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MASTER

SODIUM-TO-GAS LEAK-DETECTION
TESTING FOR FFTF

Letter #7754921

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DECEMBER 1975

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NAME	APPROVE	DATE
TB McCall - Author	<i>[Signature]</i>	11/3/77
WD Yule	<i>[Signature]</i>	11-8-77
WJ McShane	<i>[Signature]</i>	11-8-77
DD Stepnewski	<i>[Signature]</i>	11-8-77
AR Schade	<i>[Signature]</i>	11-8-77

THIS LETTER SATISFIES COMMITMENT NO.

THIS LETTER (DOES) (DOES NOT) ESTABLISH A NEW COMMITMENT

November 11, 1977 ✓

MEOL CORRESPONDENCE NO.

7754921

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Central Files

* Without attachment

Director, FFTF Project Office (5)
U. S. Department of Energy
Richland, Washington 99352

SODIUM-TO-GAS LEAK-DETECTION TESTING

Attached for forwarding to NRC are copies of an interim report issued by the Liquid Metal Engineering Center (LMEC) on sodium-to-gas leak detection testing. The report is a summary of work done through October 21, 1977 and consists of briefing charts and preliminary data plots.

The current status of the program is as follows: Work is in progress on "Evaluation of Sodium Aerosol Generation Versus Leak Rate". Testing on "Demonstration of Contact Leak Detector Performance in FFTF Reactor Inlet Guard Pipe" has been completed and the final report is in preparation. Testing of "Sodium Ionization Detector Response to Extraneous Materials" is delayed until a current design Sodium Ionization Detector is available.

Significant results of these tests include the following:

- (1) The aerosol quantities obtained support the conclusion of previous analyses of aerosol transport in the reactor guard vessel that small leaks in the guard vessel will be detected by the sodium ionization detectors.
- (2) The aerosol and hydrogen quantities obtained are consistent with the results of earlier tests conducted with a large pipe in an inerted cell of 1500 cubic foot volume.
- (3) The reliability of contact leak detectors to detect small leaks is questionable because of the erratic behavior of slowly leaking sodium.

11 NOV 1977 12 54
CORRESPONDENCE

Director, FFTFPO (5)

Page 2

- (4) The operation of an alternative device, the "plugging tube" with aerosol filters backup, has been demonstrated and is under evaluation for FFTF application.

This satisfies our commitment to supply this information pursuant to our discussions with H. Holtz of NRC on September 22, 1977.

ORIGINAL SIGNED BY

D. E. SIMPSON

D. E. Simpson, Manager
Safety Analysis

sb

✓ Attachment: LMEC Sodium-To-Gas Leak Detection Tests for FFTF

DOE/RRD-HQ - Chief, FFTF Headquarters Office (2)*
Assistant Director for Reactor Safety

DOE/FFTFPO - Reactor Safety Field Office*

*Without Attachment

LMEC

SODIUM-TO-GAS LEAK DETECTION TESTS

FOR FFTF

- SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS
- REACTOR INLET GUARD PIPE LEAK DETECTOR
- SODIUM AEROSOL AND HYDROGEN GENERATION

SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS

● OBJECTIVE

- TO DETERMINE THE RESPONSE OF A SODIUM IONIZATION DETECTOR TO AEROSOLS OTHER THAN SODIUM

● PURPOSE

- TO DETERMINE IF THE AEROSOLS FROM MATERIALS (OTHER THAN SODIUM) ORDINARILY PRESENT IN A PLANT MAY PRODUCE A RESPONSE IN THE SODIUM IONIZATION DETECTOR WHICH WOULD BE INDISTINGUISHABLE FROM A RESPONSE TO A SODIUM LEAK

SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS

- SODIUM IONIZATION DETECTOR TO BE TESTED

- WESTINGHOUSE SODIUM IONIZATION DETECTOR USING:

- (1) MOST RECENT DESIGN SENSOR USING "LONG-LIFE
FILAMENT"

- (2) DEVELOPMENT MODEL POWER SUPPLY, CONTROL, AND
READOUT UNIT

SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS

● MATERIALS TO BE TESTED:

