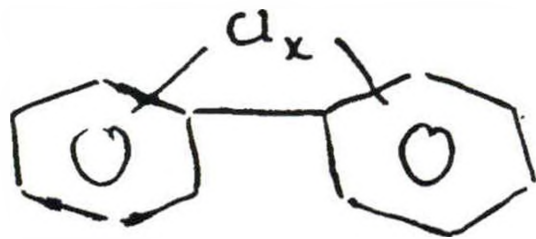
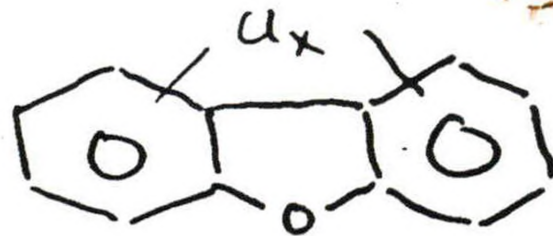


① Opening slide



PCBs



PCDFs

Polychlorinated  
Dibenzofurans

1<sup>st</sup> Discovery 1970 Vos et. al.

PCBs contained PCDFs  
1-10 ppm

Proposed 1977 Busa, Rappe  
Mechanism  
of PCB cyclization to PCDFs

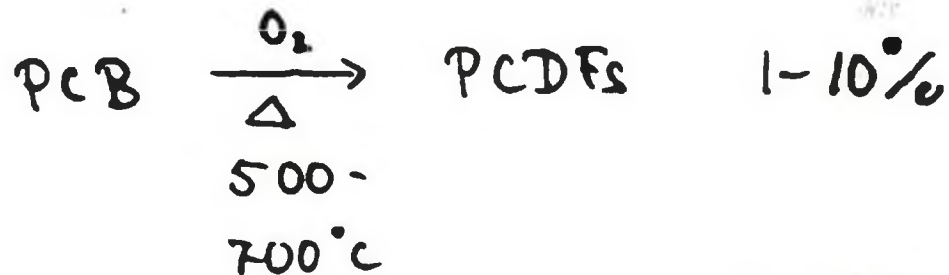


TABLE 4  
Levels of PCDFs in commercial PCBs ( $\mu\text{g/g}$ ) (from Bowes et al., 1975)

| Sample                | Dibzo | Dibenzo | Tribenzo | Total |
|-----------------------|-------|---------|----------|-------|
| Aroclor 1248 (1968)   | 0.5   | 1.2     | 0.3      | 2.0   |
| Aroclor 1254 (1968)   | 0.1   | 0.2     | 1.4      | 1.7   |
| Aroclor 1254 (1970)   | 0.2   | 0.4     | 0.9      | 1.5   |
| Aroclor 1260 (1968)   | 0.1   | 0.4     | 0.5      | 1.0   |
| Aroclor 1260 (at AEC) | 0.2   | 0.3     | 0.3      | 0.8   |
| Aroclor 1016 (1972)   | ND    | ND      | ND       | —     |
| Clophen A 80          | 1.4   | 5.0     | 2.2      | 8.4   |
| Phenoclor DP-4        | 0.7   | 10.0    | 2.9      | 13.6  |

ND = Not Detectable

Rapp, Busch similar levels 1-10 ppm  
Aroclor  
Clophen T 64

Analytical technique:

Fluorasil

n-Hexane

MC

2nd -u-

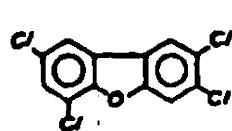
MC/n-Hexane

HRGC/MS

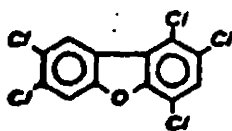
Not all isomers available

Not isomer specific

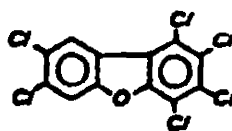
Toxic Isomers are underlined



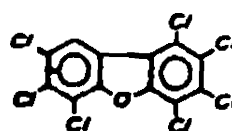
2,3,6,8-Tetra-CDF



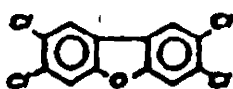
1,2,4,7-Tetra-CDF



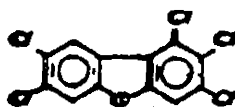
1,2,3,4,6,8-Hexa-CDF



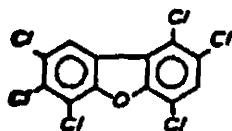
1,2,3,4,6,7,8-Hepta-CDF



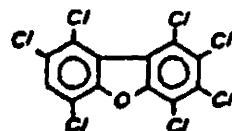
2,3,7,8-Tetra-CDF



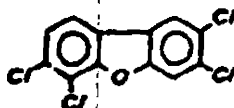
1,2,3,7-Tetra-CDF



1,2,4,5,7,8-Hexa-CDF



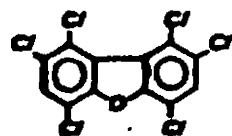
1,2,3,4,6,8,9-Hepta-CDF



2,3,6,7-Tetra-CDF



2,3,4,7-Tetra-CDF



1,2,4,5,8,9-Hexa-CDF

RAPPE, BUSER 1980

1/2

New clean-up method

1. Dissolve PCB (0.05 - 0.1 g) in MC/n-Hexane
2. Spike  $^{13}\text{C}_{12}$  - 2,3,7,8-tetra-ClDF } this is the only spike!
3. Column carbon on fibers (D. STALLING)
4. Reverse toluene, evaporate toluene
5. Dissolve MC/n-Hexane/MeOH } did not know ratios
6. Fluorosil column
7. Reverse MC ~~as was used~~ exactly what he meant by this.
8. HRGC/MS      SIM ~~as~~  
                              NCI
9. Isomer identification Toxic 2,3,7,8-Substituted
10. Quantification { this is difficult because if negative chemical ionization is used, responses can vary by several orders of magnitude for different TCOFs etc. }
11. Recovery > 65% for the  $^{13}\text{C}_{12}$ -2378-TCDF

Can also be used for wipes etc.  
in PCB Fires.

(5)

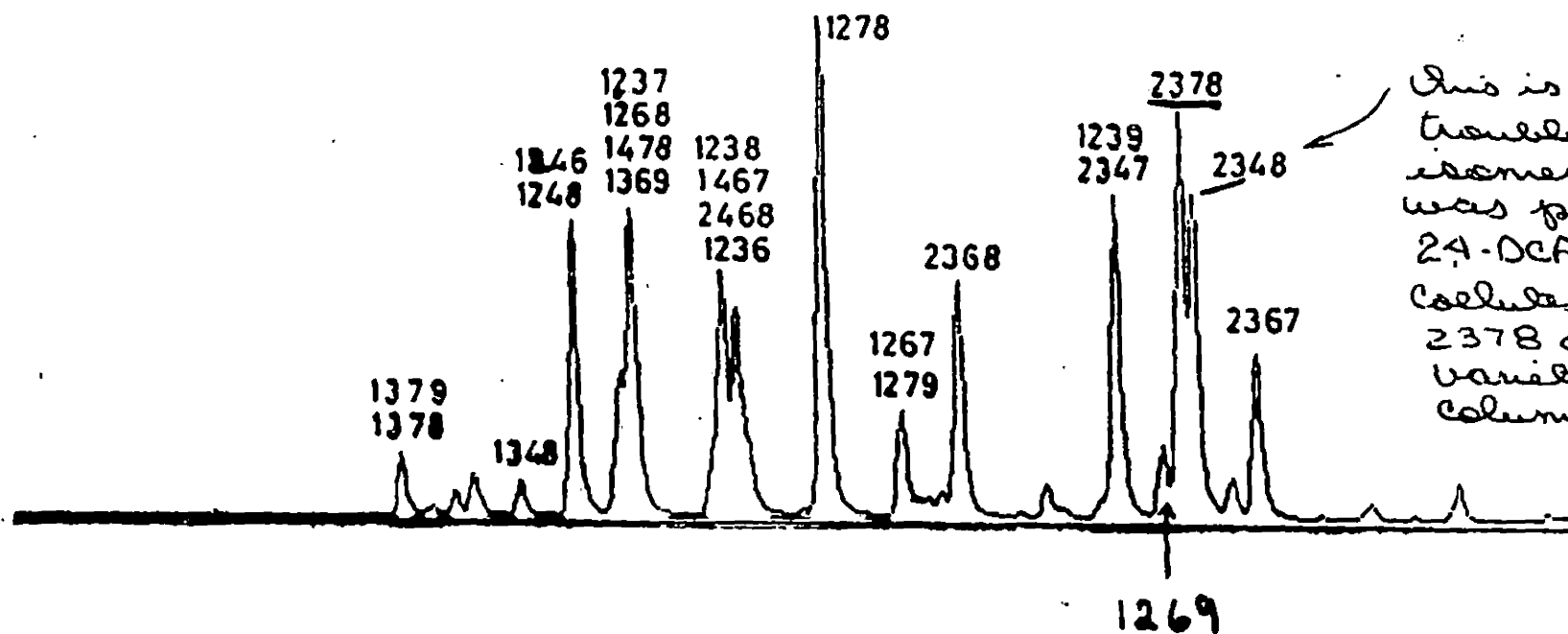
CSH 1

French PCB

Phenochlor 30.10

Ramschur is equivalent  
to  $\approx 1016$

These are T.C.L.F.s on an  
SP-2330. Detection  
made most likely EI-MS



This is the  
troublesome  
isomer that  
was present in  
24-DCP. It  
coelutes with  
2378 on a  
variety of  
columns.

MID MASS CHROMATOGRAMS

03/23/04 7:36:00

SAMPLE: HPR 260 5

COND: SUPELCO 60M 100-100/20-250/3 40 PSI

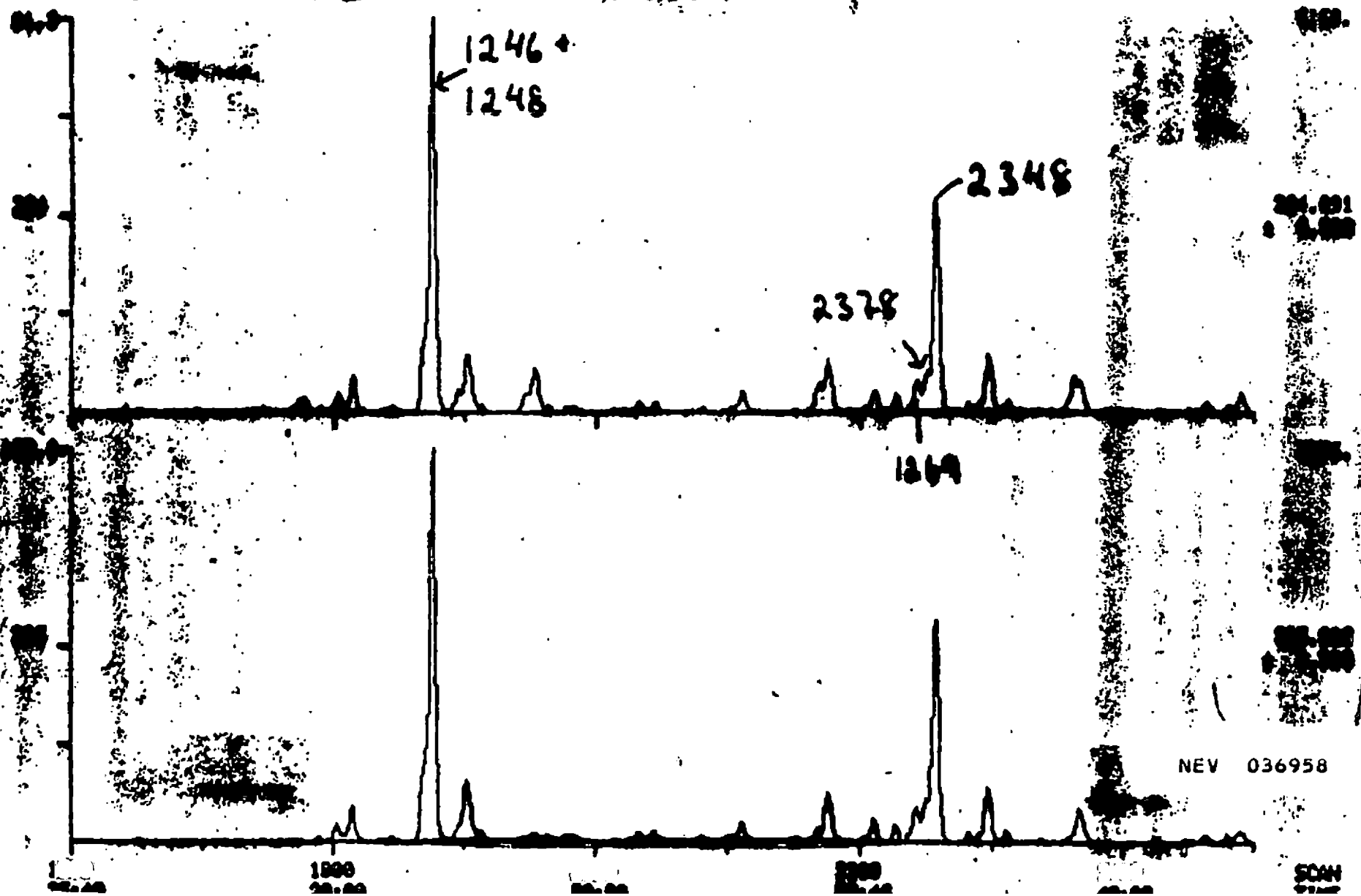
RANGE: G 1, 1 LABEL: N 2, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 20, 3

DATA: HPR2605 01

CALI: NCAL0322 00

SCANS 1600 TO 2500

Aroclor 1254



7

CSH 17

HID MASS CHROMATOGRAMS

03/23/84 0:51:00

SAMPLE: NFR 267 3

CONDOS.: SUPELCO 60A 100-100/20-200/3 40 PSI

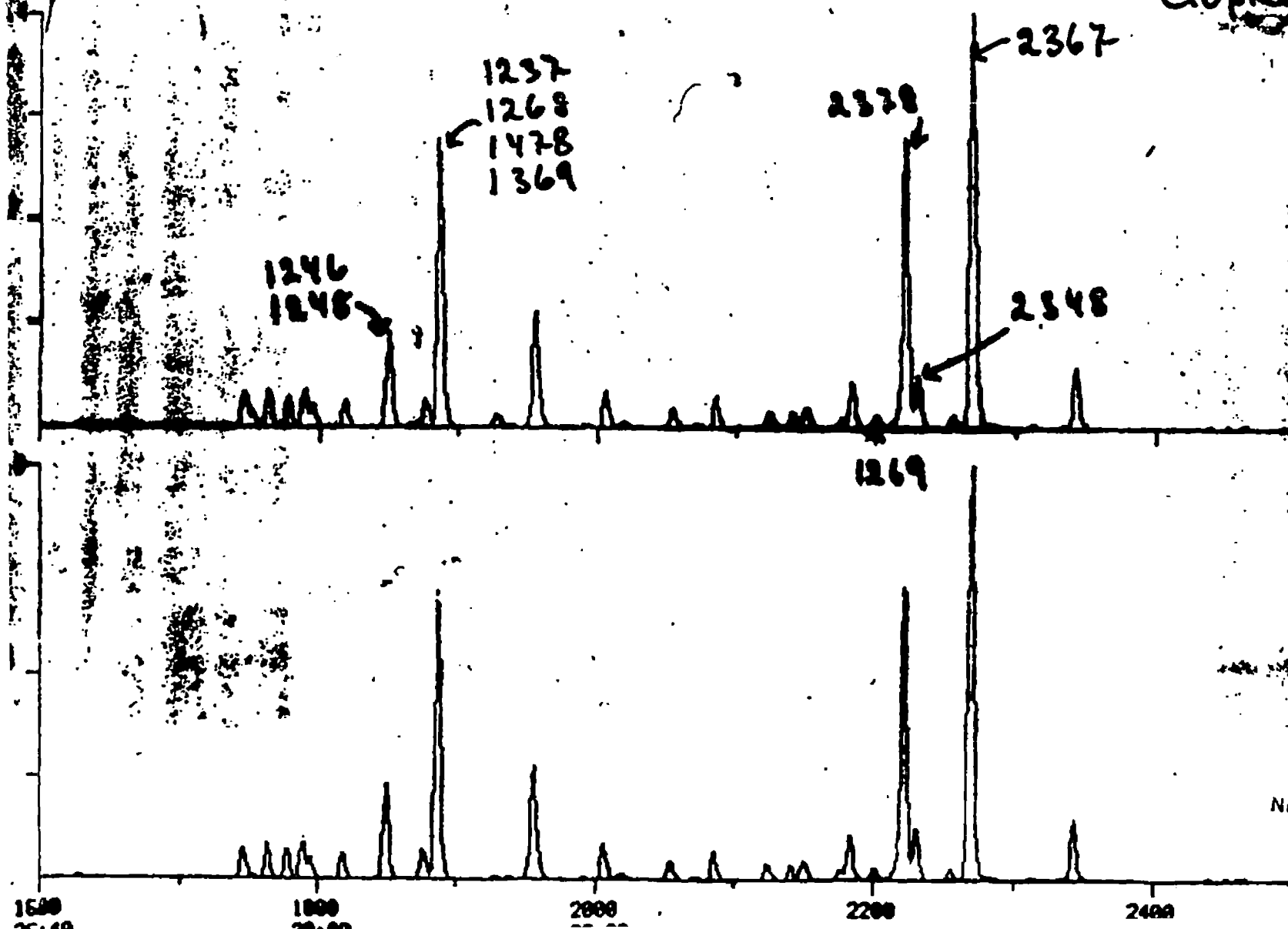
RANGE: C 1, 1 LABEL: H 2, 4.0 QUANT: A 0, 1.0 J 0 BASE: U 20, 3

DATA: NFR2673 01

CALI: NCAL8322 03

SCANS 1600 TO 2500

German  
Clophen ASD



304.091  
± 0.500

24932

306.092  
± 0.500

NEV 036959

1600  
20.00

1800  
20.00

2000  
20.00

2200

2400

SCAN

90

MID MASS CHROMATOGRAMS

03/23/04 7:35:00

SAMPLE: HPR 260 5

COND.: SUPELCO 60N 100-100/20-260/3 40 PSI

RANGE: C 1, 1 LABEL: N 2, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 28, 3

DATA: HPR2605 01

CALI: NCAL0322 03

SCANS 2000 TO 2800

1254

7016

12469  
23468

12348  
12378

23978

340.104  
± 0.500

10000

340.102  
± 0.500

NEV 036960

2000 2100 2200 2300 2400 2500 2600 2700 2 SCAN

(5)

MID MASS CHROMATOGRAMS

83/23/84 8:51:00

SAMPLE: MPR 267 3

COND.: SUPELCO 60M 100-100/20-260/3 40 PSI

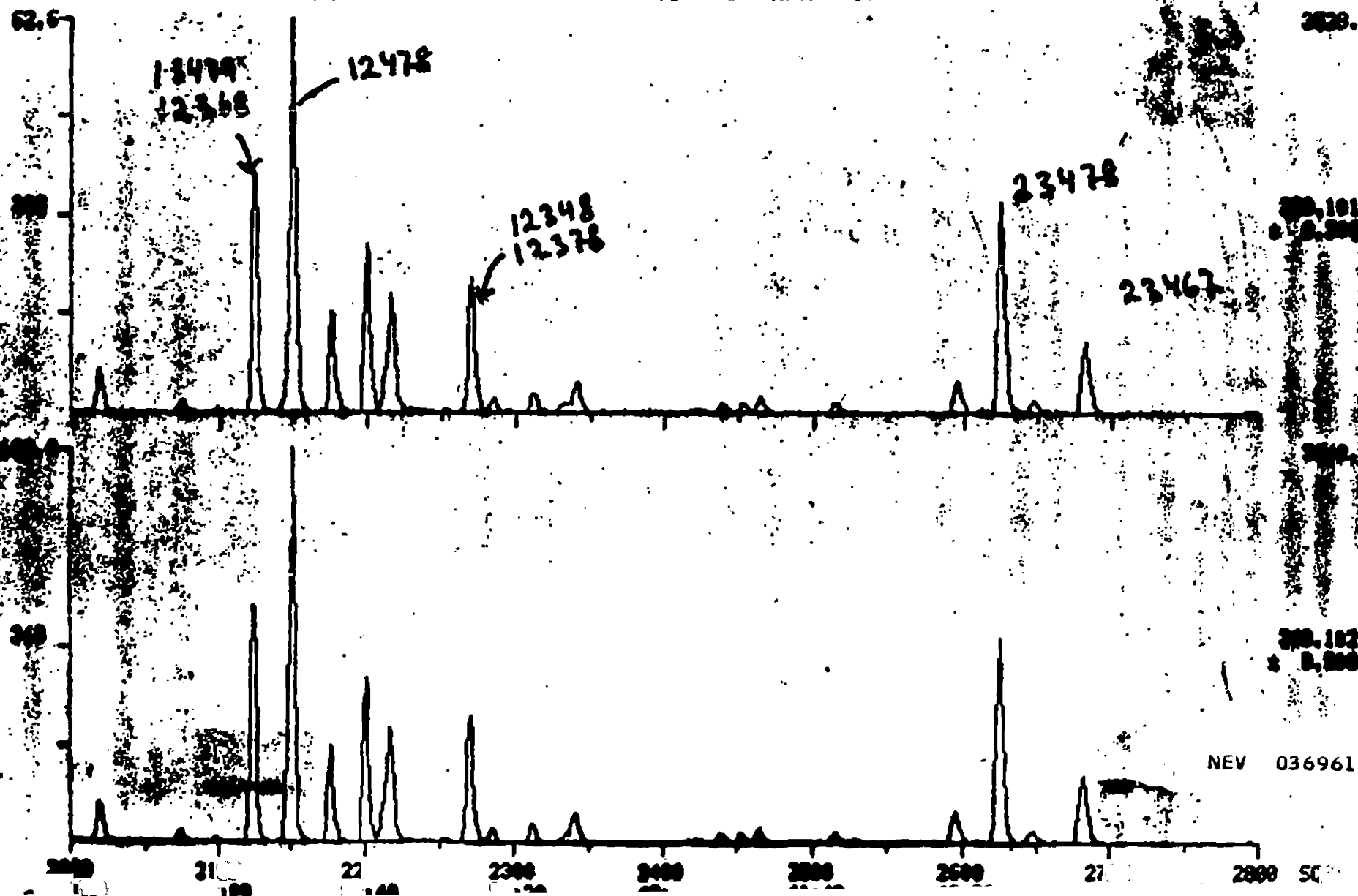
RANGE: G 1, 1 LABEL: M 2, 4.0 QUAN: A 8, 1.0 J 0 BASE: U 20, 3

