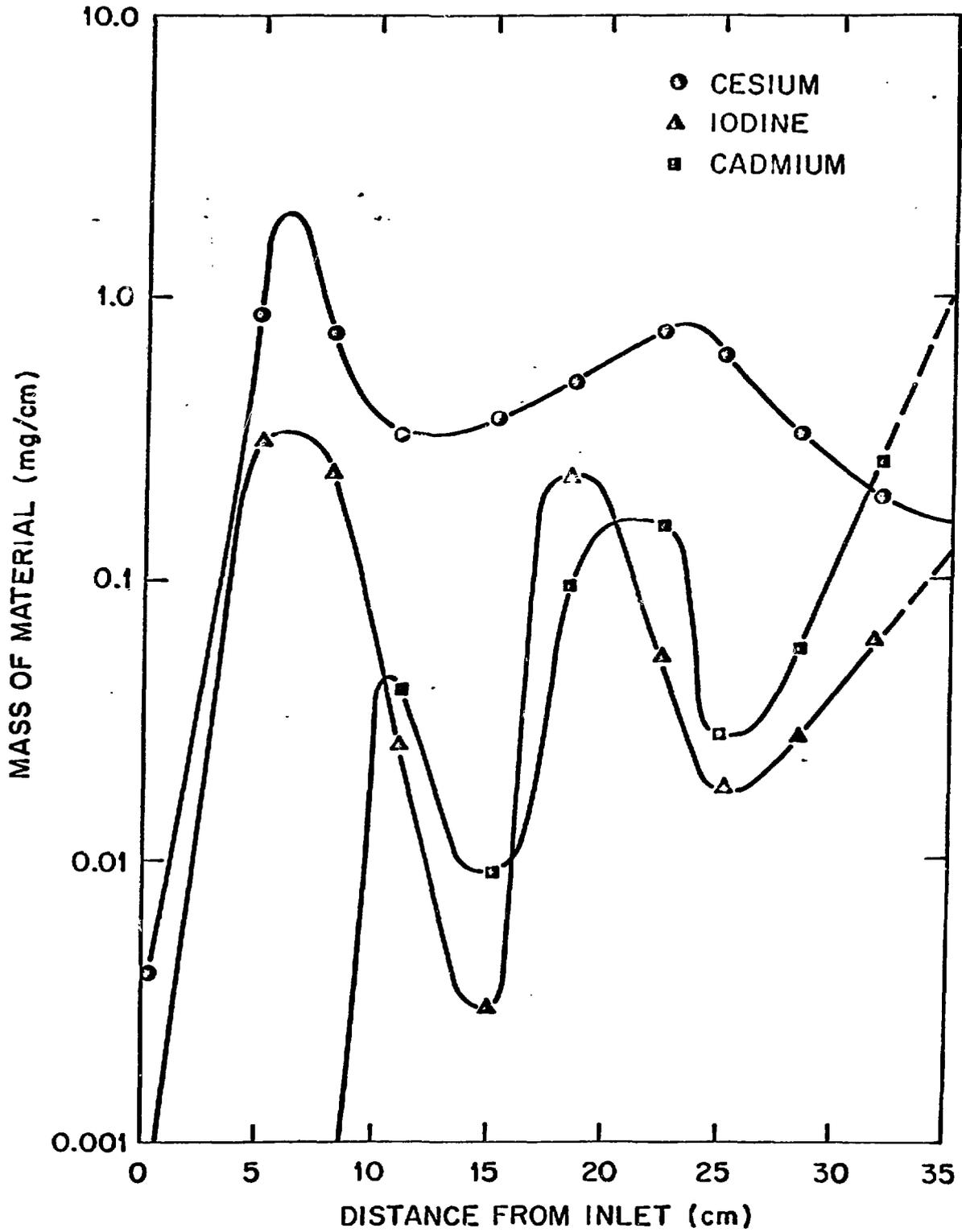
MASS COLLECTED ON TGT

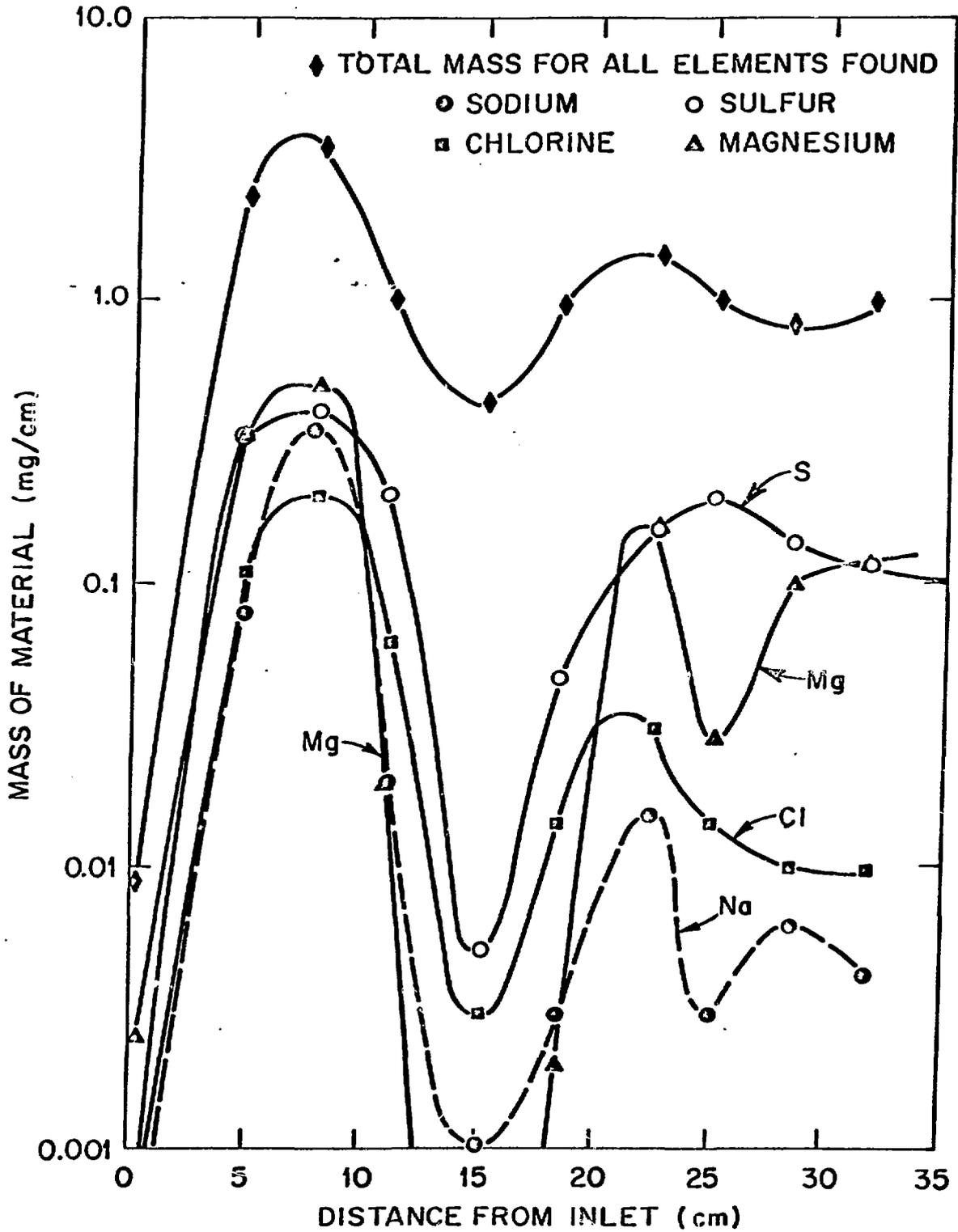
SSMS-GS - ~40 MG

WEIGHING - 30 ± 5 MG

~58% OF MASS WAS FISSION PRODUCTS







MATERIALS FOUND ON THE GLASS WOOL FILTER BY SPARK
SOURCE MASS SPECTROMETRIC ANALYSIS

<u>FISSION PRODUCTS</u>	<u>MASS OF ELEMENTS (MG)</u>
Cs (R)	17.4
Rb (R)	2.9
Ag (R)	1.4
Cd (R)	8.6
I (R)	4.0 (NA = 2.8 MG)
Br (R)	<u>0.3</u>
	34.6

OTHER MATERIALS

Mg	20.0
Na	2.6
Zn	1.4
Pb	0.9
(K, Ca, Fe, Mn)	0.3 (EACH)
S	5.7
Cl	<u>8.6</u>
	40.4

$$\text{TOTAL} = \frac{75 \text{ MG BY SSMS-GS}}{(70 \pm 5 \text{ MG BY WEIGHING})}$$

~46% OF AEROSOL MASS WAS FISSION PRODUCT

FISSION PRODUCT RELEASE TEST HI-5

FUEL SPECIMEN

- OCONEE-1 (PWR) REACTOR
- IRRADIATED — FEBRUARY 1975—NOVEMBER 1979
- BURNUP — ~40,000 MW_D/MT
- SEGMENT LENGTH — 6.0 IN. (15.2 CM)
- 1.6-MM HOLE DRILLED AT MIDLENGTH