1. SOAP, BAR	16. ULTRASONIC COUPLANT NO. 1
2. TRISODIUM PHOSPHATE, TSP	17. ULTRASONIC COUPLANT NO. 2
3. BORAX	18. ULTRASONIC COUPLANT NO. 3
4. DETERGENT	19. ULTRASONIC COUPLANT NO. 4
5. SCOURING POWDER	20. LUBRICANT, MOLYKOTE NO. 505
6. SOIL, HEDL AREA	21. SOLDER FLUX
7. CALCIUM CARBONATE	22. BRAZING FLUX
8. POTASSIUM CARBONATE	23. SODIUM HYDROXIDE
9. MAGNESIUM OXIDE	24. SODIUM
10. CEMENT DUST	25. WATER, TAP
11. THERMAL INSULATION, REFRACTORY FIBER	26. WATER, DISTILLED
12. THERMAL INSULATION, FIBERGLASS	27. ANTIFREEZE, GLYCOL
13. THERMAL INSULATION, MIN-K	28. AMMONIA
14. THERMAL INSULATION, MARIMET	29. LUBRICANT, OIL
15. THERMAL INSULATION, CAL-SIL	30. SMOKE, CIGARETTE

SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS

● METHOD

- PRODUCE AN AEROSOL OF EACH MATERIAL AND PASS THE AEROSOL THROUGH A SODIUM IONIZATION DETECTOR AND (FOR COMPARISON) A FILTER
- SOLID MATERIALS TO BE GROUND TO SMALL PARTICLE SIZE AND TUMBLED IN THE SAMPLE GAS STREAM
- LIQUID AND VOLATILE MATERIALS TO BE HEATED IN THE SAMPLE GAS STREAM
- RECORD THE ION CURRENT IN THE SODIUM IONIZATION DETECTOR
- MEASURE THE AEROSOL CONCENTRATION IN THE SAMPLE GAS STREAM BY MEASURING THE QUANTITY OF MATERIAL DEPOSITED ON THE FILTER

SODIUM IONIZATION DETECTOR RESPONSE TO EXTRANEEOUS MATERIALS

- PRESENT (10-21-77) STATUS OF TESTING PROGRAM
 - "EXTRANEEOUS MATERIALS" ARE ON HAND
 - THE TEST APPARATUS IS SET UP AND READY FOR OPERATION
 - THE TEST PROCEDURE IS RELEASED
 - THE SODIUM IONIZATION DETECTOR SENSOR IS AVAILABLE
 - THE POWER SUPPLY, CONTROL, AND READOUT UNIT (A DEVELOPMENT MODEL DESIGNATED AS A SUBSTITUTE FOR A PRODUCTION MODEL), WAS FOUND IN CHECKOUT TESTS TO BE UNRELIABLE
 - CONTINUATION OF THE PROGRAM IS AWAITING RECEIPT OF A NEW (LATEST DESIGN) POWER SUPPLY, CONTROL, AND READOUT UNIT PROMISED BY WESTINGHOUSE TO BE SHIPPED BY 12-15-77

FFTF REACTOR INLET GUARD PIPE

LEAK DETECTOR

● OBJECTIVE

- TO DETERMINE THE LOWEST SODIUM LEAK RATE AT WHICH THE ELECTRICAL CONTACT LEAK DETECTOR MOUNTED IN A GUARD PIPE MOCKUP WILL RESPOND

● PURPOSE

- TO VERIFY ADEQUATE PERFORMANCE OF THE ELECTRICAL CONTACT LEAK DETECTOR MOUNTED IN THE FFTF REACTOR GUARD PIPE

FFTF REACTOR INLET GUARD PIPE

LEAK DETECTOR

● TEST REQUIREMENTS

- FFTF REACTOR INLET AND GUARD PIPE MOCKUP AND DETECTOR
(SUPPLIED BY HEDL)
- MOCKUP TEMPERATURE, 600F
- AMBIENT ENVIRONMENT
 - MOISTURE, 1000 PPM (v)
 - OXYGEN, 1% (v)
 - NITROGEN, BALANCE
- SODIUM LEAK RATES, 50, 100, 200, 400, AND 800 GRAMS/HOUR

FFTf REACTOR GUARD PIPE LEAK TEST

FFTF REACTOR INLET GUARD PIPE

LEAK DETECTOR

● TEST RESULTS

- SATISFACTORY RESPONSE TO LEAK AT 400 AND 800 GRAMS/HOUR (2 TESTS)
- NO RESPONSE TO LEAK AT 200 GRAMS/HOUR (1 TEST)
 - APPROXIMATELY 4000 GRAMS OF SODIUM WAS LEAKED
 - THE DETECTOR WAS FILLED WITH SODIUM REACTION PRODUCTS
 - THE DETECTOR ELECTRICAL CIRCUIT WAS TESTED AND SHOWN TO BE OPERATIONAL
- HEDL REQUESTED TERMINATION OF ELECTRICAL CONTACT SODIUM LEAK DETECTOR TESTING
- HEDL SUPPLIED A SKETCH FOR A NEW DETECTOR (PLUGGING TUBE TYPE) AND REQUESTED LMEC TO CONSTRUCT A MODEL AND RESUME TESTING USING THE NEW MODEL