DATA: MPR2573 01

CALI: NCAL8322 03

SCANS 2000 TO 2800

A50



(10)

MID MASS CHROMATOGRAMS

03/23/84 7:35:00

SAMPLE: MPR 260 5

CONDS.: SUPELCO 60M 100-180/20-250/3 40 PSI

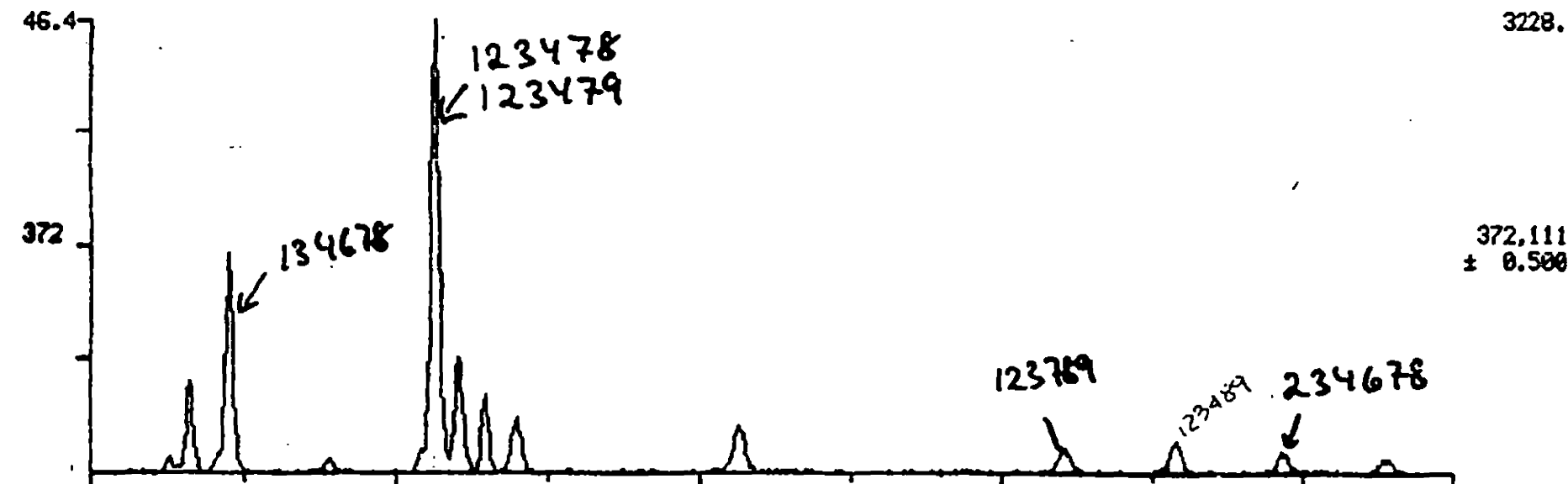
RANGE: G 1, 1 LABEL: N 2, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 20, 3

DATA: MPR2605 #1

CALI: NCAL0322 #3

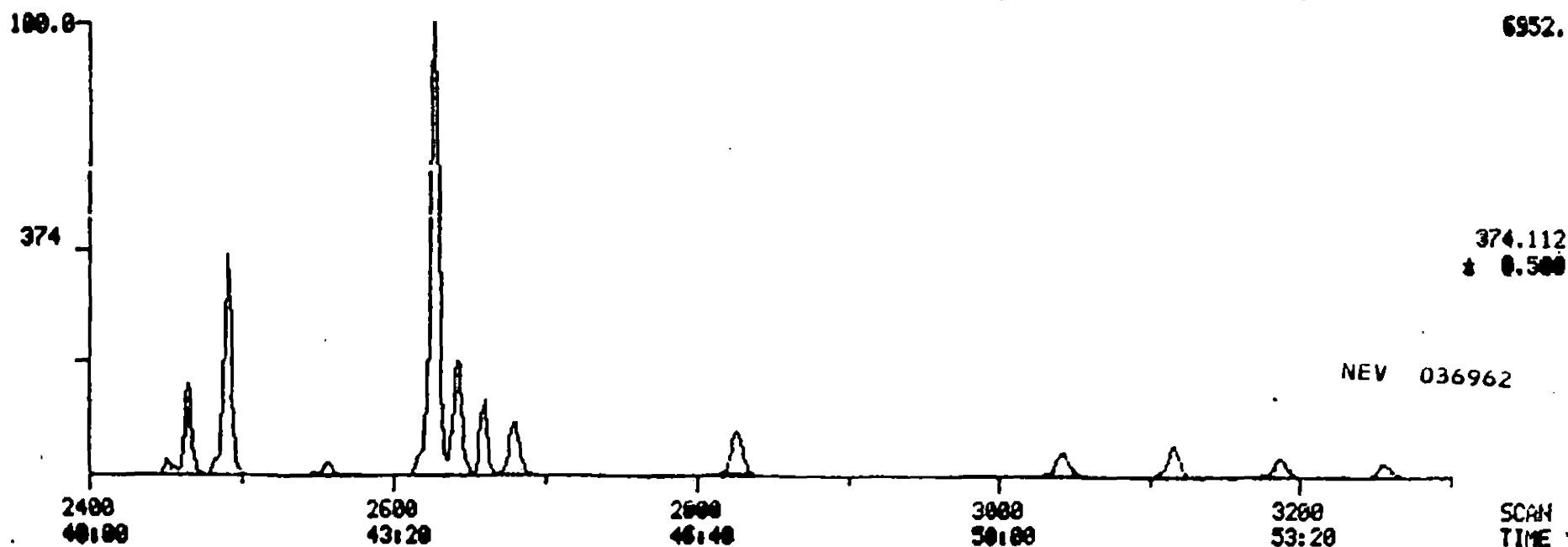
SCANS 2400 TO 3300

1254



3228.

372.111  
± 0.500



6952.

374.112  
± 0.500

NEV 036962

SCAN  
TIME

# MID MASS CHROMATOGRAMS

03/23/84 8:51:00

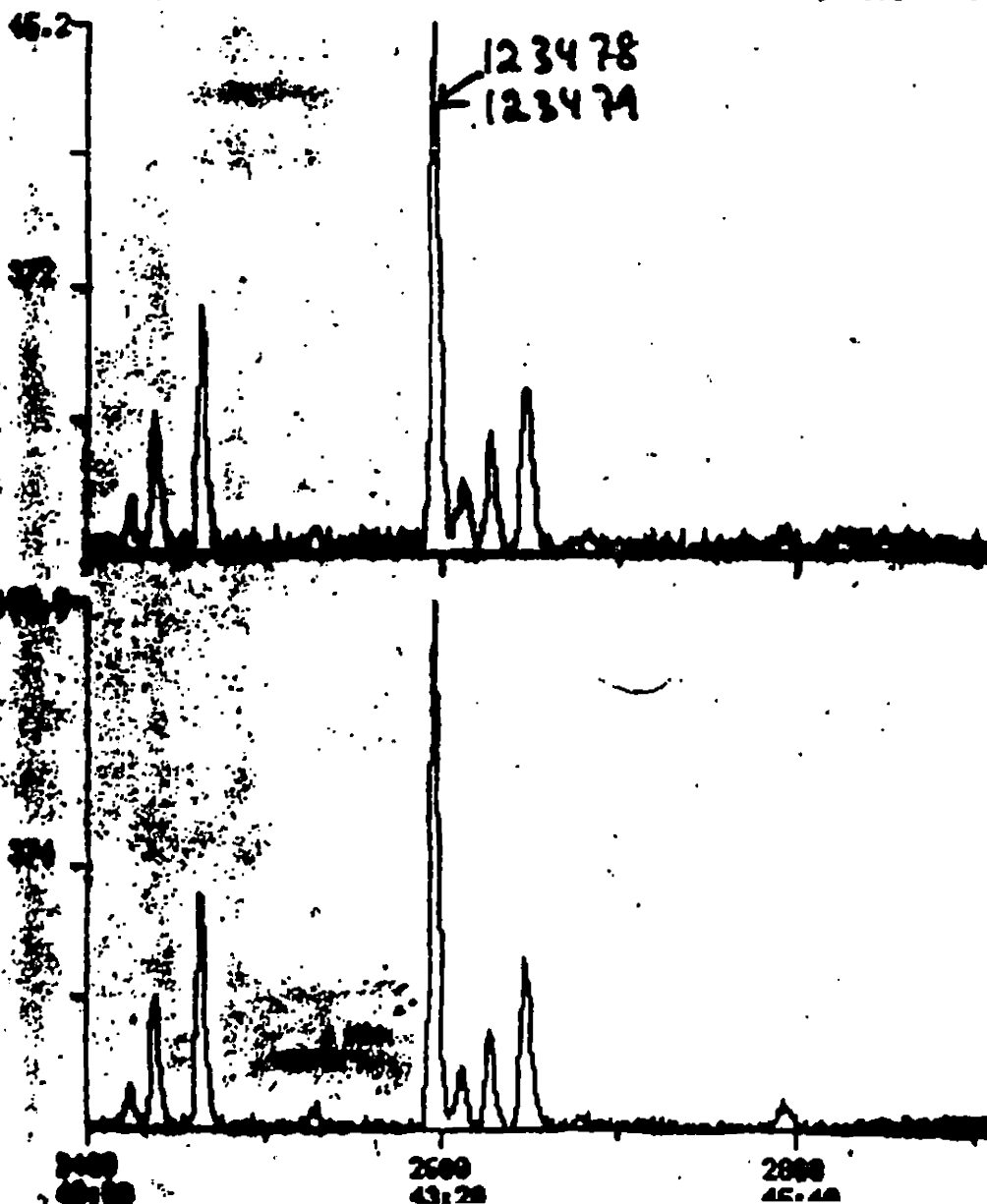
SAMPLE: MPR 267 3

CONDS.: SUPELCO 50M 100-100/20-250/3 40 PSI

RANGE: G 1, 1 LABEL: N 2, 4.0 QUAN: A 0, 1.0 J 0

DATA: MPR2673 #1

CALI: NCAL0322 #3



SCANS 2400 TO 2800

BASE: U 28. 3

A 50

220.

872.111  
± 0.500

874.112  
± 0.500

NEV 036963

3000  
28.00

3200  
28.00

SCN  
28.00

# (N) Levels of PCDFs in PCB samples (ppm)

|                                                      | 3010     | 1254     | 1260     | A 40     | A 50     |
|------------------------------------------------------|----------|----------|----------|----------|----------|
| 2,3,7,8-TCDF (C.01 ppm)                              | 0.05     | 0.019    | 0.013    | 0.18     | 3.30     |
| Σ TCDFs                                              | 0.63     | 1.40     | 0.110    | 2.60     | 20.0     |
| 1,2,3,7,8-PeCDF (C.002 ppm)                          | 0.01     | 0.09     | 0.048    | 0.10     | 0.76     |
| 2,3,4,7,8- " " " "                                   | tr       | 0.19     | 0.032    | 0.01     | 1.10     |
| Σ PeCDFs                                             | 0.035    | 1.10     | 0.240    | 1.70     | 8.00     |
| 123478/9-HxCDF                                       | < 0.01   | 2.50     | 0.50     | 0.08     | 0.70     |
| 123678- " " " "                                      | - " -    | 2.10     | 0.12     | 0.07     | 0.36     |
| 123789- " " " "                                      | - " -    | 0.19     | 0.19     | < 0.01   | 0.02     |
| 234789- " " " "                                      | - " -    | 0.13     | 0.03     | tr       | 0.90     |
| Σ HxCDFs                                             | < 0.01   | 10.00    | 1.50     | 0.31     | 3.00     |
| Σ HpCDFs                                             | < 0.01   | 0.96     | 1.30     | < 0.01   | 0.08     |
| OCDF                                                 | < 0.02   | tr       | tr       | < 0.02   | < 0.02   |
| TOTAL PCDFs                                          | 0.70 ppm | 16.4 ppm | 3.17 ppm | 4.61 ppm | 31.7 ppm |
| Recovery ( <sup>13</sup> C <sub>12</sub> -2378-TCDF) | 79.2%    | 79.2%    | 79.2%    | 79.2%    | 79.2%    |

(3)

PCB 2.2 ppm

Used capacitors

- 11 -

No increase

PCB Drained

Swollen capacitors

- 11 -

- 11 -

Dark spots,  
extracted

- 11 -

- 11 -

Pure PCB + Sparks  
18 kV, 2  $\mu$ F

- 11 -

- 11 -

These PCB were not deoxygenated

PCB + Epoxid  
7 sparks

20 ppm

10X increase

(however, still no biphenyls)

1977 Olwe, Hutzinger

PCDDs + PCDFs in fly ash

No quantitative figures

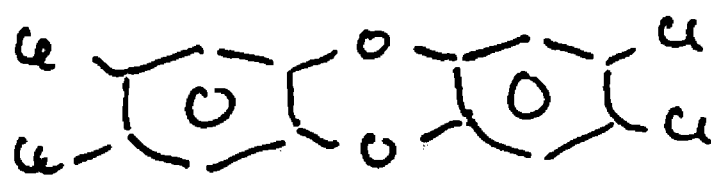
No isomer identification

1977-78 Buser, Rappe, Bosshardt

ppm levels

Some isomers identified

For risk evaluation: isomer specific  
analyses for the highly  
toxic isomers

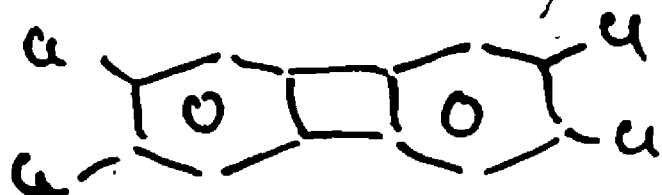


2,3,7,8-TCDD

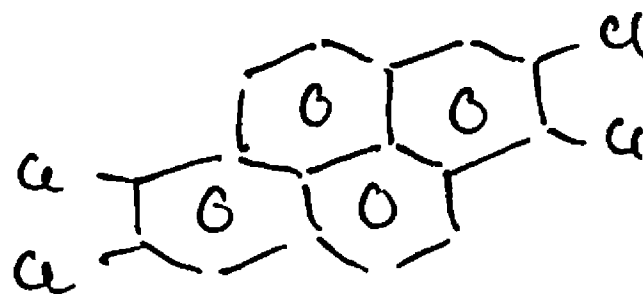


2,3,7,8-TCDF

on between toxicity



2,3,6,7-TCBP



2,3,7,8-TCPY

synthesis

— make  
acid  
then  
chlorinate

present in mineral oil fines

+ PCBs

testburn TLD many

Slemmestad, Norway

NORCEM

Conditions:

Kiln

150 m long

Ø 3.5 m

1450°C in the solid material

2000°C in the flames

4 m<sup>3</sup> of PCB (from capacitors)

feeding rate 50 kg/h (just PCBs being fed in)

NEV 036969

## SAMMANSTÄLLNING AV RESULTAT

(18)

| Isomer  | Condensat                   | Cement                |                       |                           |                         |                            |                            |
|---------|-----------------------------|-----------------------|-----------------------|---------------------------|-------------------------|----------------------------|----------------------------|
|         | Rökgas<br>kondensat<br>ng/l | Nr 3<br>XAD 2<br>ng/g | Nr 4<br>XAD 2<br>ng/g | Elektro<br>filter<br>ng/g | Klinker<br>prov<br>ng/g | Filter<br>3<br>ng<br>total | Filter<br>4<br>ng<br>total |
| TrCDF   | < 0.04                      | < 0.2                 | < 0.05                | < 25                      | < 500                   | < 0.6                      | < 0.2                      |
| TrCDD   | < 0.1                       | < 0.2                 | < 0.05                | < 12                      | < 500                   | < 1.9                      | < 0.2                      |
| 4-ClPCB | -                           | Ja                    | Ja                    | -                         | -                       | -                          | Ja                         |
| TCDF    | < 0.2                       | < 0.1                 | < 0.2                 | < 1.0                     | < 50                    | < 6.3                      | < 0.1                      |
| TCDD    | < 0.2                       | < 0.1                 | < 0.05                | < 1.0                     | < 50                    | < 3.0                      | < 0.1                      |
| PnCDF   | < 0.04                      | < 0.05                | < 0.05                | < 2.5                     | < 50                    | < 6.3                      | < 0.2                      |
| PnCDD   | < 0.1                       | < 0.05                | < 0.05                | < 1.5                     | < 50                    | < 6.3                      | < 0.2                      |
| HxCDF   | < 2.4                       | < 0.7                 | < 0.3                 | < 2.5                     | < 250                   | < 6.3                      | < 0.9                      |
| HxCDD   | < 0.6                       | < 0.7                 | < 0.2                 | < 2.5                     | < 250                   | < 6.3                      | < 0.9                      |
| HpCDF   | < 4.6                       | < 1.4                 | < 3                   | < 5.0                     | < 50                    | < 6.3                      | < 0.2                      |
| HpCDD   | < 0.2                       | < 0.1                 | < 0.05                | < 0.3                     | < 5                     | < 0.3                      | < 0.1                      |
| OCDF    | < 1.0                       | < 0.3                 | < 0.3                 | < 0.50                    | < 250                   | < 1.3                      | < 0.4                      |
| OCDD    | < 0.4                       | < 0.2                 | < 0.1                 | < 0.50                    | < 250                   | < 0.6                      | < 0.2                      |

TrCDF = Triklordibensofuran  
 TrCDD = Triklordibensodioxin  
 TCDF = Tetraklordibensofuran  
 PnCDF = Pentaklordibensofuran  
 HxCDF = Hexaklordibensofuran  
 HpCDF = Heptaklordibensofuran  
 OCDF = Oktaklordibensofuran

Stellan Marklund  
 Forskningsingenjör

Conclusions:

No PCDFs could be identified.

No PCPYs were observed.

NEV 036970

A safe (!?) method  
 < 100 ppt (Yusho 300 ppt)

Second test barn Degerhamn, Sweden

PCDFs before,

during

after PCB feeding

Rotary Cement Kiln

~ 150 m

Ø 3 m

OXYGEN DEFICIENCY

TEMP.