- FISSION GAS RELEASED DURING IRRADIATION — 4% OF TOTAL

TEST HI-5 OPERATING CONDITIONS

- TEMPERATURE – 1750°C
- TEST TIME – 20 MIN
- CARRIER GAS – STEAM (0.39 L/MIN) – He (0.41 L/MIN)
- HEATUP RATE – 66°C/MIN

DISTRIBUTION OF CESIUM IN TEST HI-5.*

LOCATION	TEMPERATURE (°C)	AMOUNT (mCi ¹³⁷ Cs)	PERCENT OF SPECIMEN INVENTORY	PERCENTAGE OF RELEASED
FURNACE	1750-900	820	7.8	37.8
THERMAL GRADIENT TUBE	900-150	511	4.9	23.6
FILTER PACKAGE	130	836**	8.0	38.6
TOTAL		2167†	20.7	100

*DETERMINED BY GAMMA SPECTROMETRY.

**ABOUT 98% WAS ON GLASS WOOL FILTER.

†APPROXIMATELY 59.8-MG TOTAL CESIUM.

PRELIMINARY RESULTS

IN BOTH TESTS,

- >70% OF TRACER MATERIAL WAS TRANSPORTED
- <0.01% OF ^{131}I REACHED THE CHARCOAL

IN FIRST TEST,

- MOST (~80%) OF TRACER MATERIAL WAS DEPOSITED
IN THE TG TUBE
- MASS BALANCE WAS GOOD, $\pm 10\%$, FOR ALL 4
TRACERS