FFTF REACTOR INLET GUARD PIPE

LEAK DETECTOR

● SUMMARY OF CONTACT AND PLUGGING TUBE DETECTOR TEST RESULTS

TEST NO.	1	2	3	4	5	6	7	8	9
TEST CONDITIONS									
LEAK RATE, GRAMS/HOUR	200	200	800	200	100	50	50	50	50
TEMP., F	600	680	680	680	680	680	680	680	400
OXYGEN, %	1	1	1	1	1	1	1	1	1
MOISTURE, PPM	1000	1000	1000	1000	1000	1000	1000	1000	1000
LEAK DURATION, HOURS	1.2	16.1	0.85	1.13	1.53	0.22	5.6	9.6	13.7
QUANTITY LEAKED, GRAMS	1740	4040	683	261	155	164	4500 ⁺	478	700
CONTACT DETECTOR RESPONSE	YES	NO	YES						
PLUGGING TUBE DETECTOR RESPONSE				YES	YES	YES	NO	YES	NO
QUANTITY OF SODIUM ON FILTER				54 <i>μg</i>	8332 <i>μg</i>	132 <i>μg</i>	12000 <i>μg</i>	30000 <i>μg</i>	21 <i>μg</i>

SODIUM AEROSOL AND HYDROGEN

GENERATION TESTS

● OBJECTIVE

TO DETERMINE THE INFLUENCE OF

- (1) SODIUM LEAK RATE
- (2) LEAK SURFACE GEOMETRY AND ORIENTATION
- (3) SODIUM AND AMBIENT TEMPERATURE
- (4) AMBIENT GAS COMPOSITION

ON THE GENERATION OF SODIUM AEROSOL AND HYDROGEN

● PURPOSE

TO DETERMINE THE APPLICATIONS IN WHICH SODIUM AEROSOL AND HYDROGEN
DETECTORS MAY BE USED AS SODIUM LEAK DETECTORS.

SODIUM AEROSOL AND HYDROGEN

GENERATION TESTS

(CONT'D)

● PLAN

- TO LEAK SODIUM IN A TEST VESSEL AND MEASURE THE QUANTITY OF SODIUM AEROSOL AND HYDROGEN GENERATED AS A FUNCTION OF THE LEAK RATE, GEOMETRY AND SURFACE ORIENTATION, TEMPERATURE, AND GAS COMPOSITION.
- PROVIDE A FLOWING GAS STREAM THROUGH THE TEST VESSEL TO PRECLUDE REACTION LIMITING BY DEPLETION OF OXYGEN OR MOISTURE.
- PERFORM TESTS ON A STANDARD GEOMETRY TEST FIXTURE TO PROVIDE A BASE LINE: THEN PERFORM TESTS ON A LENGTH OF PIPE.

SODIUM AEROSOL AND HYDROGEN GENERATION

STANDARD GEOMETRY TESTS

		VALUES				TESTS																			
PARAMETER	UNITS	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Leak Rate	Grams/Hour	0.1	1	10	100	2	1	3	4	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
Temperature	Deg. F	400	600	800	-	2	2	2	2	1	3	2	2	2	2	2	2	1	3	2	2	2	2	2	2
Oxygen Concentration	% Volume	0.5	1	2	3	2	2	2	2	2	2	1	3	4	2	2	2	2	2	1	3	4	2	2	2
Moisture Concentration	PPM Volume	200	500	1000	2000	3	3	3	3	3	3	3	3	3	1	2	4	3	3	3	3	3	1	2	4