RESIDENCE TIME

OXYGEN

DUST

(20)

# Results from PCB test burn Cementa, Degerhamn Sweden

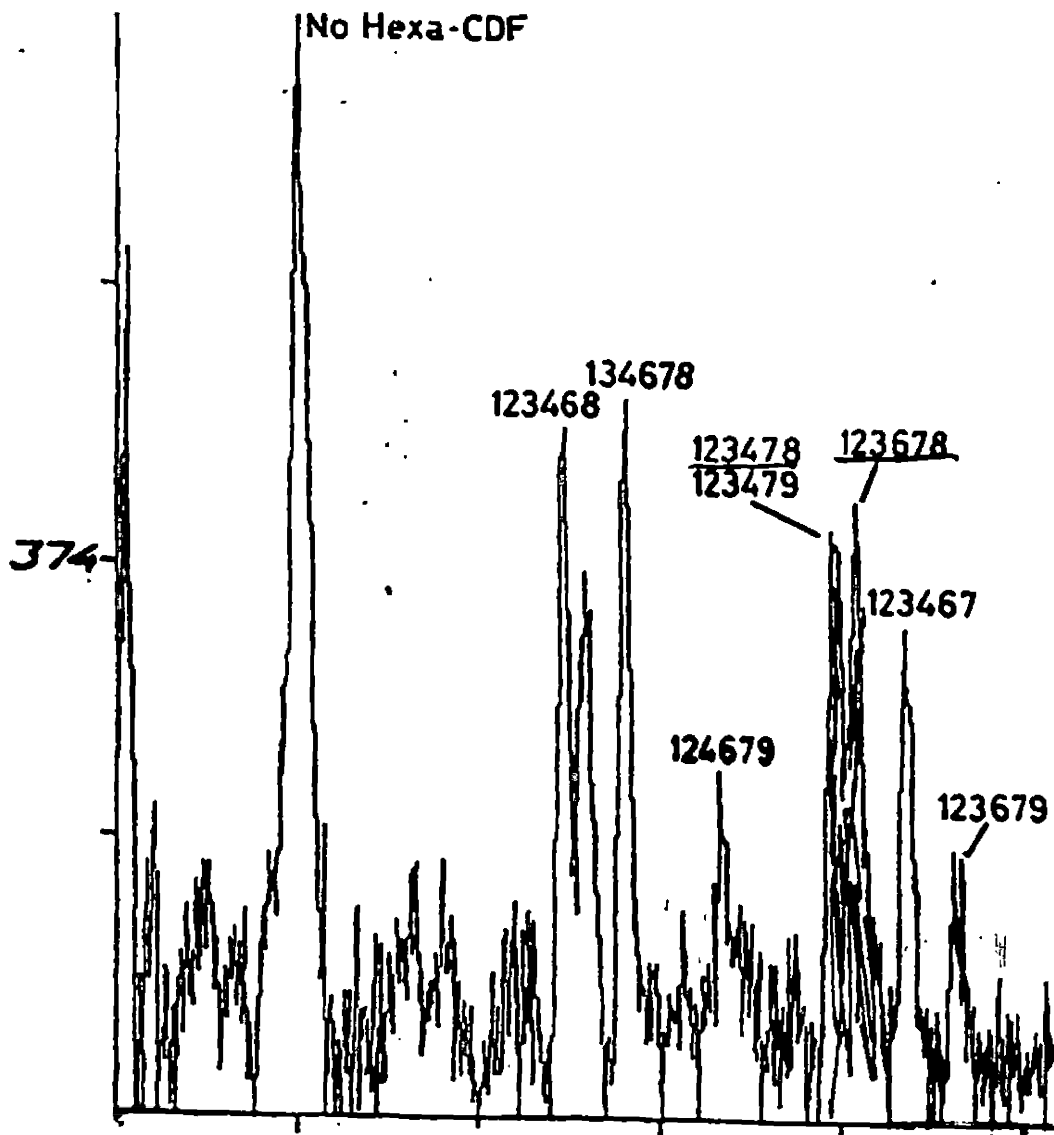
ng i sample received, unknown volume

|                  | Series A (3) | Blanks    | Series B (3) second burn |
|------------------|--------------|-----------|--------------------------|
|                  | Mean         |           | Mean                     |
| 2378-TCDF        | 33 ng        | < 0.05 ng | 1.0 ng                   |
| $\Sigma$ TCDFs   | 330 --       | < 0.5 --  | 10 --                    |
| $\Sigma$ Pe CDFs | 18 ---       | < 0.1     | 2.4 ---                  |
| $\Sigma$ Hx CDFs | < 0.8 ---    | < 0.1     | 2.0 ---                  |
| $\Sigma$ Hp CDFs | < 0.3        | < 0.1     | 2.0 ---                  |
| OCDF             | < 0.1        | < 0.1     | 0.2 ---                  |
|                  |              |           | 1.0 ---                  |
| $\Sigma$ Hx CDDs | NA           | < 0.1     | 1.0 ---                  |
| $\Sigma$ Hp CDDs | NA           | < 0.1     | 0.5 ---                  |
| OCDD             | NA           | < 0.1     |                          |

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Chris guessed that sample volume was  $3m^3$

(21)



29696

Hexa CDFs  
Cement Kiln  
PCB Test Burn

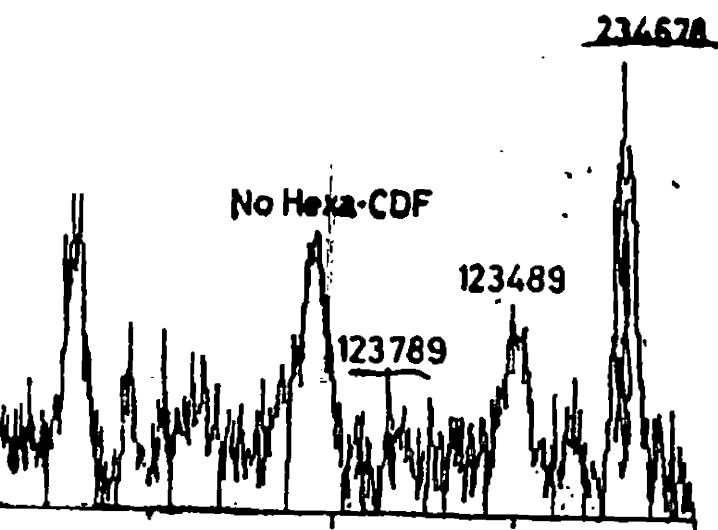


Table 2. PCB accidents during 1981 - 1983.

| Location                   | Category | Date           |
|----------------------------|----------|----------------|
| Binghamton, NY, USA        | b        | Feb. 5, 1981   |
| Stockholm, Sweden          | c        | Aug. 25, 1981  |
| Skövde, Sweden (Volvo)     | a        | March 19, 1982 |
| Arvika, Sweden (Volvo)     | c        | May, 1982      |
| Imatra, Finland            | c        | Aug. 2, 1982   |
| Helsinki, Finland          | c        | Aug. 1982      |
| Surahammar, Sweden         | a        | Sept. 23, 1982 |
| Malstahammar, Sweden       | c        | Nov. 8, 1982   |
| Railway locomotive, Sweden | c        | Winter 1982/83 |
| Kisa, Sweden               | c        | April 25, 1983 |
| San Francisco, CA, USA     | b        | May 15, 1983   |
| Halmstad, Sweden           | c        | Aug. 15, 1983  |
| Halmstad, Sweden           | c        | Nov. 15, 1983  |
| Bofors, Sweden             | c        | Nov. 30, 1983  |
| — — —                      | c        | Dec. 21, 1983  |

a = mineral oil + PCB

b = PCBs + Chlorobenzenes + electrical energy

c = capacitor explosions

Table 7. Levels of PCDFs in samples from PCB fires

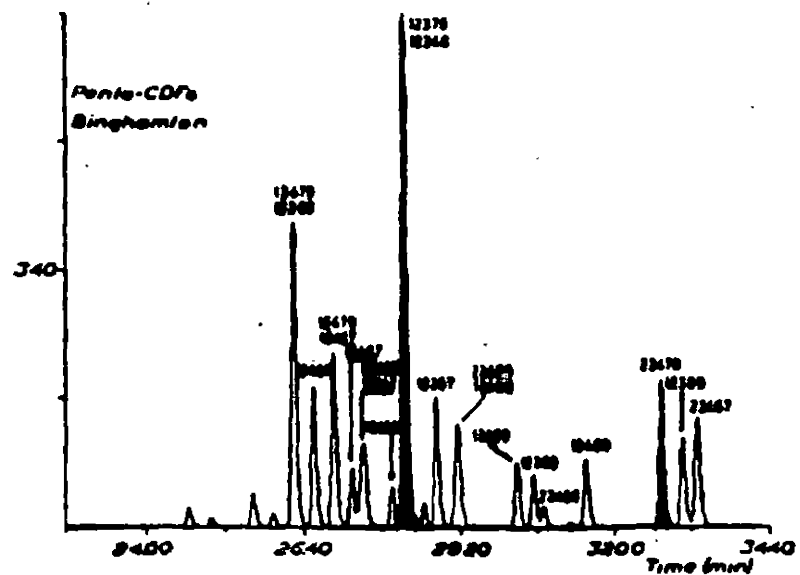
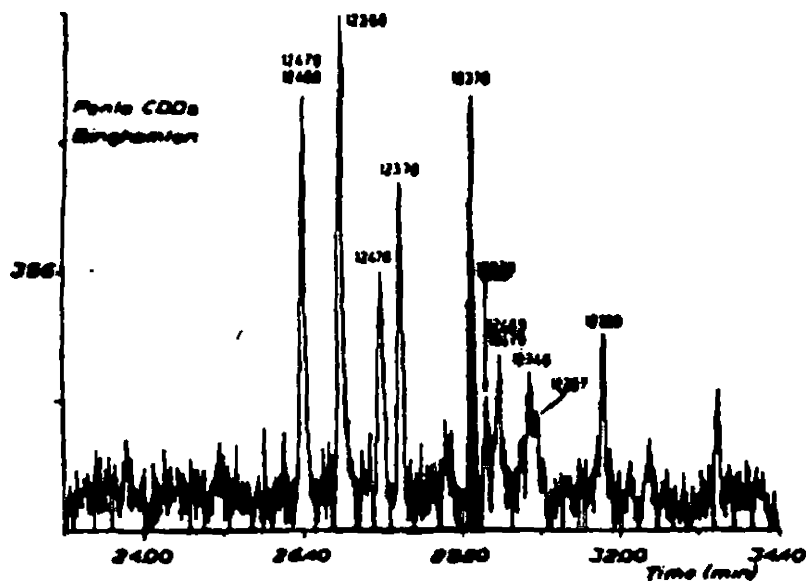
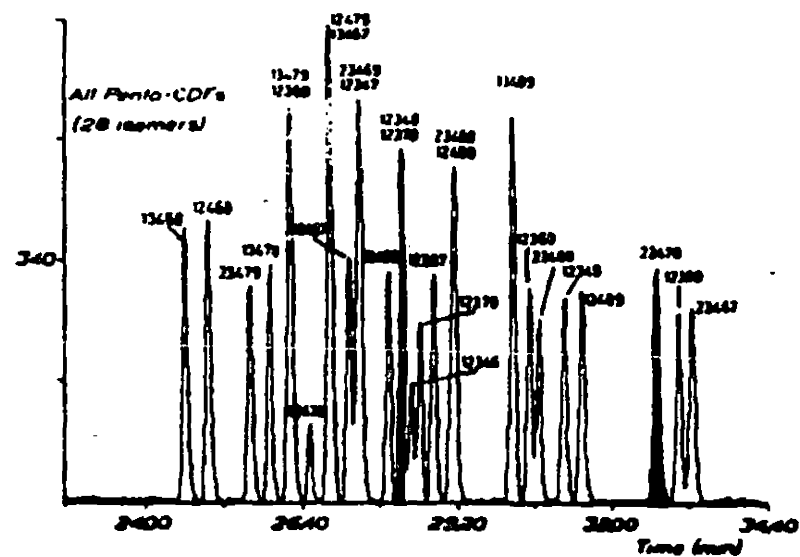
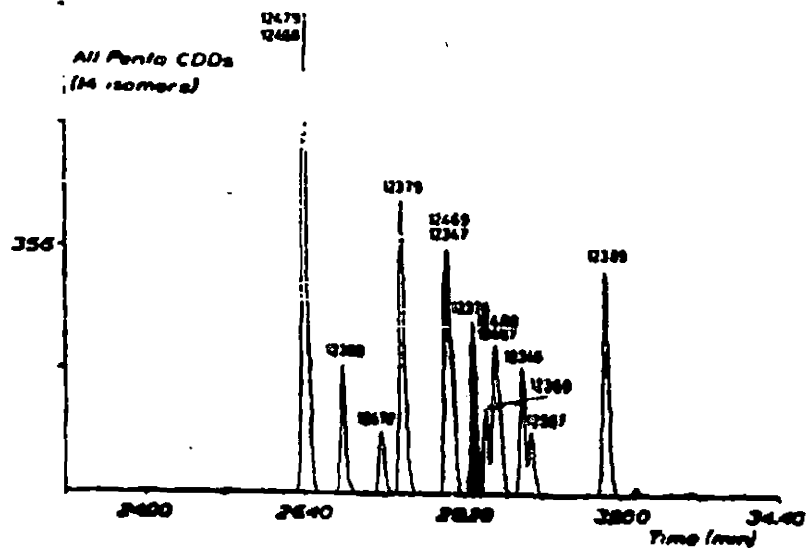
Action level, Sweden  $0.05 \mu\text{g}/\text{m}^2 \sum 2378\text{-TCDF} + 23478 \text{ PeCDF} + 2367\text{-TCBP}$

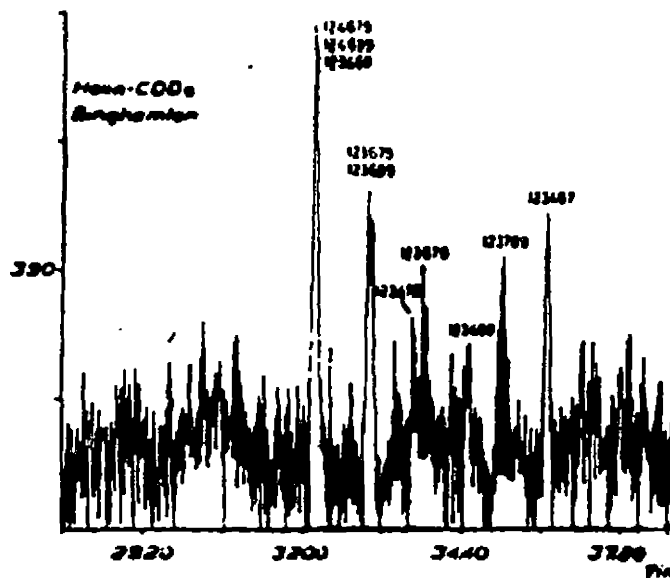
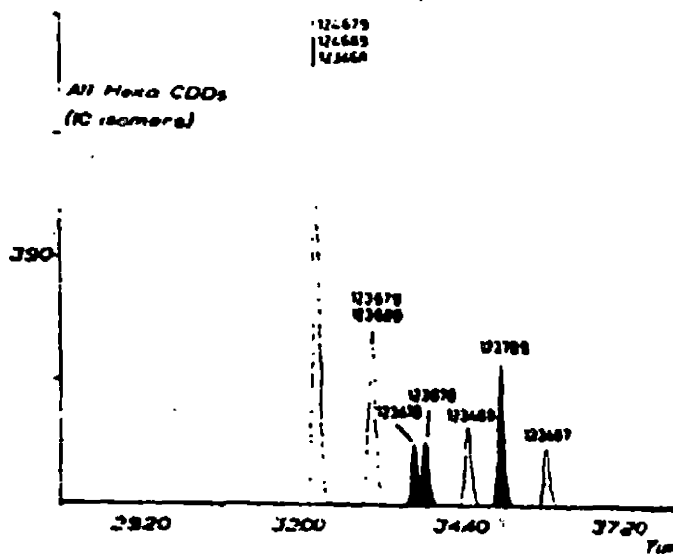
|                                                                 | $\Sigma \text{Cl}_4$ | 2378-   | $\Sigma \text{Cl}_5$ | $\Sigma \text{Cl}_6$ | $\Sigma \text{Cl}_7$ | $\text{Cl}_8$ | $\Sigma \text{PCDDs}$ | <u>PCBPs<sup>a</sup></u> |
|-----------------------------------------------------------------|----------------------|---------|----------------------|----------------------|----------------------|---------------|-----------------------|--------------------------|
| Binghamton ( $\mu\text{g}/\text{g}$ )                           | 20                   | 12      | 670                  | 965                  | 460                  | 40            | 20                    | +                        |
| Stockholm ( $\mu\text{g}/\text{m}^2$ )                          | 1.2                  | 0.15    | 0.175                | -                    | -                    | -             | -                     | +++                      |
| Skövde ( $\mu\text{g}/\text{m}^2$ )                             | 0.6                  | 0.1     | 0.1                  | 0.06                 | 0.008                | 0.006         | -                     | -                        |
| Surahammar ( $\mu\text{g}/\text{m}^2$ )<br>(before cleaning)    | 1.2                  | 0.3     | 0.3                  | 0.15                 | 0.07                 | 0.01          | -                     | -                        |
| Surahammar ( $\mu\text{g}/\text{m}^2$ )<br>(after cleaning)     | < 0.02               | < 0.004 | < 0.01               | < 0.01               | < 0.015              | < 0.002       | -                     | -                        |
| Hallstahammar ( $\mu\text{g}/\text{m}^2$ )<br>(before cleaning) | 1.6                  | 0.54    | 0.36                 | 0.60                 | 0.80                 | 1.34          | -                     | -                        |
| Hallstahammar ( $\mu\text{g}/\text{m}^2$ )<br>(after cleaning)  | 0.002                | 0.0002  | 0.0005               | 0.0003               | 0.0007               | 0.0011        | -                     | -                        |
| Electrical locomotive<br>( $\mu\text{g}/\text{m}^2$ )           | 4.9                  | 1.2     | 1.5                  | 0.4                  | 0.17                 | 0.04          | -                     | -                        |

<sup>a</sup> polychlorinated biphenylenes    +++ high levels,    + low levels



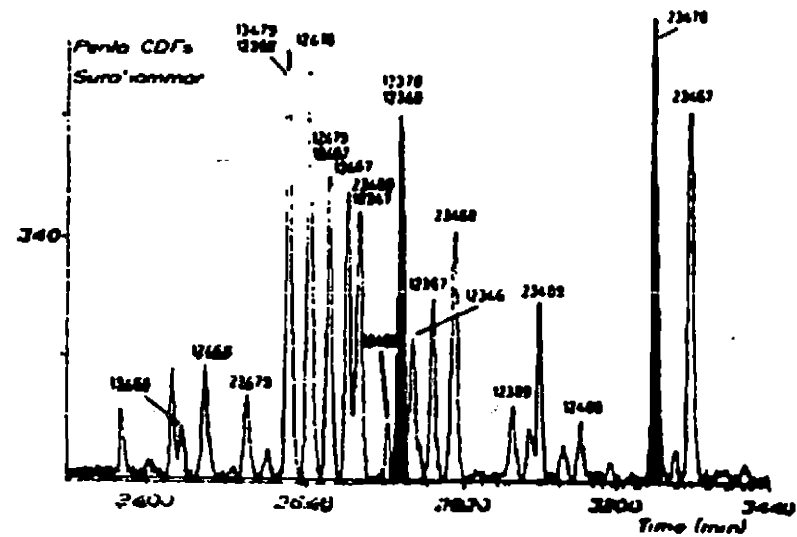
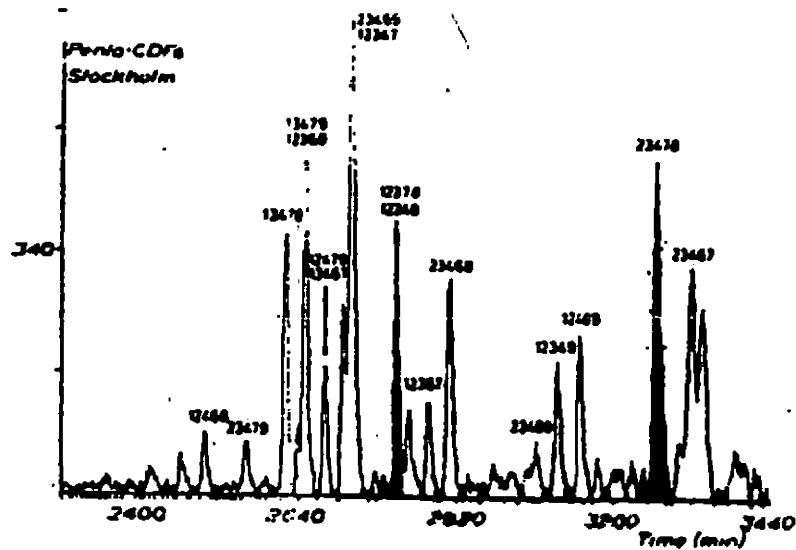