PIPE SPECIMEN TESTS

PARAMETER	UNITS	VALUES				TESTS																						
		1	2	3	4	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39				
Leak Rate	Grams/Hour	0.1	1	10	100	1	2	3	4	3	4	1	2	3	3	3	3	3	3	1	2	3	4					
Temperature	Deg. F	400	600	800	-	2	2	2	2	1	1	3	3	3	2	2	2	2	2	2	2	2	2					
Oxygen Concentration	% Volume	0.5	1	2	3	2	2	2	2	2	2	2	2	2	1	3	4	2	2	2	2	2	2					
Moisture Concentration	PPM Volume	200	500	1000	2000	3	3	3	3	3	3	3	3	3	3	3	3	1	2	4	3	3	3					
Orientation						H	H	H	H	H	H	H	H	H	H	H	H	H	H	V	V	V	V					

H = Horizontal, Opening Up

V = Vertical

SODIUM AEROSOL AND HYDROGEN
GENERATION TEST APPARATUS

SODIUM AEROSOL AND HYDROGEN GENERATION

● TESTS PERFORMED (AS OF 10-21-77)

TEST NO.	LEAK RATE G/H	TEMPERATURE F	OXYGEN %	MOISTURE PPM	GAS FLOWRATE SCPH
3	10	600	1	1000	172
3R	10	600	1	1000	172
3M1	10	680	1	1000	172
11M1	100	680	1	500	172
12M1	100	680	1	2000	172
13	10	400	1	1000	172
13M1	10	400	1	1000	20
13M2	10	400*	1	1000	25
14	10	800	1	1000	172
14R	10	800	1	1000	172
15	10	600	0.5	1000	172
15M1	10	680	0.5	1000	172
16	10	600	2	1000	172
16M1	10	680	0.5	1000	172
16M1R	10	680	2	1000	172
17	10	600	3	1000	172
17M1	10	680	3	1000	172
18	10	600	1	200	172
18M1	10	680	1	200	172

*TEMPERATURE INCREASED TO 680 DURING TEST

SODIUM AEROSOL AND HYDROGEN GENERATION

(CONT'D)

TEST NO.	LEAK RATE G/H	TEMPERATURE F	OXYGEN %	MOISTURE PPM	GAS FLOWRATE SCPH
19	10	600	1	500	172
19M1	10	680	1	500	172
20	10	600	1	2000	172
20M1	10	600	1	2000	50
20M2	10	680	1	2000	172
12M1	100	680	1	2000	172
11M1	100	680	1	500	172
10M1	100	680	1	200	172

LMEC DATA PLOT

TEST 3 PROCEDURE TP-46-CE-014 TEST DATE 6-15-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 600 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LINEAR DATA PLOT

TEST 3 PROCEDURE TP-46-CE-014 TEST DATE 6-15-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 1 PCT
- 3. TEMPERATURE 600 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

PICOGRAMS/CC 6012

- - FILTER NO. 1
- - FILTER NO. 2

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K&E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

100

K&E

SODIUM ENTERED CYLINDER
SODIUM ENTERED CCNE

HOURS

10

1 0 1 2 3 4

LMEC DATA PLOT
TEST 3 PROCEDURE TP-46-CE-014 TEST DATE 6-15-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 3R PROCEDURE TP-46-CE-018 TEST DATE 7-26-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

100.000

LMEC DATA PLOT

TEST 3R PROCEDURE TP-46-CE-018 TEST DATE 7-26-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

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SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K&E

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

1.0

-1.5

0

1.5

3

4.5

6

LMEC DATA PLOT
TEST 3R PROCEDURE TP-46-CE-018 TEST DATE 7-26-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMC DATA PLOT

TEST 3M1 PROCEDURE TP-46-CE-014 TEST DATE 7-15-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 680 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100.000

LINE DATA PLOT

TEST 3M1 PROCEDURE TF-46-CE-014 TEST DATE 7-18-77

SODIUM PEROXYL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 1 FCT
- 3. TEMPERATURE 400 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

10.000

46 6012

PICOGRAMS/CC

□ - FILTER NO. 1
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SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K₂E

100

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SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

LMEC DATA PLOT

TEST 3M1 PROCEDURE TP-46-CE-014 TEST DATE 7-15-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 620 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMC DATA PLOT

TEST 11M1 PROCEDURE TP-46-CE-018 TEST DATE 9-29-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 500 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 690 F
 4. SODIUM LEAK RATE 100 GRAMS/HOU

100.000

LMEC DATA PLOT

TEST 1111 PROCEDURE TP-48-CE-018 TEST DATE 9-29-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 690 F
4. SODIUM LEAK RATE 100 GRAMS/HOUR

10.000

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□ - FILTER NO. 1
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SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6012

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE
HOURS

-0.5 0 0.5 1 1.5 2

LMEC DATA PLOT
TEST 11M1 PROCEDURE TP-46-CE-018 TEST DATE 9-29-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 880 F
4. SODIUM LEAK RATE 100GRAMS/HOUR

LNEC DATA PLOT

TEST 10M1 PROCEDURE TP-46-CE-014 TEST DATE 10-11-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 690 F
4. SODIUM LEAK RATE 100 GRAMS/HOU

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LMEC DATA PLOT

TEST 10M1 PROCEDURE TP-46-CE-014 TEST DATE 10-11-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 100 GRAMS/HOUR

46 6212
PICOGRAMS/CC

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SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

NO. 1

LMEC DATA PLOT

TEST 10M1 PROCEDURE TP-46-CE-014 TEST DATE 10-11-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 880 F
4. SODIUM LEAK RATE 100 GRAMS/HOUR

LMEC DATA PLOT

TEST 12M1 PROCEDURE TP-46-CE-018 TEST DATE 10-04-77
PARAMETERS AND NOMINAL VALUES
1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 100 GRAMS/HOU

100,000

46 6012

K&E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

LINES DATA PLOT

TEST 12M1 PROCEDURE TP-46-CE-019 TEST DATE 10-04-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 2000 PPM(V)
- 2. OXYGEN 1 PCT
- 3. TEMPERATURE 680 F
- 4. SODIUM LEAK RATE 100 GRAMS/HOUR

□ - FILTER NO. 1
○ - FILTER NO. 2

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PICOGRAMS/CC

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SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

LMEC DATA PLOT
TEST 12M1 PROCEDURE TP-46-CE-018 TEST DATE 10-04-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 100 GRAMS/HOUR

LMEC DATA PLOT

TEST 13 PROCEDURE TP-46-CE-018 TEST DATE 6-08-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 400 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

46 6012

K&E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

LPEC DATA PLOT

TEST 13 PROCEDURE TP-46-CE-018 TEST DATE 6-09-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 1 PCT
- 3. TEMPERATURE 400 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

1000

PICOGRAMS/CC

□ - FILTER NO. 1
○ - FILTER NO. 2

1.0

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

0 1 2 3 4 5

LMEC DATA PLOT
TEST 13 PROCEDURE TP-46-CE-018 TEST DATE 6-08-77

ARGON CONCENTRATION
A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES
MOISTURE 1000 PPM(V)
OXYGEN 1 PCT
TEMPERATURE 400 F
SODIUM LEAK RATE 10 GRAMS/HOUR

LMC DATA PLOT

TEST 13M1 PROCEDURE TP-46-CE-018 TEST DATE 7-15-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 400 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LMC DATA PLOT

TEST 13M1 PROCEDURE TP-46-CE-018 TEST DATE 7-15-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 1 PCT
- 3. TEMPERATURE 400 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

46 6012

PICGRAMS/CC

□ - FILTER NO. 1
○ - FILTER NO. 2

K&E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

10 3 0 3 6 9 12

LMEC DATA PLOT
TEST 13M1 PROCEDURE TP-46-CE-018 TEST DATE 7-15-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 400 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 13M2 PROCEDURE TP-46-CE-019 TEST DATE 7-21-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 400 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

PICGRAMS/CC 6012

KE SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

IMEC DATA PLOT

TEST 13M2-PROCEDURE TP-46-CE-018 TEST DATE 7-21-77
SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

- PARAMETERS AND NOMINAL VALUES
- 1. MOISTURE 1000 PPM(V)
 - 2. OXYGEN 1 PCT
 - 3. TEMPERATURE 400 F
 - 4. SODIUM LEAK RATE 10 GRAMS/HOUR

□ - FILTER NO. 1
○ - FILTER NO. 2

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

10

1 1 3 5 7 9

LMEC DATA PLOT
TEST 13M2 PROCEDURE TP-46-CE-018 TEST DATE 7-21-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)

2. OXYGEN 1 PCT

3. TEMPERATURE 400 F

4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 14 PROCEDURE TP-46-CE-018 TEST DATE 6-10-77
PARAMETERS AND NOMINAL VALUES
1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 800 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT
TEST 14 PROCEDURE TP-46-CE-018 TEST DATE 6-10-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES
1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 800 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMC DATA PLOT

TEST 14R PROCEDURE TP-46-CE-018 TEST DATE 9-12-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 800 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

1.000.000

LMEC DATA PLOT

TEST 14R PROCEDURE TP-46-CE-018 TEST DATE 9-12-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000-PPM(V)
- 2. OXYGEN 1 PCT
- 3. TEMPERATURE 800 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

46 6212

PICOGRAMS/CC

10.000

- - FILTER NO. 1
- - FILTER NO. 2

1.000

100

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

1.0

-1

0

1

2

3

4

SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
NEUFEL & ESSER CO. MADE IN U.S.A.