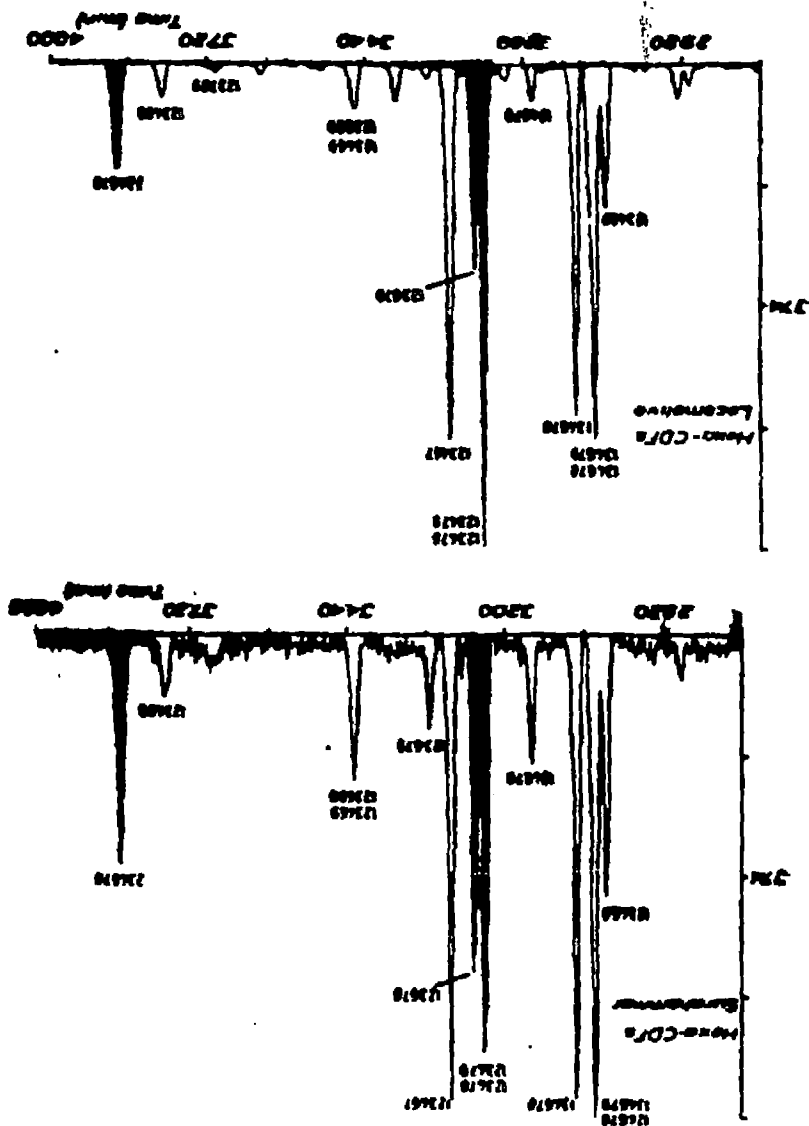


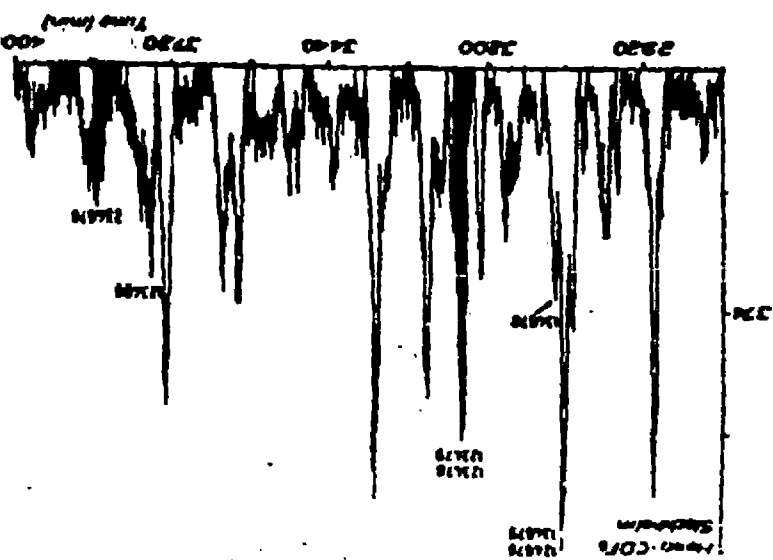
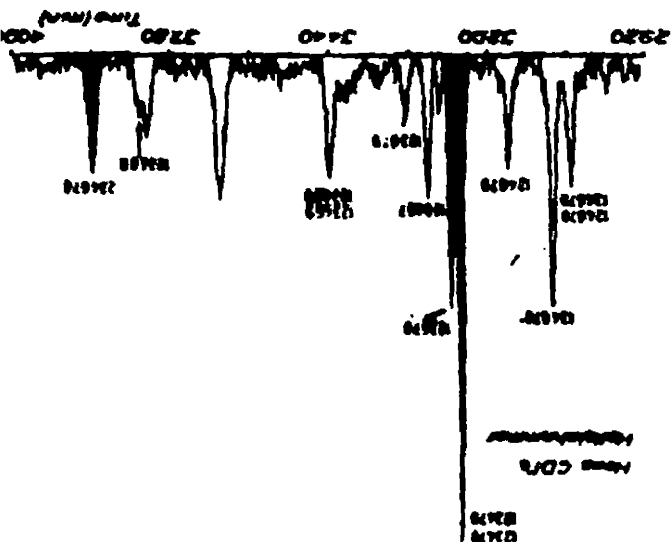












(30)

## Municipal Incinerators

## Hazardous Wastes Incinerators

Kommunekemi, Nyborg, Denmark  
SAKAB, Norrtorp, Sweden

Kema Nord, Stenungsund, Sweden

Stemmetad, Norway  
Degerhamn, Sweden

## Conclusions

He did not draw any!

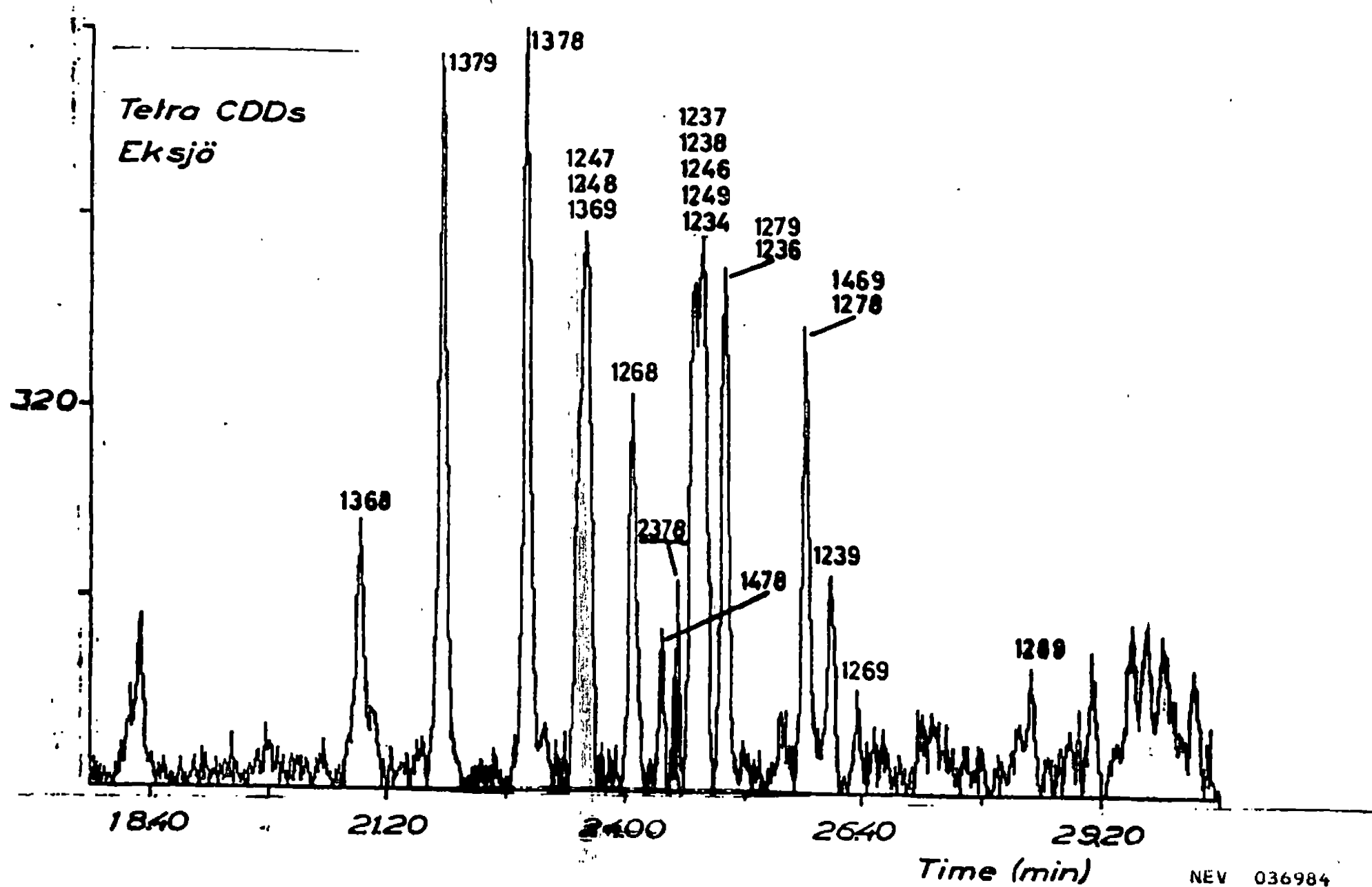
Fluidized bed incinerator, Eksjö, Sweden

Municipal waste

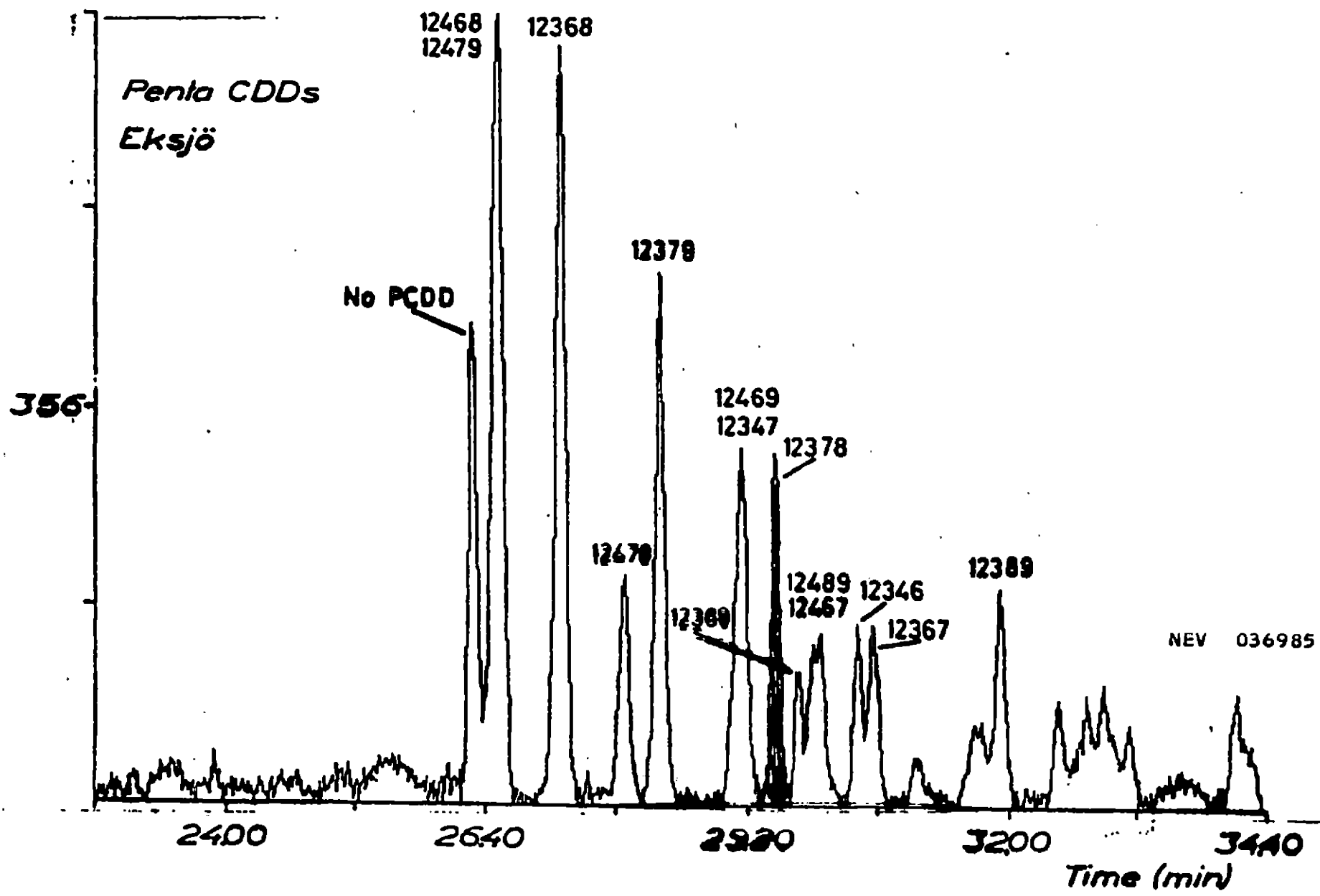
Temp.  $\sim 700^{\circ}\text{C}$

Residence time  $\sim 2 \text{ sec.}$

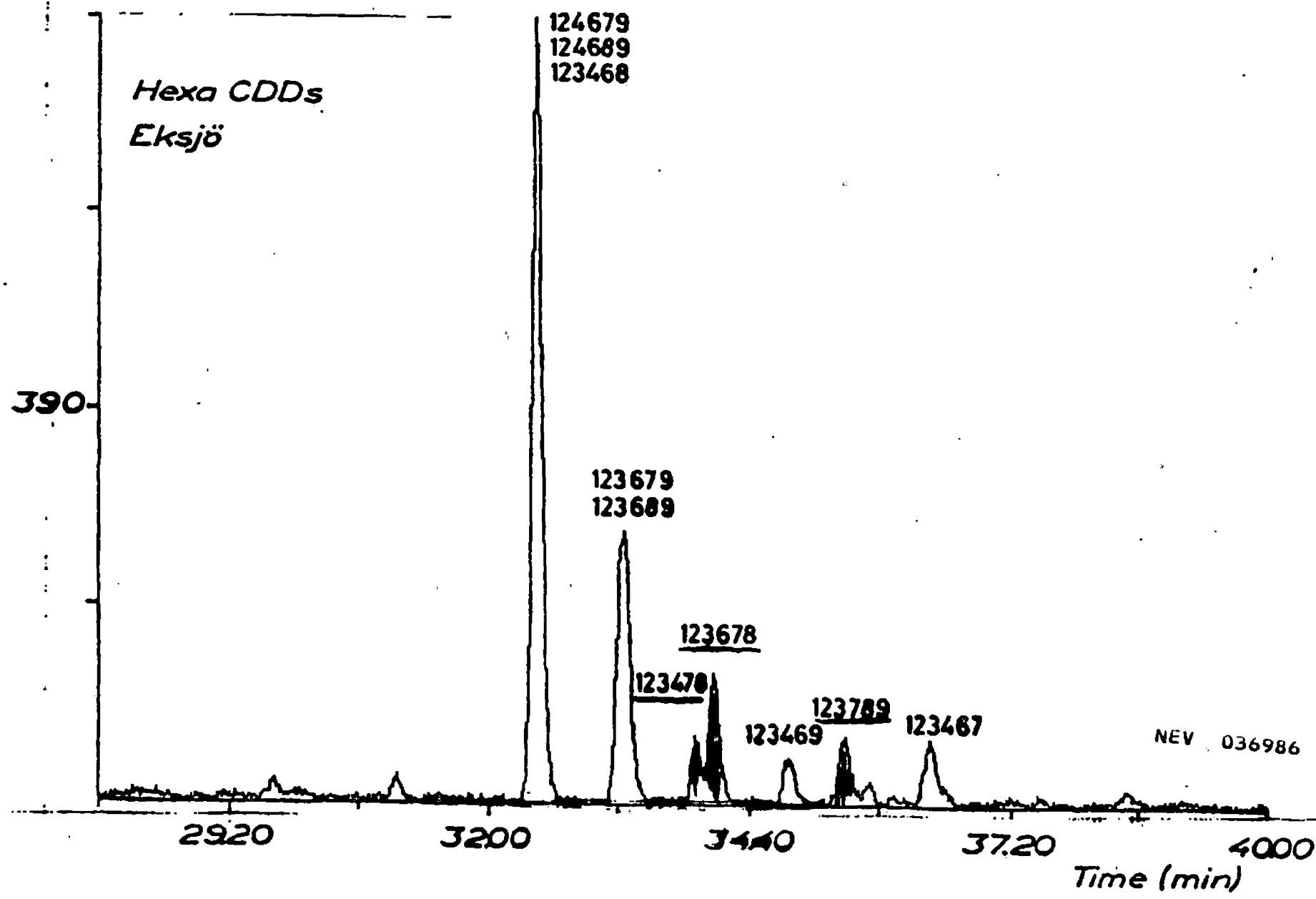
NOT optimal conditions



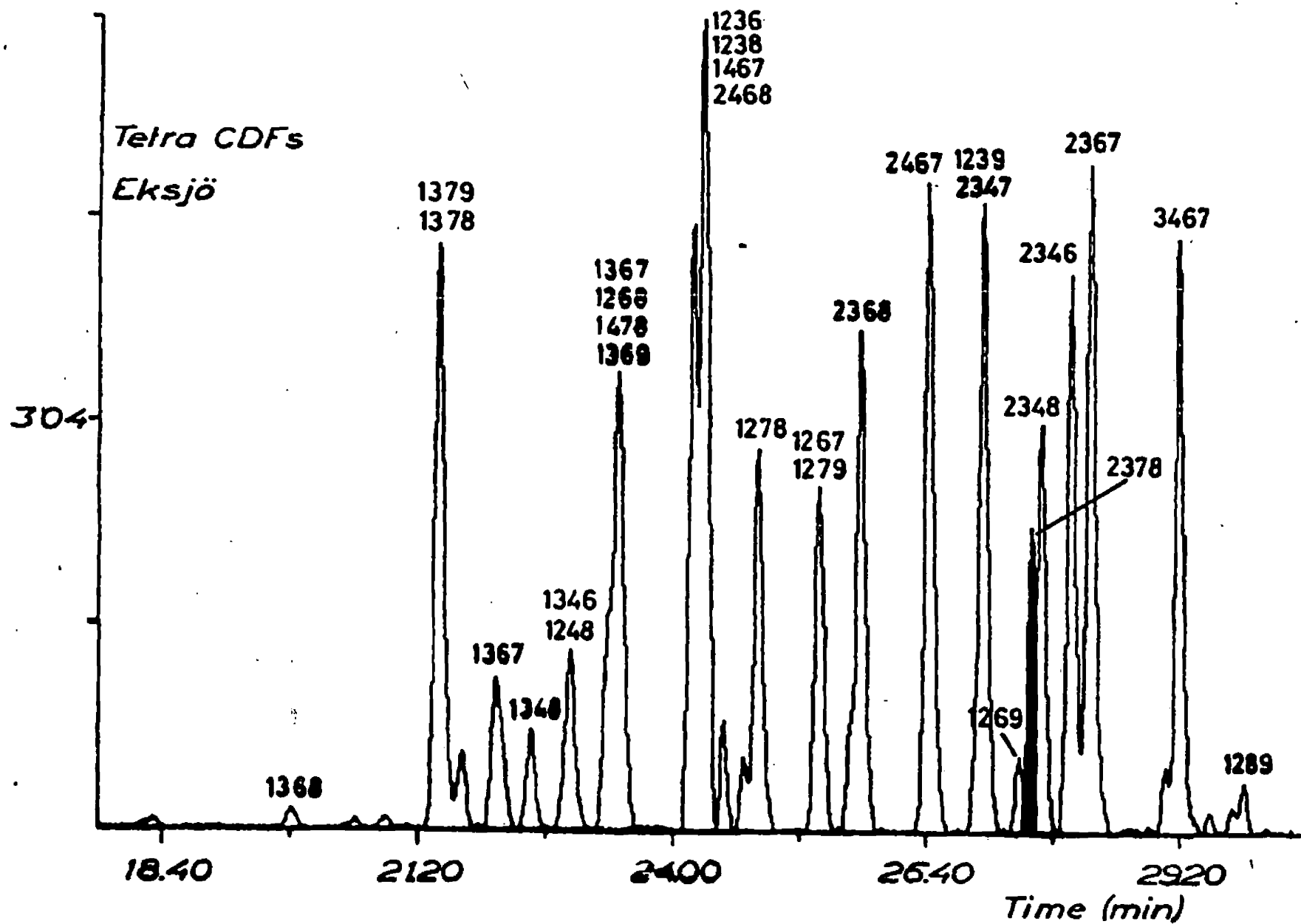
(33)