LMEC DATA PLOT
TEST 14R PROCEDURE TP-46-CE-018 TEST DATE 9-12-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 800 F
4. SODIUM LEAK RATE 10 GRANS/HOUR

LMEC DATA PLOT

TEST 15 PROCEDURE TP-46-CE-018 TEST DATE 6-17-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 0.5 PCT
 3. TEMPERATURE 600 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LMEC DATA PLOT

TEST 15 PROCEDURE TP-46-CE-018 TEST DATE 6-17-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 0.5 P
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

46 6012

PICOGRAMS/CC

□ - FILTER NO. 1

○ - FILTER NO. 2

1000

100

SODIUM ENTERED CYLINDER

SODIUM ENTERED CONE

HOURS

1.0

0

1

2

3

4

LNEC DATA PLOT
TEST 15 PROCEDURE TP-46-CE-018 TEST DATE 6-17-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 0.5 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 16 PROCEDURE TP-46-CE-018 TEST DATE 6-21-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 1000 PPM(V)
 2. OXYGEN 2 PCT
 3. TEMPERATURE 600 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT
TEST 16 PROCEDURE TP-46-CE-018 TEST DATE 6-21-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 2 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 16M1 PROCEDURE TP-46-CE-018 TEST DATE 8-24-77
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
 2. OXYGEN 2 PCT
 3. TEMPERATURE 680 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR
- NOTE: THIS TEST WAS RUN AT 0.5% BY ERROR. SEE REPEAT TEST 16M1R

100,000

46 6012
PICOGRAMS/CC

K-E
SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

LMEC DATA PLOT

TEST 16M1 PROCEDURE TP-46-CE-018 TEST DATE 8-24-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 2 PCT NOTE: THIS TEST WAS RUN AT 0.5% BY ERROR. SEE REPEAT TEST 16M1P
- 3. TEMPERATURE 680 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

□ - FILTER NO. 1
○ - FILTER NO. 2

1000

1.00

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

LO

LMEC DATA PLOT
TEST 16M1 PROCEDURE TP-46-CE-018 TEST DATE 8-24-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 2 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

NOTE: THIS TEST WAS RUN AT 0.5% BY ERROR. SEE REPEAT
TEST 16M1R

LMEC DATA PLOT

TEST 16M1R PROCEDURE TP-46-CE-018 TEST DATE 9-19-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 2 PCT
3. TEMPERATURE 880 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LINEC DATA PLOT

TEST 16M1R PROCEDURE TP-46-CE-018 TEST DATE 9-19-77

SODIUM AEROSOL CONCENTRATION AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 2 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

PICOGRAMS/CC

☒ - FILTER NO. 1
☐ - FILTER NO. 2

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

2

LMEC DATA PLOT
TEST 16M1R PROCEDURE TP-46-CE-018 TEST DATE 9-19-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 2 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 17 PROCEDURE TP-46-CE-018 TEST DATE 6-23-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 3 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

1,000,000

LMEC DATA PLOT

TEST 17 PROCEDURE TP-46-CE-018 TEST DATE 6-23-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)

2. OXYGEN 3 PCT

3. TEMPERATURE 600 F

4. SODIUM LEAK RATE 10 GRAMS/HOUR

PICOGRAMS/CC

10,000

□ - FILTER NO. 1

○ - FILTER NO. 2

1000

100

SODIUM ENTERED CYLINDER

SODIUM ENTERED CONE

HOURS

-10

-1

0

1

2

3

4

LMEC DATA PLOT
TEST 17 PROCEDURE TP-46-CE-018 TEST DATE 6-23-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 3 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

TEST 17M1 PROCEDURE TP-46-CE-018 TEST DATE 8-29-77
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 3 PCT
3. TEMPERATURE 690 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

1.0E+6

46 6012
PICOGRAMS/CC

K-E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

LMEC DATA PLOT

TEST 17MI PROCEDURE TP-46-CE-018 TEST DATE 8-29-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

- 1. MOISTURE 1000 PPM(V)
- 2. OXYGEN 3 PCT
- 3. TEMPERATURE 680 F
- 4. SODIUM LEAK RATE 10 GRAMS/HOUR

▣ - FILTER NO. 1
○ - FILTER NO. 2

— SODIUM ENTERED CYLINDER
— SODIUM ENTERED CONE

HOURS

100,000

10000

1000

100

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 1000 PPM(V)
2. OXYGEN 3 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMC DATA PLOT

TEST 18 PROCEDURE TP-46-CE-018 TEST DATE 6-24-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT
TEST 18 PROCEDURE TP-46-CE-018 TEST DATE 6-24-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 18M1 PROCEDURE TP-46-CE-018 TEST DATE 9-01-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT
TEST 18M1 PROCEDURE TP-46-CE-018 TEST DATE 9-01-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 200 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 19 PROCEDURE TP-46-CE-018 TEST DATE 6-28-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

46 6012

K&S SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

LMEC DATA PLOT
TEST 19 PROCEDURE TP-46-CE-018 TEST DATE 6-28-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 19M1 PROCEDURE TP-46-CE-018 TEST DATE 9-08-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 500 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 680 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

~~TEST 19M1 PROCEDURE TP-46-CE-018 TEST DATE 9-08-77~~

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)

2. OXYGEN 1 PCT

~~3. TEMPERATURE 680 F~~

4. SODIUM LEAK RATE 10 GRAMS/HOUR

☒ - FILTER NO. 1

Q - FILTER NO. 2

SODIUM ENTERED CYLINDER

SODIUM ENTERED CONE

HOURS

LMEC DATA PLOT

TEST 19M1 PROCEDURE TP-46-CE-018 TEST DATE 9-08-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 500 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 20 PROCEDURE TP-46-CE-018 TEST DATE 7-05-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LMEC DATA PLOT

TEST 20 PROCEDURE TP-46-CE-018 TEST DATE 7-05-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

46 6012

PICOGRAMS/CC

□ - FILTER NO. 1
○ - FILTER NO. 2

1000

100

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

1.0

0

1

2

3

4

LMEC DATA PLOT
TEST 20 PROCEDURE TP-46-CE-018 TEST DATE 7-05-77

HYDROGEN CONCENTRATION
AS A FUNCTION OF TIME
PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 20M1 PROCEDURE TP-46-CE-018 TEST DATE 7-11-77

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LMEC DATA PLOT

TEST 20MI PROCEDURE TP-46-CE-018 TEST DATE 7-11-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

46 6012

PICOGRAMS/CC

- - FILTER NO. 1
- - FILTER NO. 2

1000

K-E SEMI-CARITIMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

100

SODIUM ENTERED CYLINDER
SODIUM ENTERED CONE

HOURS

10 1 0 1 2 3 4

LNEC DATA PLOT

TEST 20M1 PROCEDURE TP-46-CE-018 TEST DATE 7-11-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 600 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

LMEC DATA PLOT

TEST 20M2 PROCEDURE TP-46-CE-018 TEST DATE 9-13-77
 PARAMETERS AND NOMINAL VALUES
 1. MOISTURE 2000 PPM(V)
 2. OXYGEN 1 PCT
 3. TEMPERATURE 680 F
 4. SODIUM LEAK RATE 10 GRAMS/HOUR

100,000

LMEC DATA PLOT

TEST 20M2 PROCEDURE TP-46-CE-018 TEST DATE 9-13-77

SODIUM AEROSOL CONCENTRATION
AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 880 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

10,000

46 6012
PICOGRAMS/CC

- - FILTER NO. 1
- - FILTER NO. 2

1000

K-E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

100

HOURS

10

LMEC DATA PLOT
TEST 20M2 PROCEDURE TP-46-CE-018 TEST DATE 9-13-77

HYDROGEN CONCENTRATION

AS A FUNCTION OF TIME

PARAMETERS AND NOMINAL VALUES

1. MOISTURE 2000 PPM(V)
2. OXYGEN 1 PCT
3. TEMPERATURE 680 F
4. SODIUM LEAK RATE 10 GRAMS/HOUR

HYDROGEN YIELD, PICOGRAMS H₂/GRAM NA

TEMPERATURE °F (°C)

HYDROGEN YIELD, PICOGRAMS H₂/GRAM NA

HYDROGEN YIELD, PICOGRAMS H_2 /GRAM NA