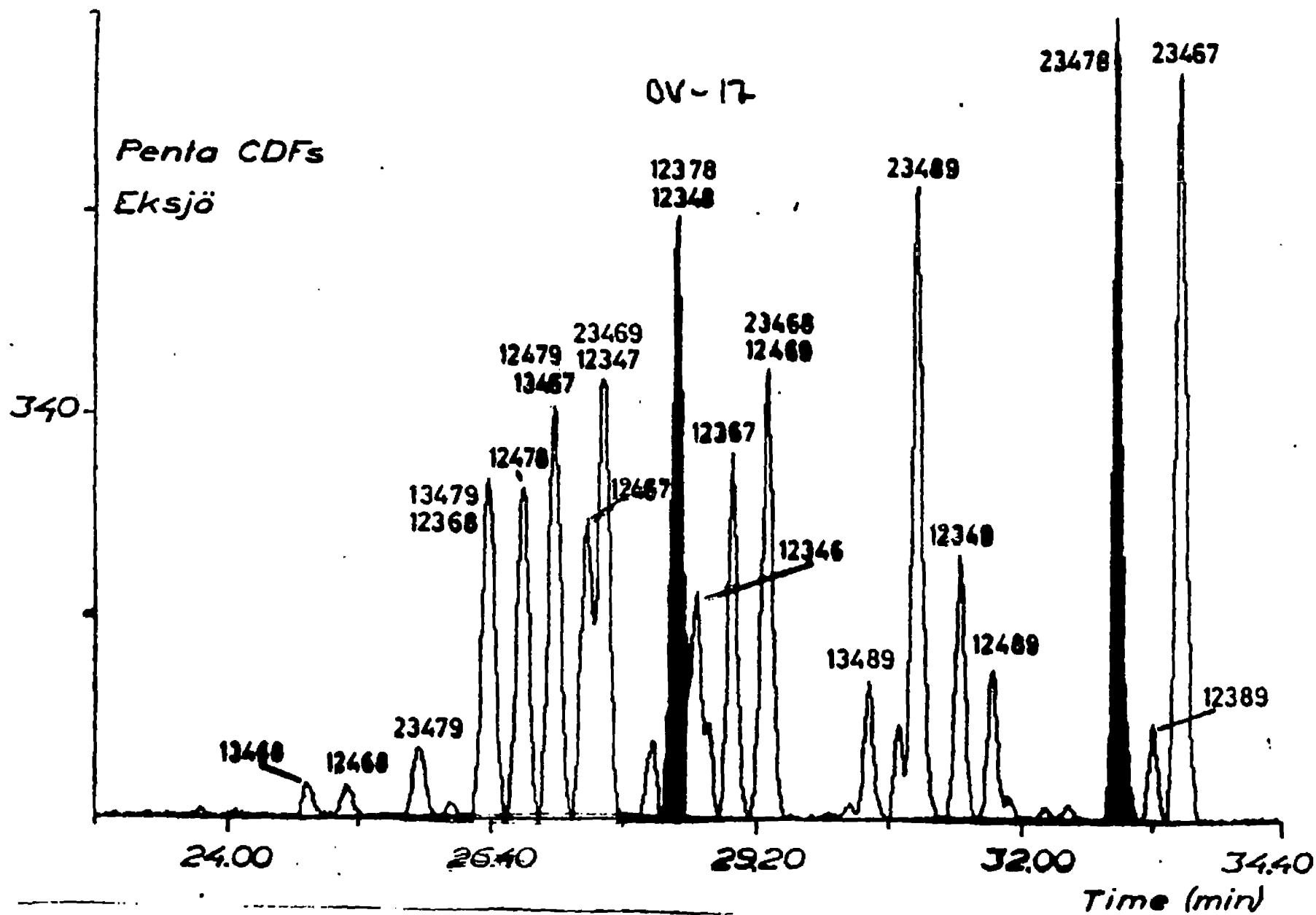
34

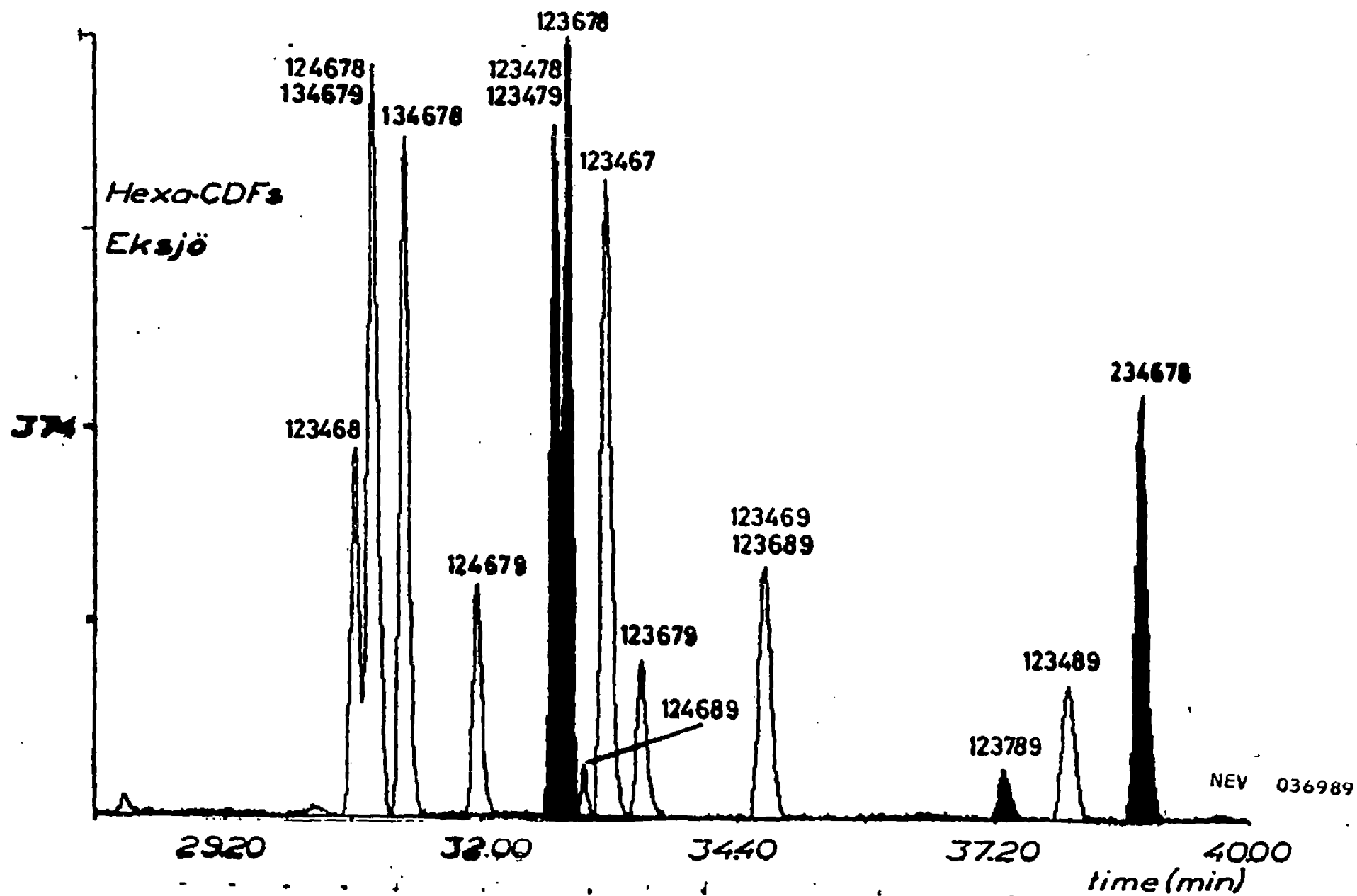


(35)



36





(38)

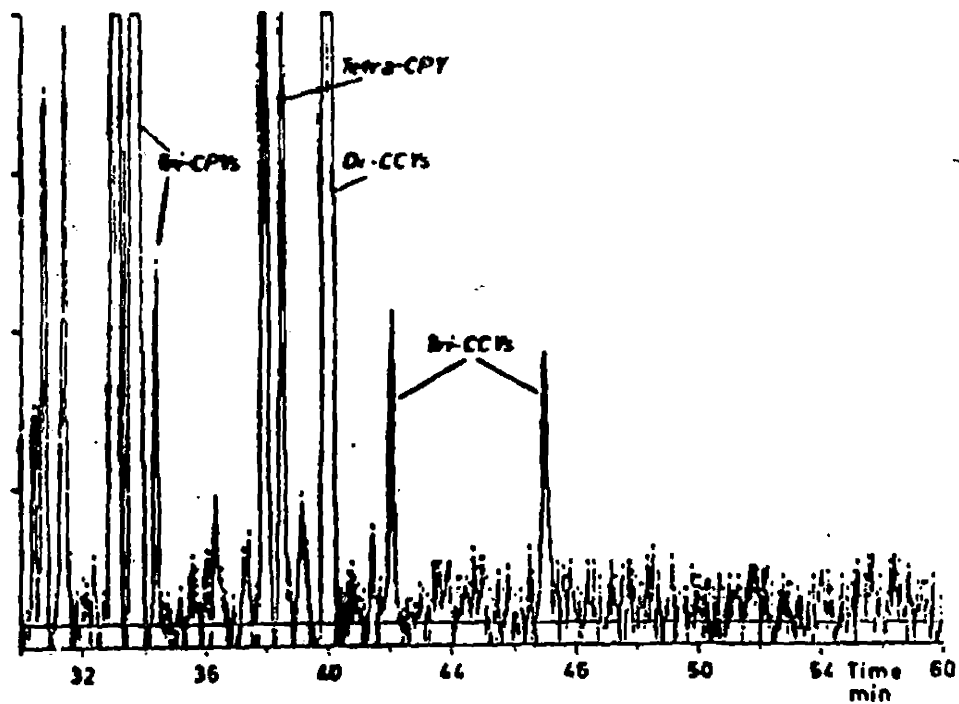
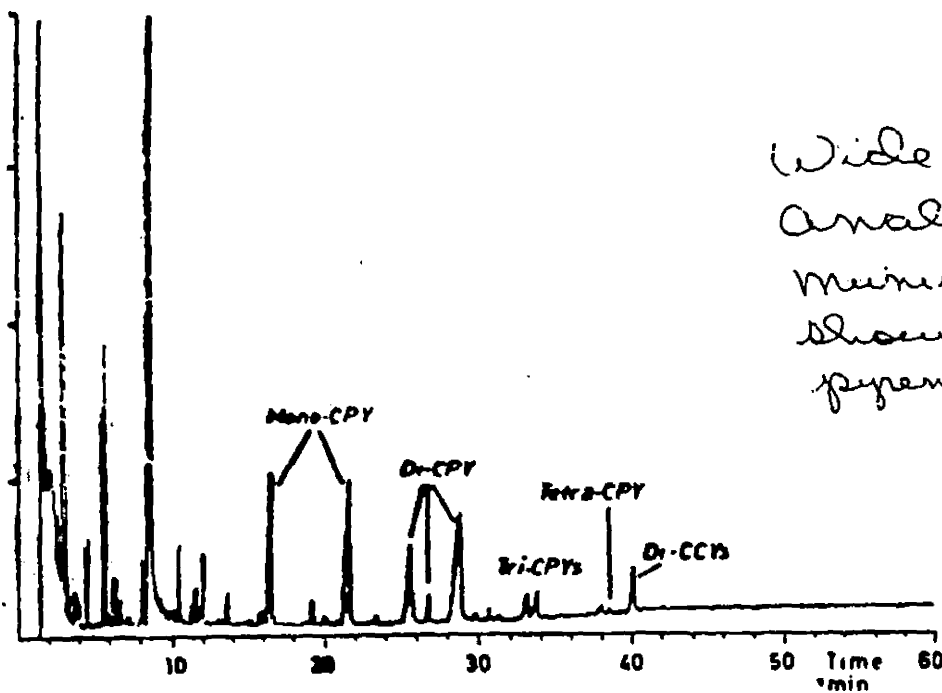
Result: fluidized bed incineration, ~ 700°C, 3 m<sup>3</sup> (ng)

|                     | Condensates (ng) |                 | Particulates (ng) |        |
|---------------------|------------------|-----------------|-------------------|--------|
|                     | 1                | 2               | 1                 | 2      |
| Σ TCDDs             | < 0.5            | 68 (12 isomers) | < 0.5             | < 0.5  |
| 2,3,7,8-TCDD        | < 0.1            | 3               | < 0.1             | < 0.1  |
| Σ TCDFs             | 205 (20)         | 1574 (20)       | 110               | 75     |
| 2,3,7,8-TCDF        | 17               | 35              | 9                 | 4      |
| Σ Penta-CDD         | < 0.5            | < 1             | < 0.5             | < 0.5  |
| Σ Penta-CDF         | 17 (4)           | 260 (5)         | 30 (5)            | 13 (2) |
| 2,3,4,6,8-Penta-CDF | 1                | 40              | 10                | 5      |
| Σ Hexa-CDDs         | < 0.1            | < 0.1           | < 0.1             | < 0.1  |
| Σ Hexa-CDFs         | 30 (3)           | 240 (6)         | 75 (5)            | 13 (3) |
| Σ Hepta-CDD         | 20 (2)           | 75 (2)          | 60 (2)            | 35 (2) |
| Σ Hepta-CDF         | 22 (3)           | 145 (3)         | 74 (3)            | 25 (3) |
| Octa-CDD            | 11               | 25              | 40                | 30     |
| Octa-CDF            | 4                | 17              | 23                | 25     |

|                |       |        |       |       |
|----------------|-------|--------|-------|-------|
| α <sub>8</sub> | 0.36  | 0.68   | 0.60  | 0.83  |
| α <sub>7</sub> | 1     | 2      | 1.2   | 0.8   |
| α <sub>6</sub> | > 300 | > 1000 | > 500 | > 200 |
| α <sub>5</sub> | > 30  | > 250  | > 60  | > 25  |
| α <sub>4</sub> | > 500 | 25     | > 100 | > 100 |
| α <sub>3</sub> | -     | > 2500 | -     | -     |

condensates 2  
 Particulates 2

Ratio



EKSjö

(7)

Eksjö, Umeå + 2 other Sweden LSH  
Zürich

Toronto + 2 other Ontario

## Municipal Incinerator

PCDFs > PCDDs

Tetra-CDFs >> Tetra-CDDs

Octa-CDF  $\approx$  Octa-CDD

Levels:  $5 \text{ ng/m}^3$  -  $1 \mu\text{g/m}^3$

No complete  
negative

$\sim 10\,000 \text{ m}^3/\text{hr}$

PCPYs

PCCYs

NEV 036993

The PCDDs and PCDFs were equally distributed between the flyash, particulates and flue gas.

(42)

NYBORO

Test # 7

Test # 8 (PCB)

ng/m<sup>3</sup>

ng/m<sup>3</sup>

> 99.795%

2378-TCDD

> 0.02

> 0.03

$\Sigma$  TCDDs

> 5.7

> 5

2378-TCDF

> 36

> 8

$\Sigma$  TCDFs

> 108

> 40

$\Sigma$  Pe CDDs

> 25

> 5

$\Sigma$  Pe CDFs

> 26

> 5

$\Sigma$  Hx CDDs

> 10

> 1

$\Sigma$  Hx CDFs

> 22

> 4

$\Sigma$  Hp CDDs

> 15

> 1

$\Sigma$  Hp CDFs

> 23

> 3

O CDD

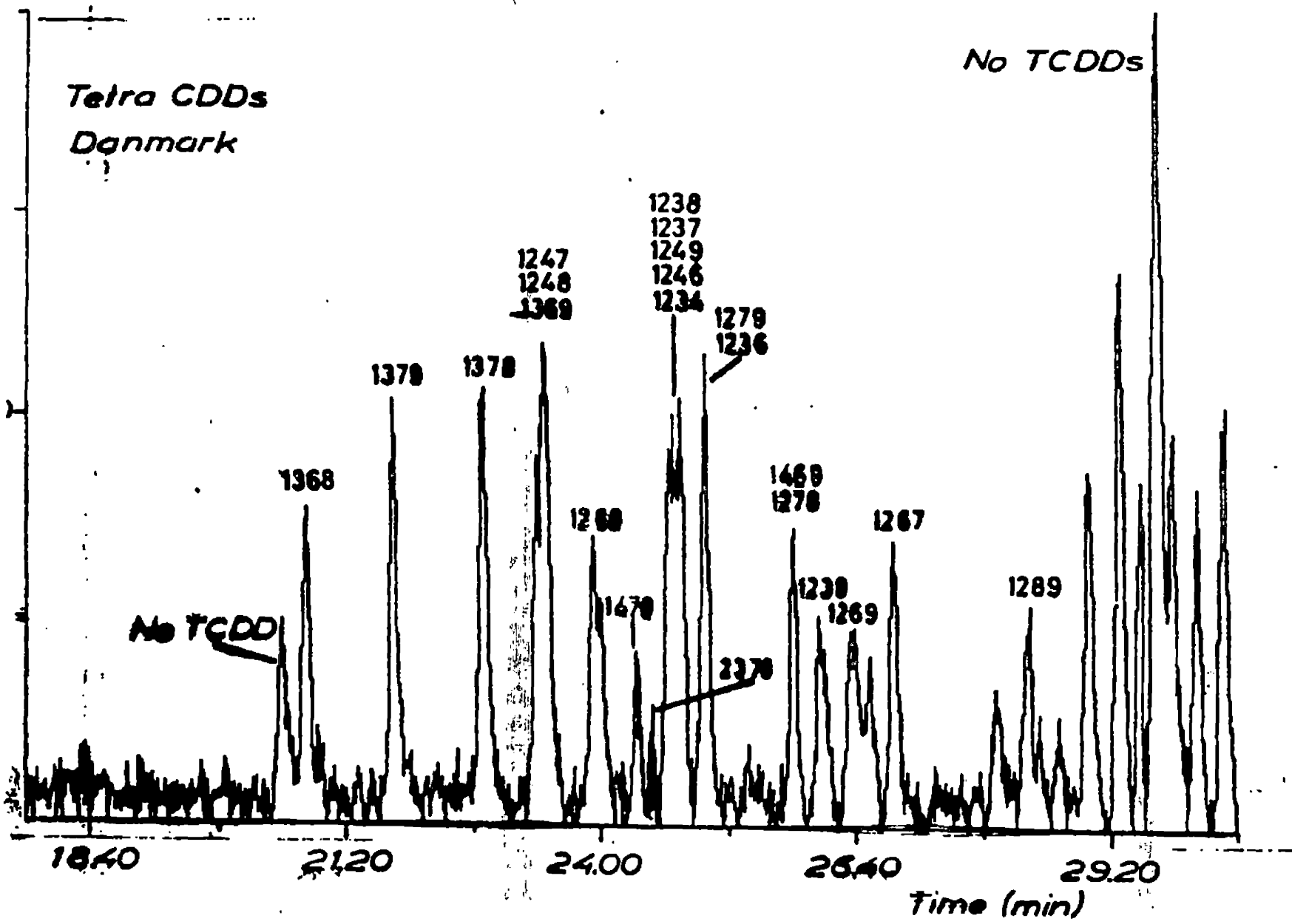
> 2

> 0.2

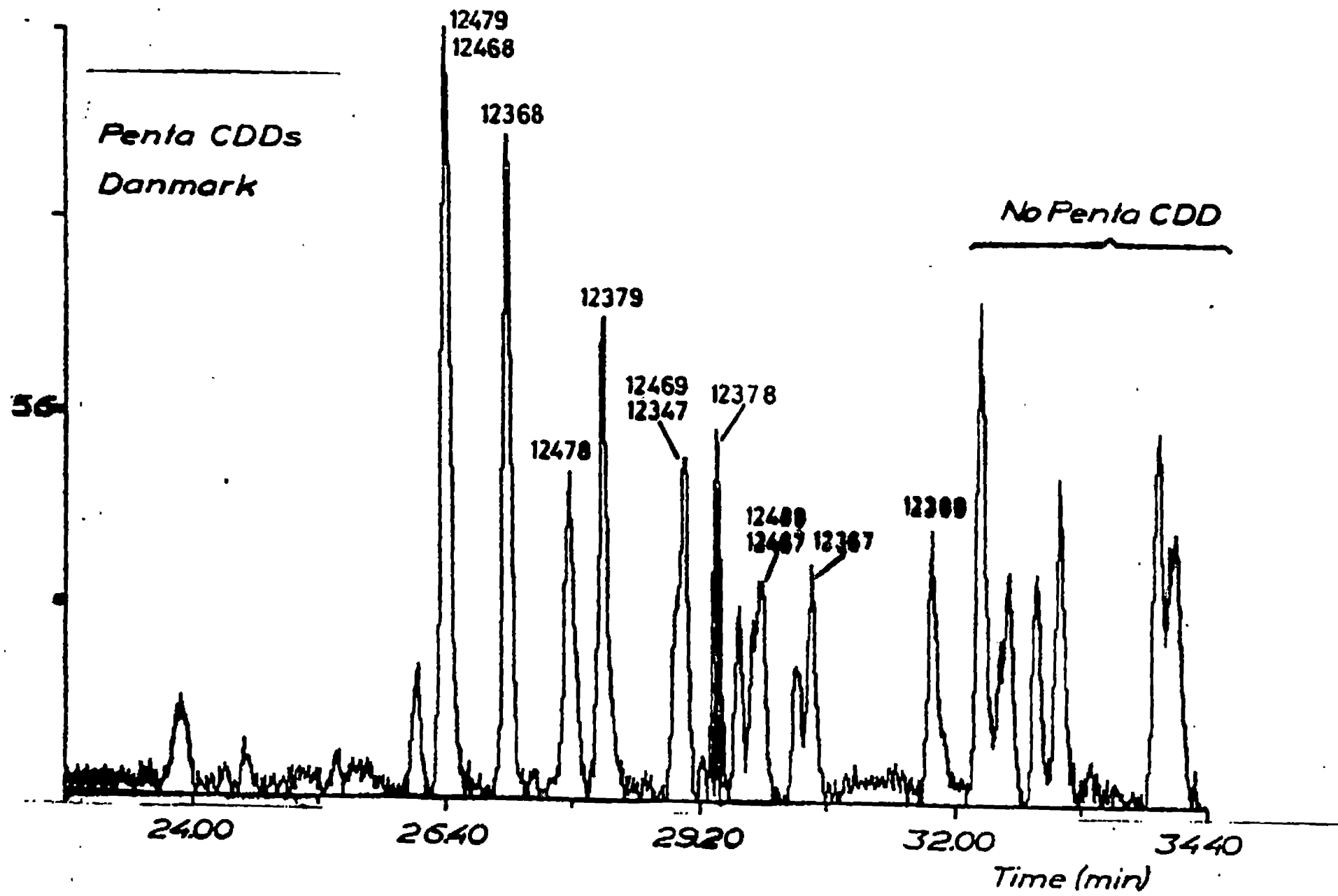
O CDF

> 6

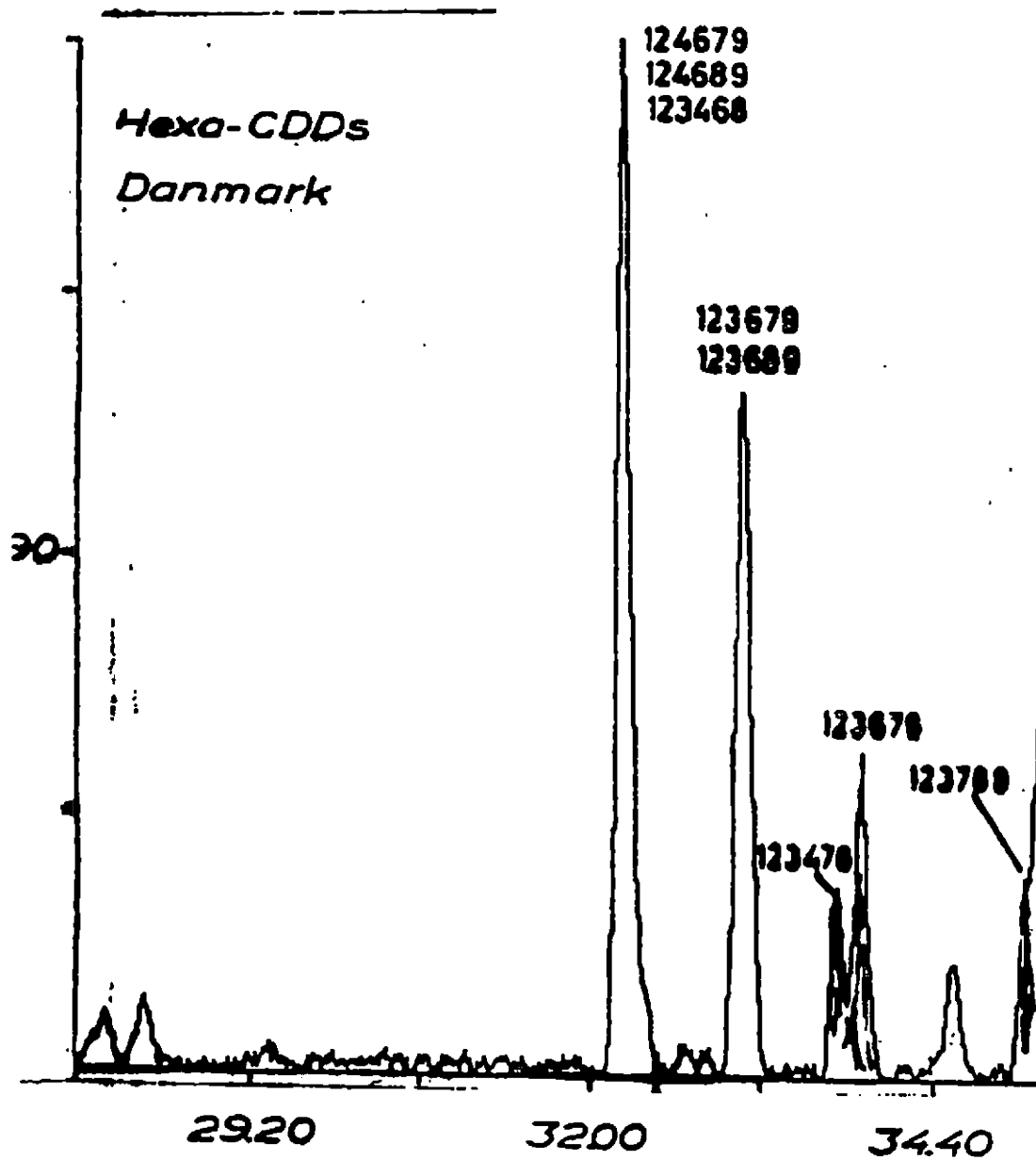
> 0.6



(7)



(54)



123467

NEV 036997

3720

4000

Time (min)

MASS CHROMATOGRAM

05/30/89 9:01:00

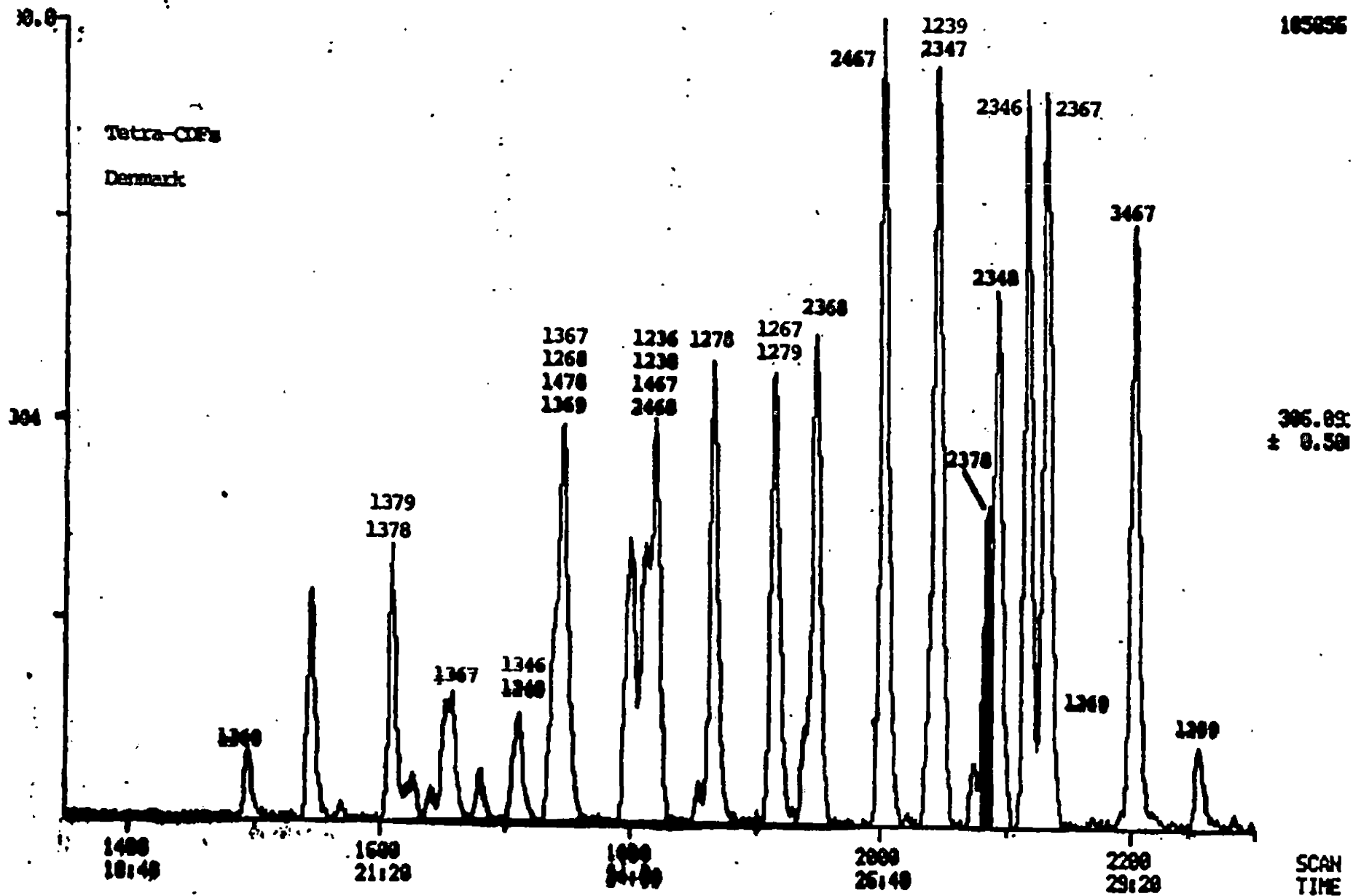
SAMPLE: KOMUNEKEMI D7X INJ 1/50 EI SP2330FS MID/54

RANGE: C 1, 3 LABEL: H 2, 7.0 QUAN: A 2, 8.0 BASE: U 20, 3

DATA: KOMUNEKEMI2 #1

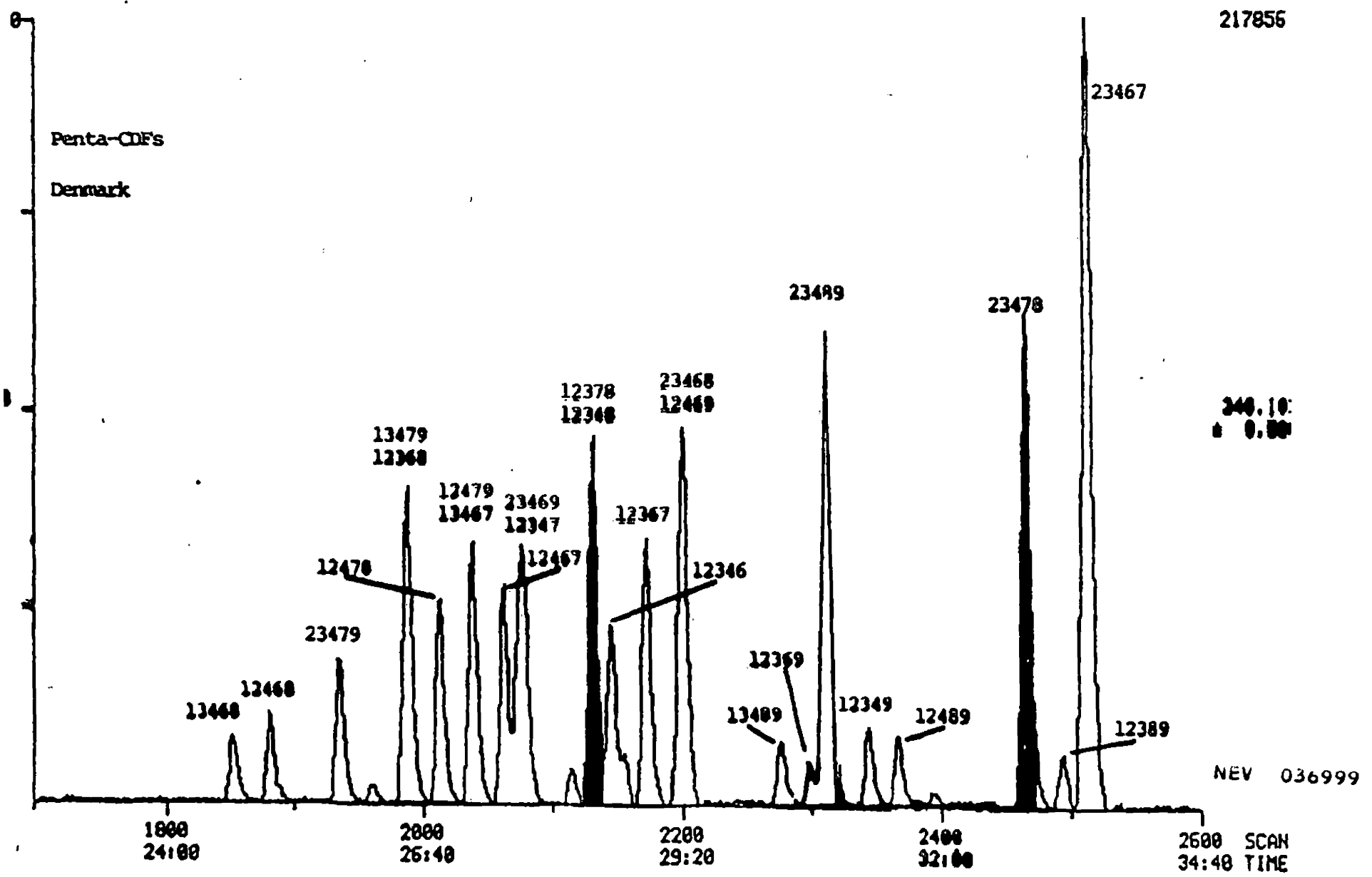
CALL: CAL0529 #3

SCANS 1350 TO 2300



47

4



(48)

MASS CHROMATOGRAM

06/30/89 9:01:00

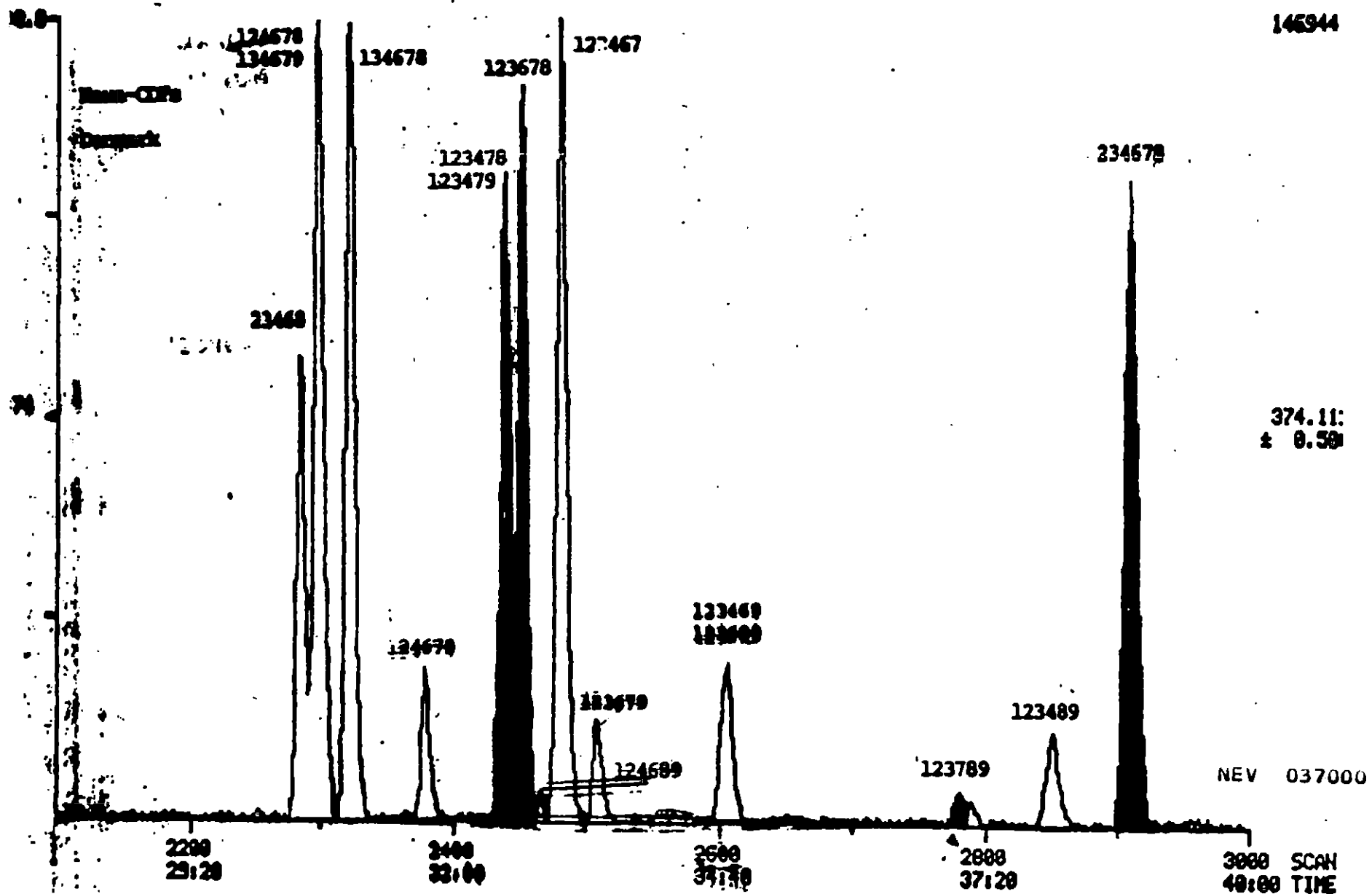
SAMPLE: KPMNHEMI 07X INJ 1/50 EI SP2330FS MID/54

RANGE: 1, 3 LABEL: H 2, 7.0 QUANT: A 2, 2.0 BASE: U 20, 3

DATA: KPMNHEMI2 01

FILE: CAL0629 03

SCANS 2100 TO 2000



(5)

## RESULTS KEHA NORD

$\Sigma Hx CDF$  1-3 ng/m<sup>3</sup>

$\Sigma Hp CDF$  3-20 ng/m<sup>3</sup>

OCDF 3-400 ng/m<sup>3</sup>

OCDD 0.1-1 ng/m<sup>3</sup>

No Cl<sub>4</sub>, Cl<sub>5</sub> Dibenzofurans

No Cl<sub>4</sub>, Cl<sub>5</sub>, Cl<sub>6</sub>, Cl<sub>7</sub> Dioxins

# KEMA NORD STENUNGSUND, SWEDEN

vinyl chloride  
VCM tar

vinyl chloride monomer

LURGI ~ 1200°C

0.5 sec residence time

|                      |      |                   |       |
|----------------------|------|-------------------|-------|
| Vinylklorid          | 0,9  | Kloral            | 0     |
| Etenoxid             | 0,4  | 1-brom-2-kloreten | 0,2   |
| Etylklorid           | 5,8  | 1,1,2-trikloreten | 6,6   |
| 1,1-dikloreten       | 0    | Tetrakloreten     | 0,4   |
| Diklormetan          | 0    | Diklor-C4         | 4,3   |
| Trans 1,2-dikloreten | 0    | Klorbensen        | 0,5   |
| Kloropren            | 0    | Tetrakloreten     | 7,8   |
| Cis 1,2-dekloreten   | 0    | Pentakloreten     | 3,2   |
| Kloroform            | 0,2  | Triklor-C4        | 18,7  |
| 1-klor-1,3-butadien  | 0    | 1,3-diklorbensen  | < 0,1 |
| 1,2-dikloreten       | 19,4 | Tetraklor-C4      | 3,3   |
| 1,1,1-trikloreten    | 0,6  | Hexakloreten      | 1,9   |
| Bensen               | 0    | Tetraklorbensen   | 0,2   |
| Koltetraklorid       | 0    | Pentaklorbensen   | 0,1   |
| Trikloreten          | 0,2  | Hexaklorbensen    | 0,5   |

NEV 037003

Hazardous Waste Incinerator

PCDFs > PCDDs

Tetra-CDs >> Tetra-CDDs

Octa-CDs  $\leq$  Octa-CDD

Levels  $1 \text{ ng/m}^3 - 3 \mu\text{g/m}^3$

$> 10\,000 \text{ m}^3/\text{hr}$

No complete  
negative  
(Slemestad)

## Hazardous Waste Incinerator

PCDFs > PCDDs

Tetra-CDs >> Tetra-CDDs

Octa-CDs  $\leq$  Octa-CDD

Levels  $1 \text{ ng/m}^3 - 3 \mu\text{g/m}^3$

> 10 000  $\text{m}^3/\text{hr}$

No complete  
negative  
(Slemestad)

## Conclusions

Waste incineration results in emissions of PCDDs and PCDFs

2 3 7 8 - Tetra - CDD

Minor / very minor

1 2 3 7 8 - Penta - CDD

Middle

2 3 7 8 - Tetra - CDF

Middle / Major

1 2 3 7 8 - Penta - CDF

Major

2 3 4 7 8 -

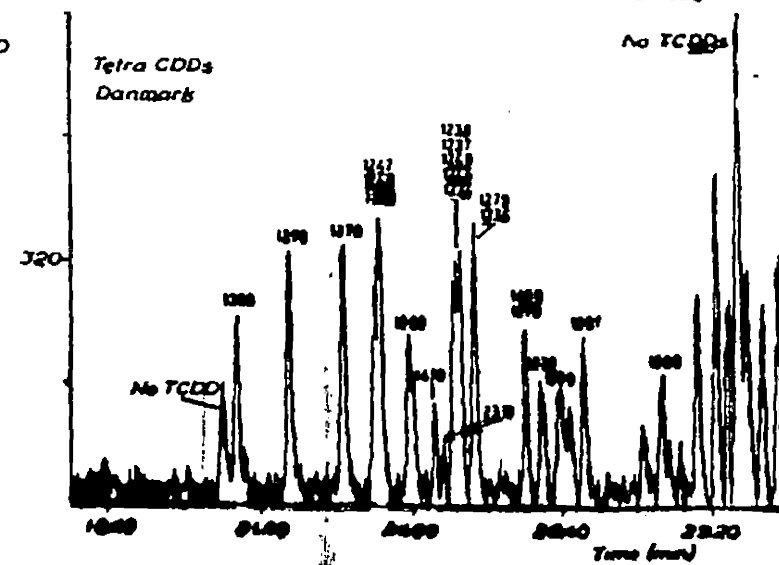
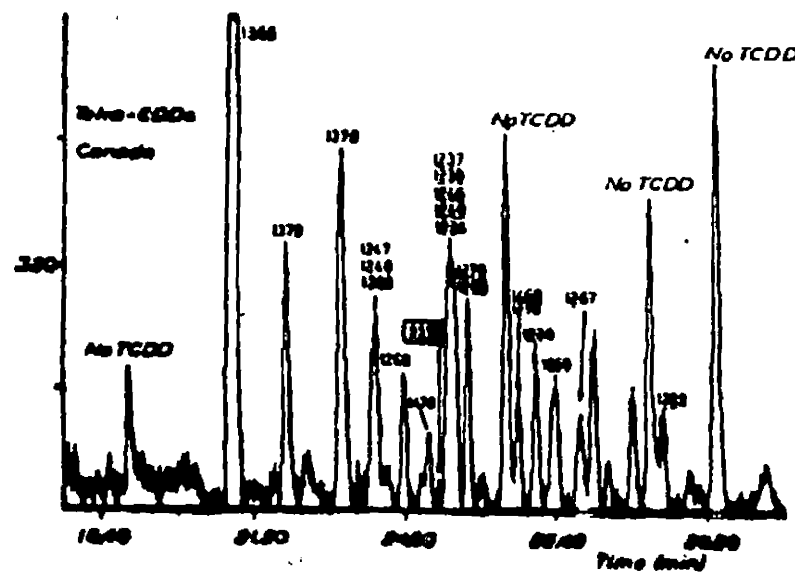
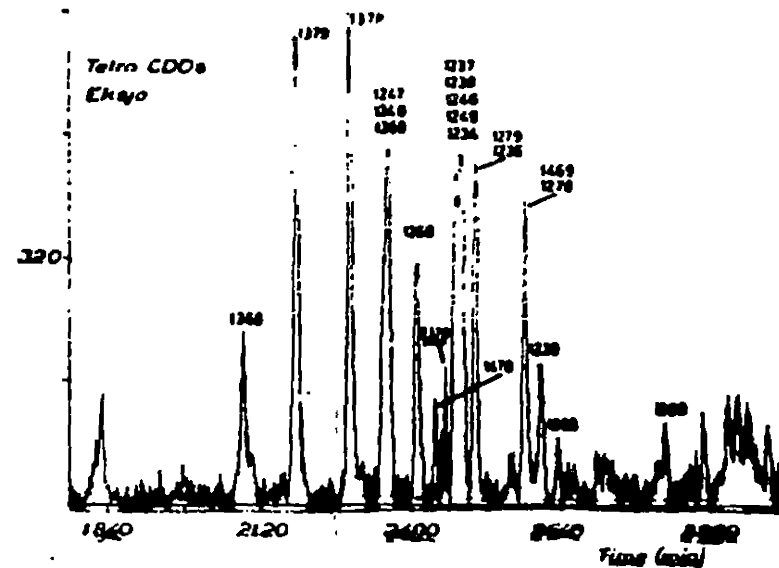
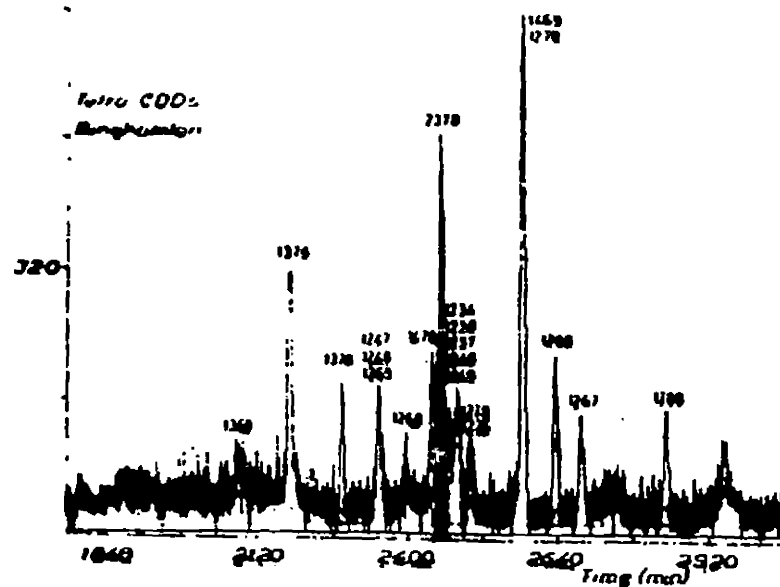
- 1 -

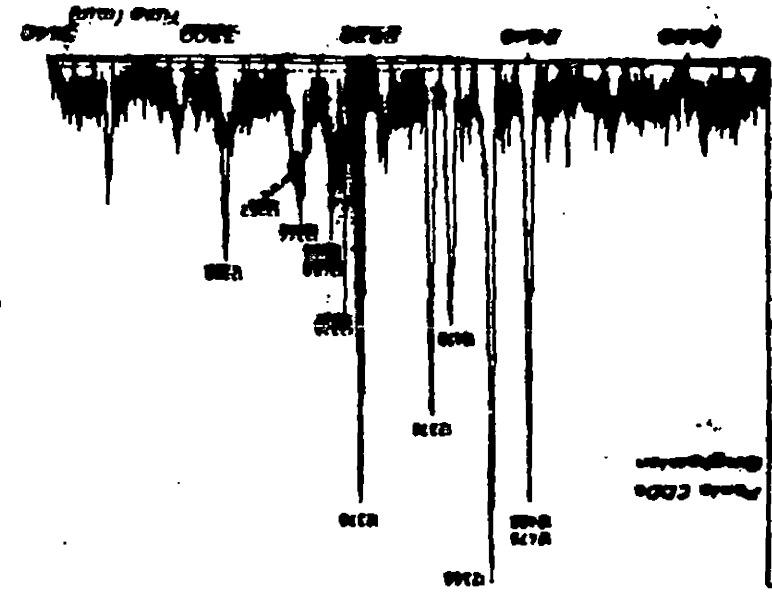
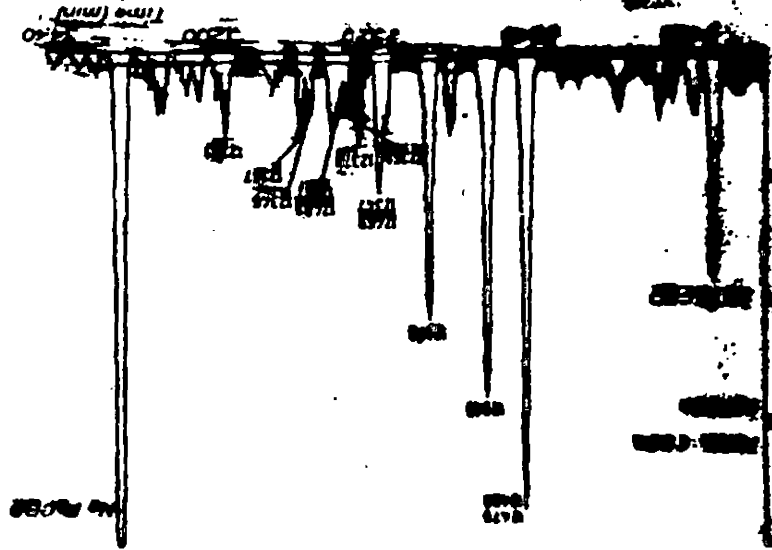
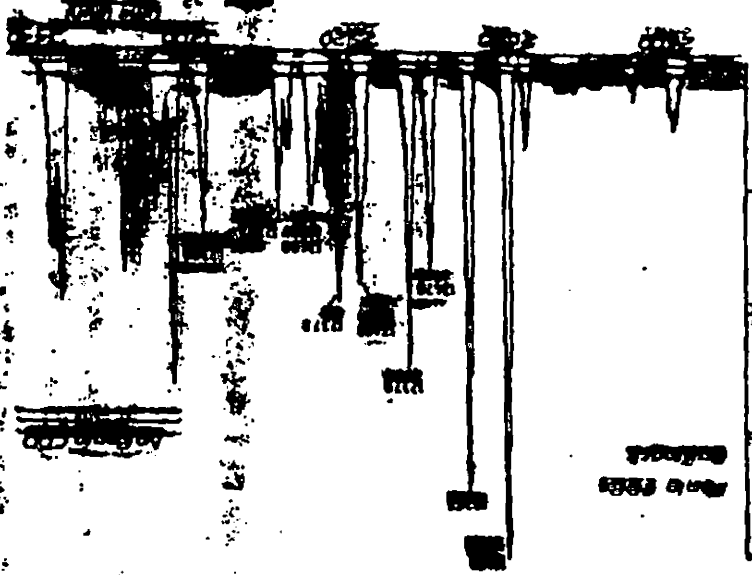
- 1 -

Sources ?

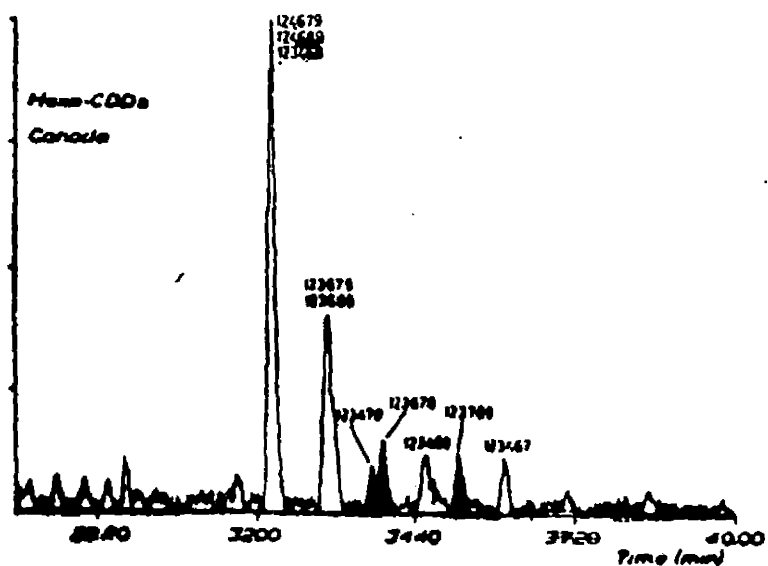
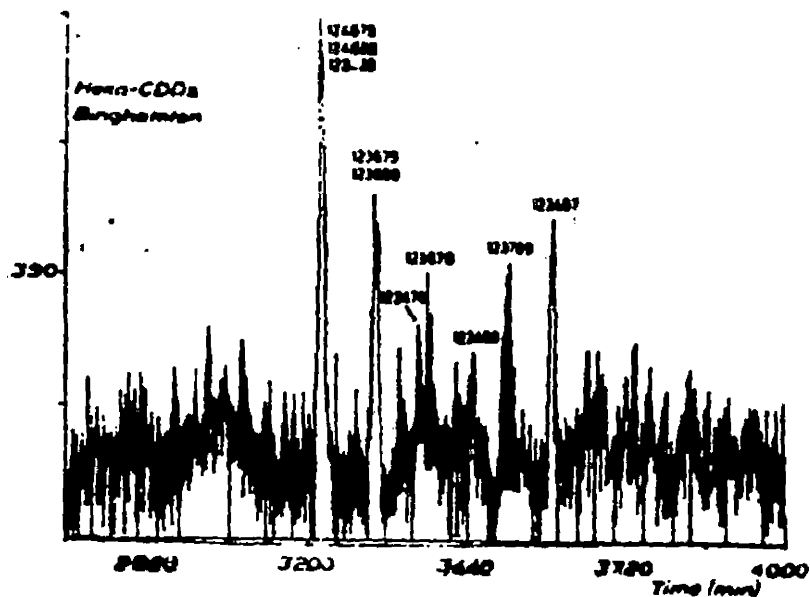
Organic chlorocompounds

Implications ?

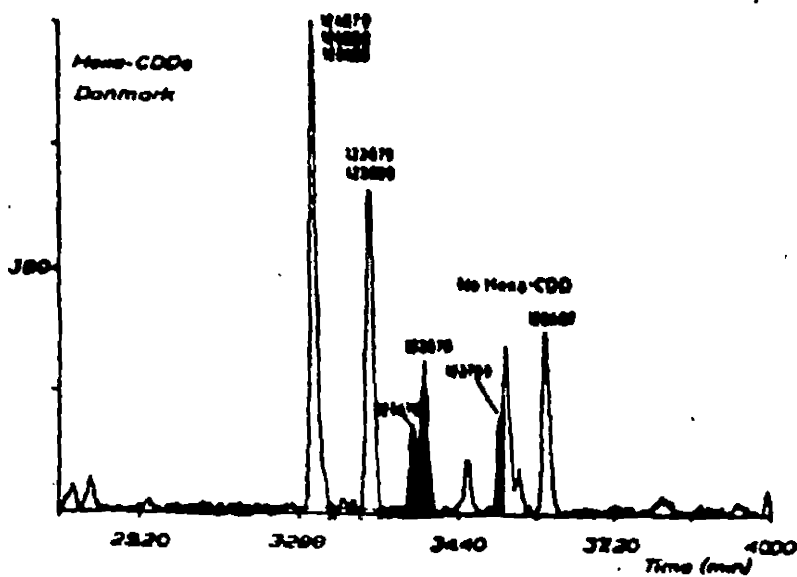
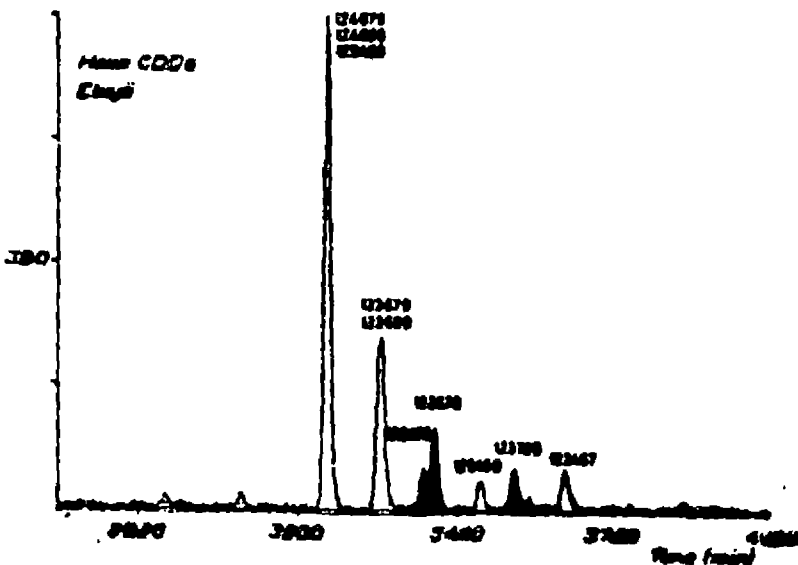




(57)



CSH



NEV 037009

Table CDFs  
Simplicial

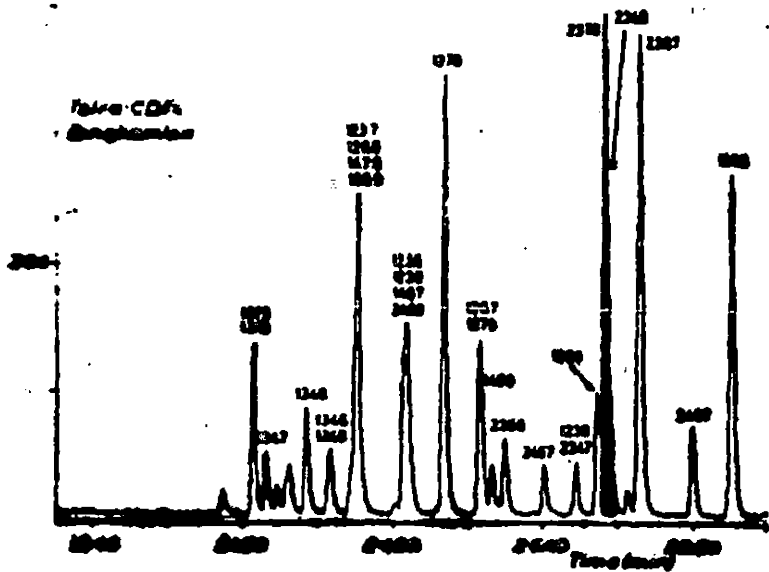
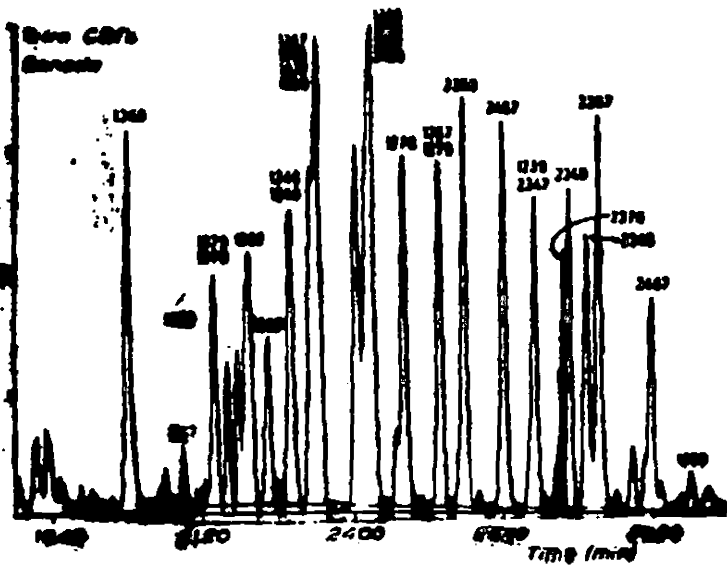
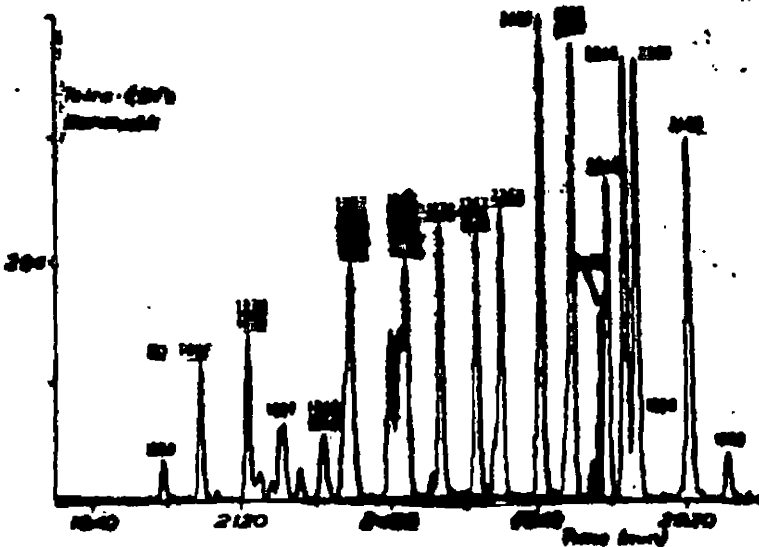
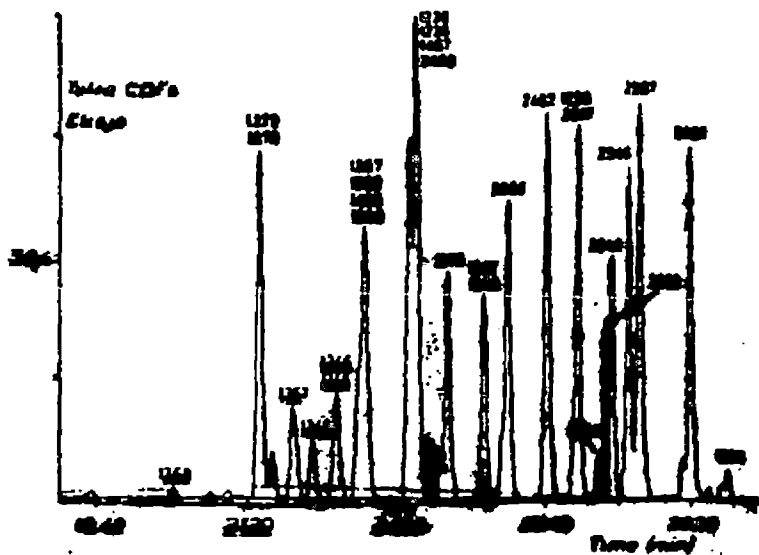


Table CDFs  
Simplicial

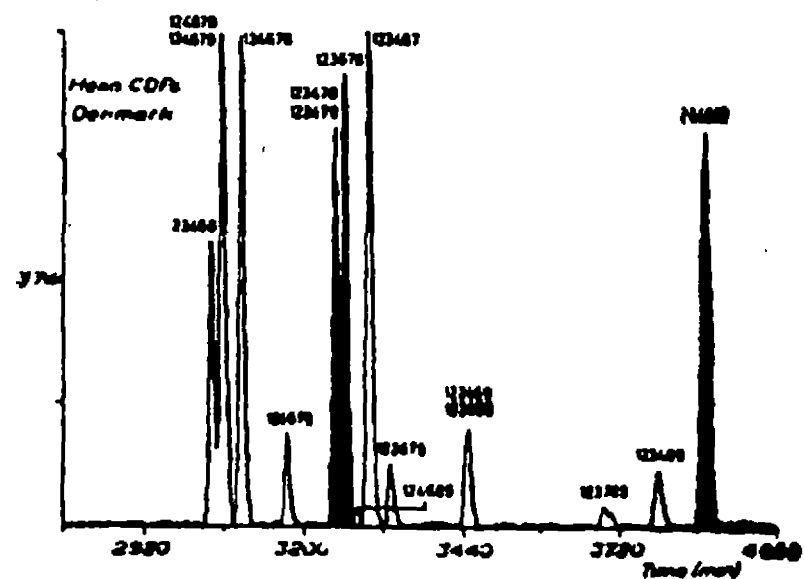
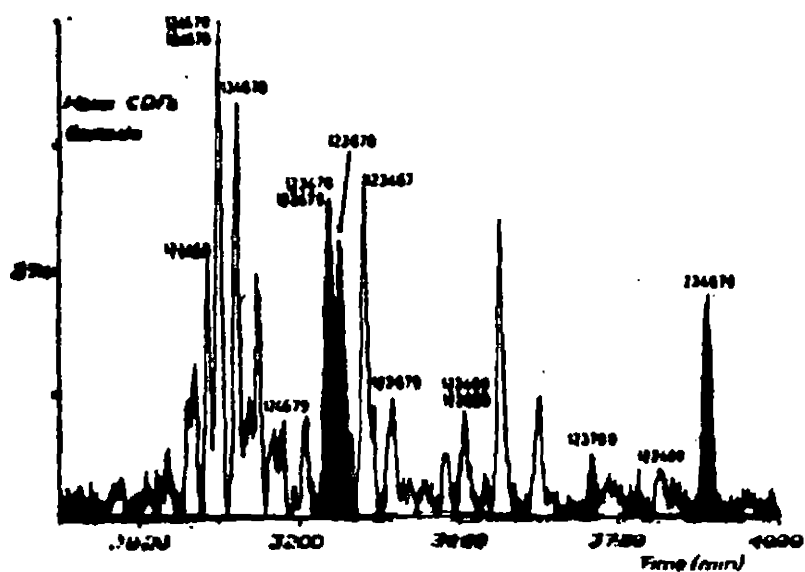
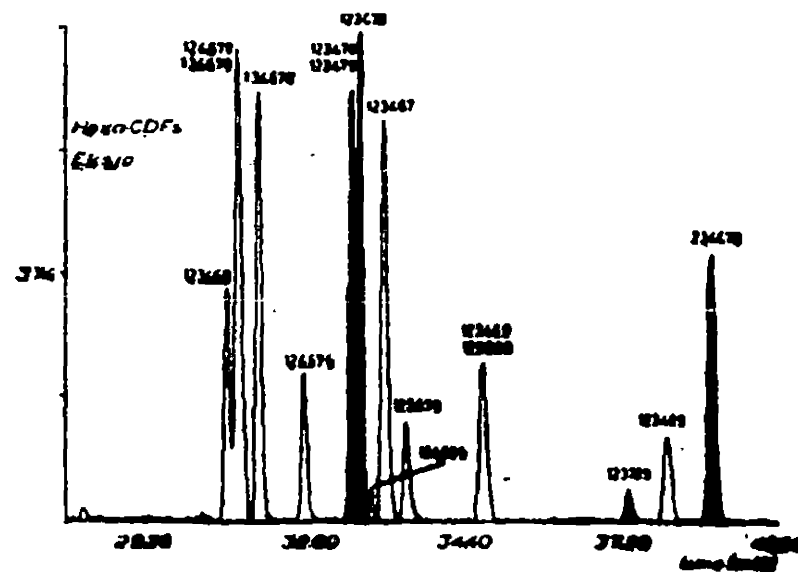
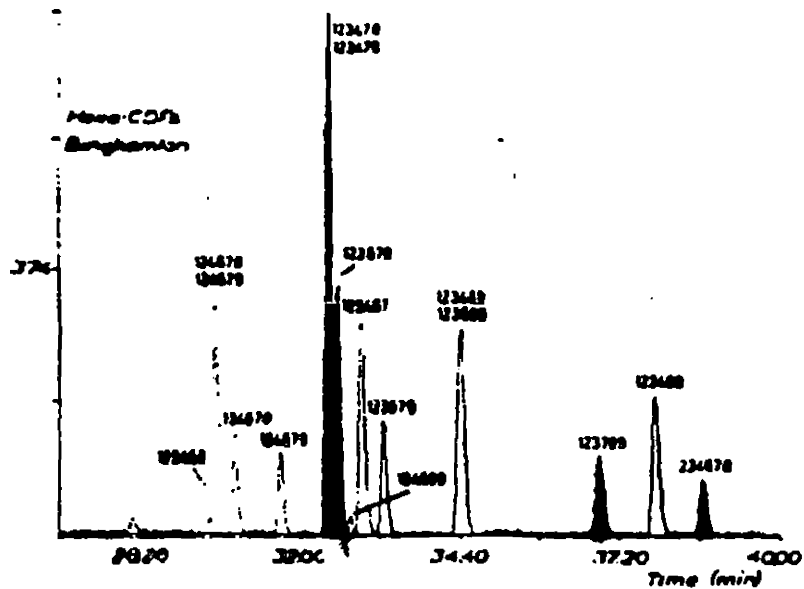






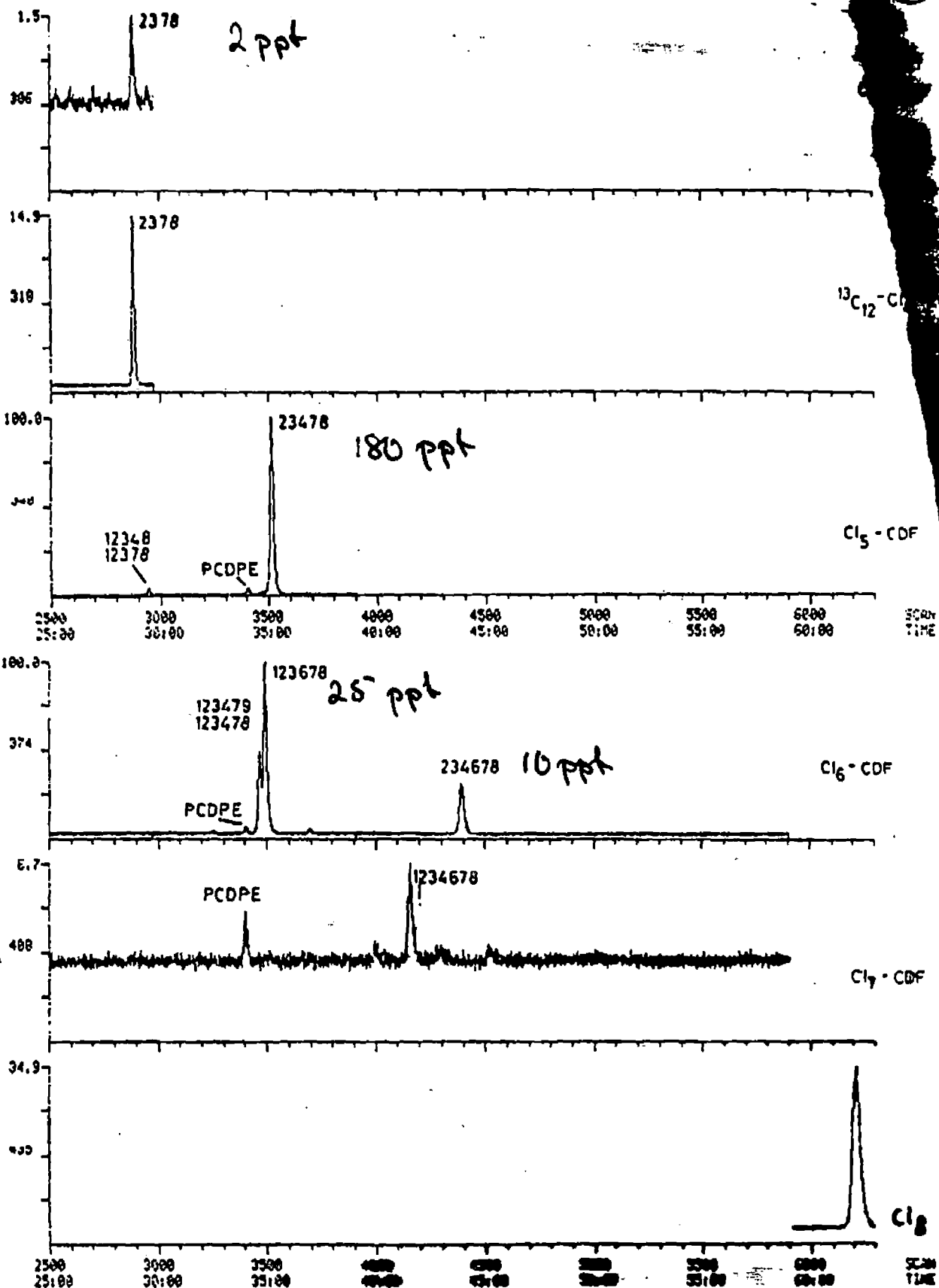
9

CSH 27



②

61



2378 - Tetra-CD 7 ppt  
12378 - Penta-CD 22 ppt

2011

(2)

## Ecological levels

Herring, Guillemot S. Baltic

|               |             |
|---------------|-------------|
| 2378 - TCDD   | ~ 5 ppt     |
| 12378 - PeCDD | ~ 10-20 ppt |
| Hexa - CDDs   | ~ 100 ppt   |
| Hepta - CDDs  | - " -       |
| Octa - CDD    | - " -       |
| 2378 - TCDF   | ~ 5 ppt     |
| 23478 - PeCDF | > 100 ppt   |
| Hexa - CDF    | ~ 100 ppt   |
| Hepta - CDF   | - " -       |
| Octa - CDF    | ~ 5 ppt     |

.....

Human samples

Blood plasma (occupational exp.)

Adipose tissue N. Sweden Umeå Hospital

Cancer patients

soft tissue sarcoma, lymphoma

Controls

bile bladder surgery

Exposed

- Nonexposed

Phenoxy herbicides -  $\alpha$ -Phenols

Mother's milk Germany

**重要事項**

1

NEW 037018

49

69

## Results

All samples : SAME PATTERN

Cancer } SAME LEVELS  
Controls }

LEVELS : EXPOSED > NONEXP

C17 , C8

(P)

CSH

Levels PCDDs / PCDFs Human Adipose Tissue

Umea

|                     |           |
|---------------------|-----------|
| 2378-TCDD           | ~ 5 ppt   |
| 12378-PeCDD         | ~ 10 ppt  |
| 123478- } HxCDD     | ~ 10 ppt  |
| 123678- }           |           |
| HpCDDs (2 isomers)  | ~ 75 ppt  |
| OctaCDD             | ~ 200 ppt |
| 2378-TCDF           | ~ 5 ppt   |
| 12378- } PeCDF      | ~ 40 ppt  |
| 23478- }            |           |
| HxCDFs (77 isomers) | ~ 25 ppt  |
| Hp-CDFs (2 isomers) | ~ 50 ppt  |
| Octa-CDF            | ~ 3 ppt   |

DATA: HP227121 1000

CALL: HPLC

SCANS 3000 TO 4100

MID MASS CHROMATOGRAM

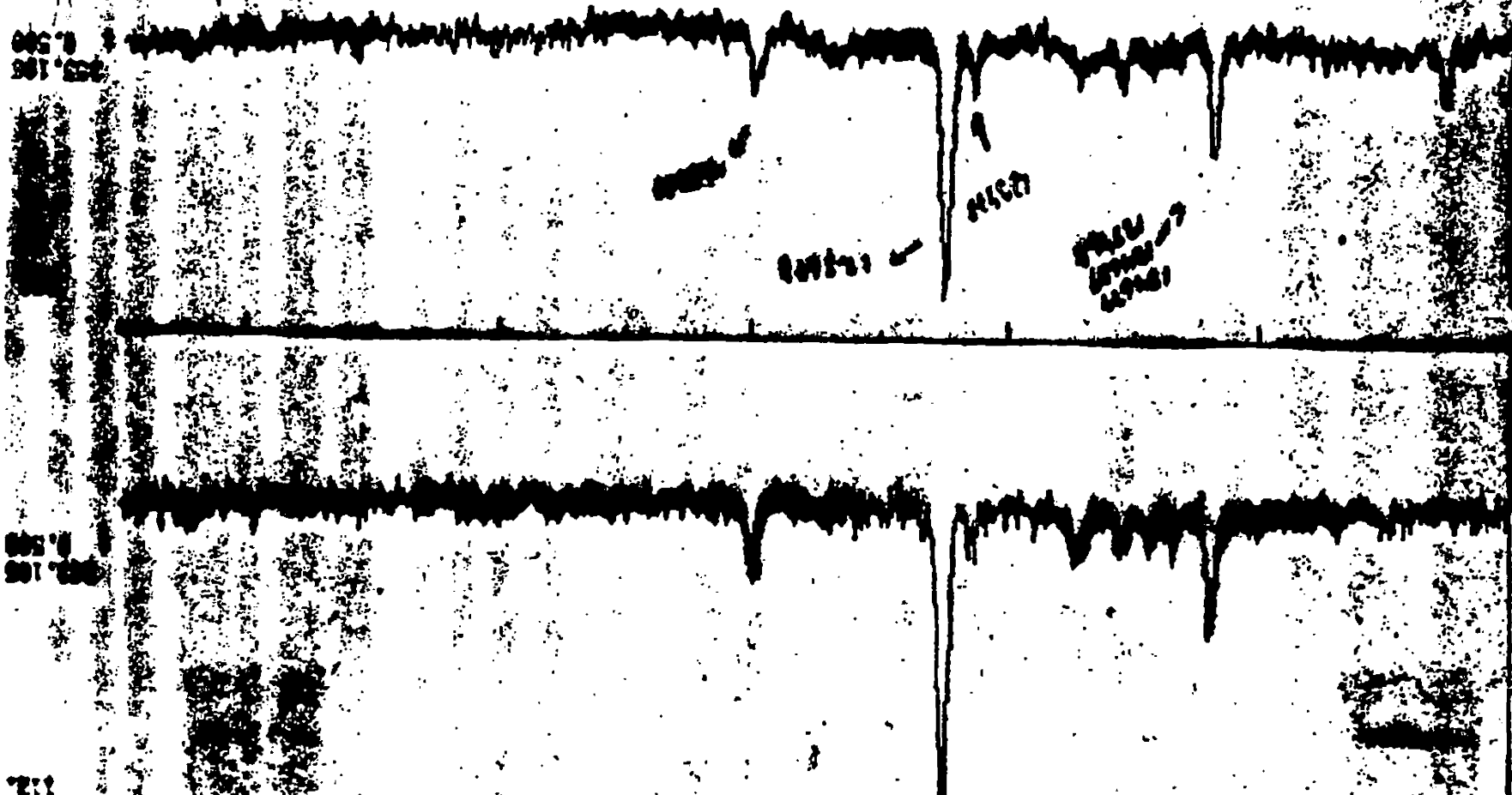
02/05/94 15:27:00

SAMPLE: MPR 257.1 MODER MILK C. LINDSTRON HCL

COND: 1 SUPPLD 572200 PS M02 100-180-20-250-3 0001

RANGE: 0 1.0000 LABEL: H 0. 4.0 QMVA H 0. 1.0 F 0 0000 U 20. 2

Hexa-CDDs



0.500  
0.500  
0.500

0.500  
0.500  
0.500

1.2

NEV 037024

0000

0000

0000

0000

0000

0000

037025

NEW

Y2000 10-5  
CAMPBELL

Christoffer Rappé, professor

The corrections for recovery

The values are calculated on whole life basis.

| DATE | TIME        | LOCATION    | REMARKS     |
|------|-------------|-------------|-------------|
| 1961 | 0.00 - 0.05 | 0.00 - 0.05 | 0.00 - 0.05 |
| 1961 | 0.05 - 0.10 | 0.05 - 0.10 | 0.05 - 0.10 |
| 1961 | 0.10 - 0.15 | 0.10 - 0.15 | 0.10 - 0.15 |
| 1961 | 0.15 - 0.20 | 0.15 - 0.20 | 0.15 - 0.20 |
| 1961 | 0.20 - 0.25 | 0.20 - 0.25 | 0.20 - 0.25 |
| 1961 | 0.25 - 0.30 | 0.25 - 0.30 | 0.25 - 0.30 |
| 1961 | 0.30 - 0.35 | 0.30 - 0.35 | 0.30 - 0.35 |
| 1961 | 0.35 - 0.40 | 0.35 - 0.40 | 0.35 - 0.40 |
| 1961 | 0.40 - 0.45 | 0.40 - 0.45 | 0.40 - 0.45 |
| 1961 | 0.45 - 0.50 | 0.45 - 0.50 | 0.45 - 0.50 |
| 1961 | 0.50 - 0.55 | 0.50 - 0.55 | 0.50 - 0.55 |
| 1961 | 0.55 - 0.60 | 0.55 - 0.60 | 0.55 - 0.60 |
| 1961 | 0.60 - 0.65 | 0.60 - 0.65 | 0.60 - 0.65 |
| 1961 | 0.65 - 0.70 | 0.65 - 0.70 | 0.65 - 0.70 |
| 1961 | 0.70 - 0.75 | 0.70 - 0.75 | 0.70 - 0.75 |
| 1961 | 0.75 - 0.80 | 0.75 - 0.80 | 0.75 - 0.80 |
| 1961 | 0.80 - 0.85 | 0.80 - 0.85 | 0.80 - 0.85 |
| 1961 | 0.85 - 0.90 | 0.85 - 0.90 | 0.85 - 0.90 |
| 1961 | 0.90 - 0.95 | 0.90 - 0.95 | 0.90 - 0.95 |
| 1961 | 0.95 - 1.00 | 0.95 - 1.00 | 0.95 - 1.00 |

THE SAMPLES OF BATTERIES WITH A LOW STATE OF CHARGE  
AND BATTERIES THAT HAVE BEEN OVERCHARGED ARE

(SL)

[illegible]

8 samples

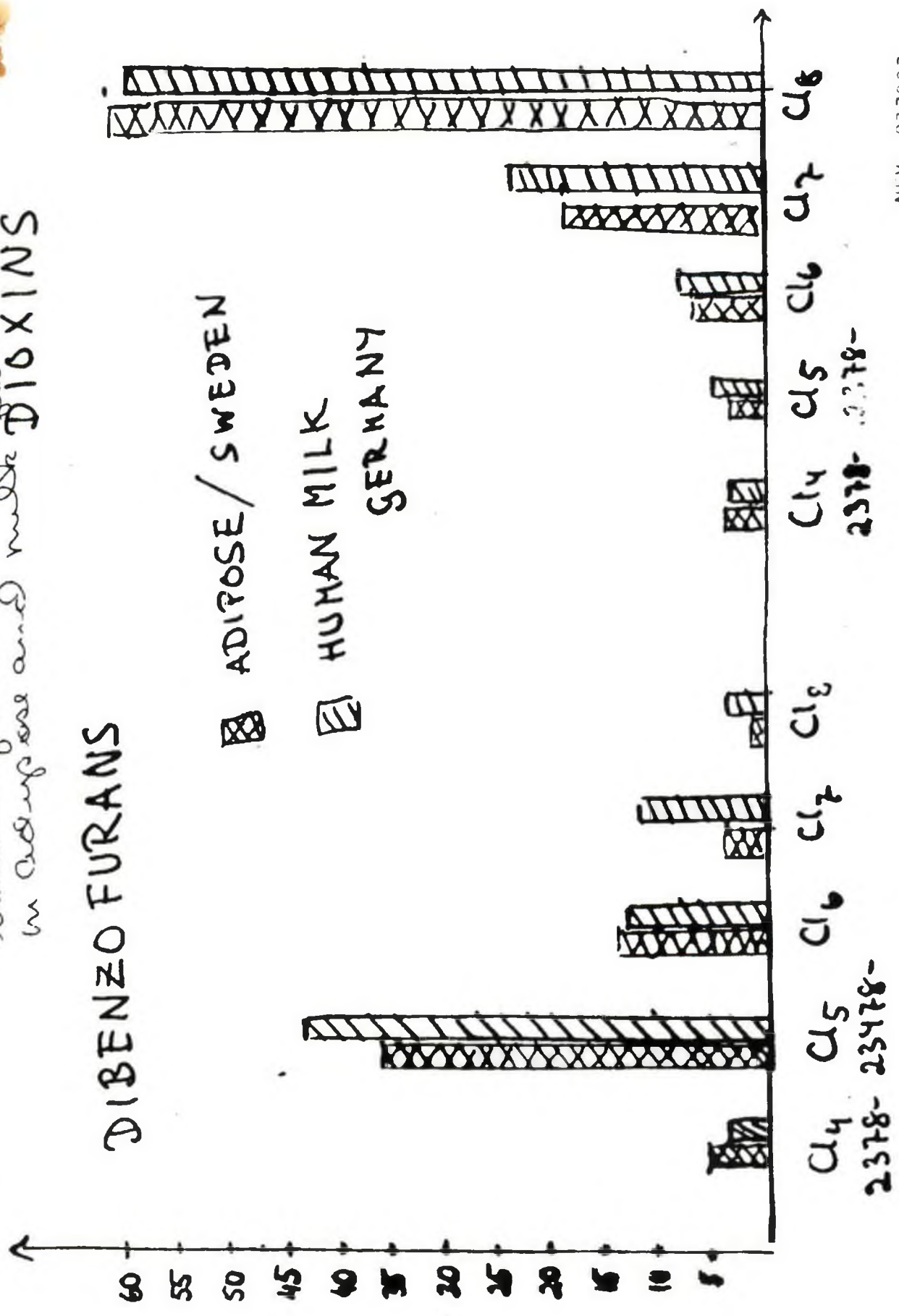
4 Laboratory blanks

## Recovery "spikes"

Shows the relationship of  
 ratios of various congeners (and FOODS) in  
 in adipose and milk fat  
**DIOXINS**

ng/g fat

# DIBENZO FURANS



Conclusions:

The same highly toxic 2,3,7,8-substituted isomers in environmental samples (Baltic, Great Lakes) and in human adipose tissue (Sweden, Canada) and mother's milk

100  
5

C SH 48

### Sources:

Naturally occurring? NO

Impurities commercial products?

Cl-Phenols

Phenoxy herbicides

PCBs

But 2378-TCDD  $\cong$  12378-Penta-CDD



$\therefore$  This is  
used as an  
concentration  
marker

12378-Penta-CDD NEVER found in ANY  
commercial product

ONLY in products from INCINERATORS

OCDD (HpCDD/CDF)

Pentachlorophenol

NEV 037029