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W. A. FINTEL
TEXTILE FIBERS DEPARTMENT
SEAFORD

INDUSTRIAL HYGIENE SURVEY ON [redacted] DURING PRIMARY APPLICATION OF [redacted] IN THE BCF AREA AT SEAFORD, DELAWARE
(Haskell Laboratory Report No. [redacted])

SUMMARY

An industrial hygiene survey was conducted at Seaford on September 20, 1982. Area and personnel samples were collected to determine the exposures of Seaford BCF spinning machine operators and tubers to [redacted] during primary application of [redacted]. Sampling results ranged from 0.4 to 7.3 mg/m^3 of [redacted]. They were evaluated using the computer program LOGAN, recommended in Du Pont Safety Engineering Standard S-12-T. This confirmed that exposures do not exceed the AEL (probability of exceeding the 5 mg/m^3 AEL is less than 5%).

BACKGROUND

[redacted] has an aqueous base containing [redacted] by weight. [redacted] which has a Du Pont AEL of 5.0 mg/m^3 is evolved during application of [redacted] containing [redacted] is present as a contaminant and/or a thermal degradation product.

[redacted] was monitored during a 28-position commercial run while [redacted] was applied as a primary finish to [redacted]. Hot chest temperatures were 180°C and finish roll speeds were 35 rpm.

AIR SAMPLING AND ANALYSIS

[redacted] was collected on Tenax®-GC tubes. Air was drawn through the tubes by Du Pont Model P-200 pumps calibrated at about 60 mL/min. Tenax®-GC tubes were thermally desorbed at 200°C using an Envirochem Unacon Series 810 Thermal Desorber at Seaford. The carrier gas was nitrogen. Samples were analyzed on a Hewlett-Packard Series 5840 gas chromatograph equipped with a 3.28' x 1/8" stainless steel column packed with 15% Igepal® C0880 and 5% potassium hydroxide on Chromosorb W. A flame ionization detector was used. Calibration data are recorded in [redacted] Analytical data are recorded in [redacted]

RESULTS

The eight personnel samples indicated that [redacted] concentrations ranged from 0.7-1.6 mg/m^3, and area samples ranged from 0.4-1.6 mg/m^3. The three blanks blindly submitted as samples had low background levels of [redacted] (Table I). Calculated eight-hour Time Weighted Average (TWA) exposures for the spinning machine operators and tubers are presented in Table II; they ranged from 0.9-1.2 mg/m^3 of [redacted] An explanation of TWA calculations is in Appendix II.

DISCUSSION AND CONCLUSIONS

Du Pont Safety Engineering Standard S-12-T "Strategy for Workplace Sampling for Exposure to Chemicals;" presents a strategy for air sampling and analysis. This analysis was done using the computer program LOGAN and is attached as Appendix I. The five eight-hour TWA and four area samples collected around Spinning Machine 35 were combined because the omega statistic indicated that they were from a single distribution (see S-12-T). Results indicate that there is less than a 5% probability of exposure exceeding the 5 mg/m^3 AEL. These jobs should be resampled at least once per quarter for a year, to provide a good history on which to base needed routine sampling frequency.

The highest [redacted] values obtained for personnel samples (7.3 and 2.8 mg/m^3) were from Tenax®-GC tubes analyzed at Jackson Laboratory. Jackson Laboratory uses ion selective chromatography to determine total fluoride; it is assumed that all fluoride is from [redacted] This assumption may lead to an overestimation of [redacted] because [redacted] and/or [redacted] can be collected on the Tenax®-GC tubes and contribute to the total amount of fluoride reported.

Seaford's analytical method may also overestimate [redacted] collected because the flame ionization detector can measure other finish components that come off the gas chromatograph column in the same detection window as one of the [redacted]. This problem is being resolved by Seaford Research and Development and the Haskell Laboratory Analytical Section.

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[redacted]

Attachments Tables I and II; Appendices I and II
Haskell Lab. Report No. 704-82

TABLE I

RESULTS OF AIR SAMPLING FOR [redacted]
AROUND BCF SPINNING MACHINE 35 ON SEPTEMBER 20, 1982

Sample #	Location	Air Vol (L)	Time (Min)	TBA (mg/m^3)	Comments
H-82-52-1	[redacted]	8.0	128	1.2	Personnel sample on tuber.
H-82-52-2	[redacted]	9.6	158	1.0	Personnel sample on SMO[a].
H-82-52-3	[redacted]	5.3	86	0.7	Personnel sample on SMO.
H-82-52-4	[redacted]	9.6	161	7.3[b]	Personnel sample on SMO.
H-82-52-5	[redacted]	11.5	182	2.8[b]	Personnel sample on tube
H-82-52-6	Above "sucker gun" Position 220.	18.5	300	0.7	Area sample.
H-82-52-7	I-Beam work station, N.E. side, in the BZ[c].	18.5	302	0.9[b]	Area sample.
H-82-52-8	Beam work station, west side, in the BZ.	17.9	295	1.4	Area sample.
H-82-52-9	Above "sucker gun" Position 211.	17.5	290	1.6	Area sample.
H-82-52-10	I-Beam work station, N.E. side of machine #34, in the BZ.	18.6	300	0.4	Area sample.
H-82-52-11	Blank	-	-	0.0 (µg)	Blank samples were submitted blindly as samples.
H-82-52-12	[redacted]	11.5	185	1.4	Personnel sample on SMO.

TABLE I (CONT.)

RESULTS OF AIR SAMPLING FOR [redacted]
AROUND BCF SPINNING MACHINE 35 ON SEPTEMBER 20, 1982

Sample #	Location	Air Vol (L)	Time (Min)	TBA (mg/m^3)	Comments
H-82-52-13	[redacted]	6.0	101	1.0	Personnel sample on SMO.
H-82-52-14	Blank	-	-	0.0 (µg)	
H-82-52-15	[redacted]	10.5	167	1.6	Personnel sample on tuber.
H-82-52-16	Blank	-	-	0.8 (µg)	
H-82-52-17	[redacted]	5.4	85	1.1	Personnel sample on tuber.
H-82-52-18	[redacted]	5.9	96	1.1	Personnel sample on SMO.

a
b SMO = spinning machine operator.
c These samples were analyzed at Jackson Lab., see text of report for details.
BZ = breathing zone.

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TABLE II

EIGHT-HOUR TIME WEIGHTED AVERAGE (TWA) EXPOSURES OF SPINNING MACHINE OPERATORS AND TUBERS TO [redacted]

Subject	Social Security #	8-Hour TWA Exposure to TBA (mg/m^3)
[redacted]	[redacted]	1.2
[redacted]	[redacted]	0.9
[redacted]	[redacted]	0.9
[redacted]	[redacted]	4.5
[redacted]	[redacted]	2.1

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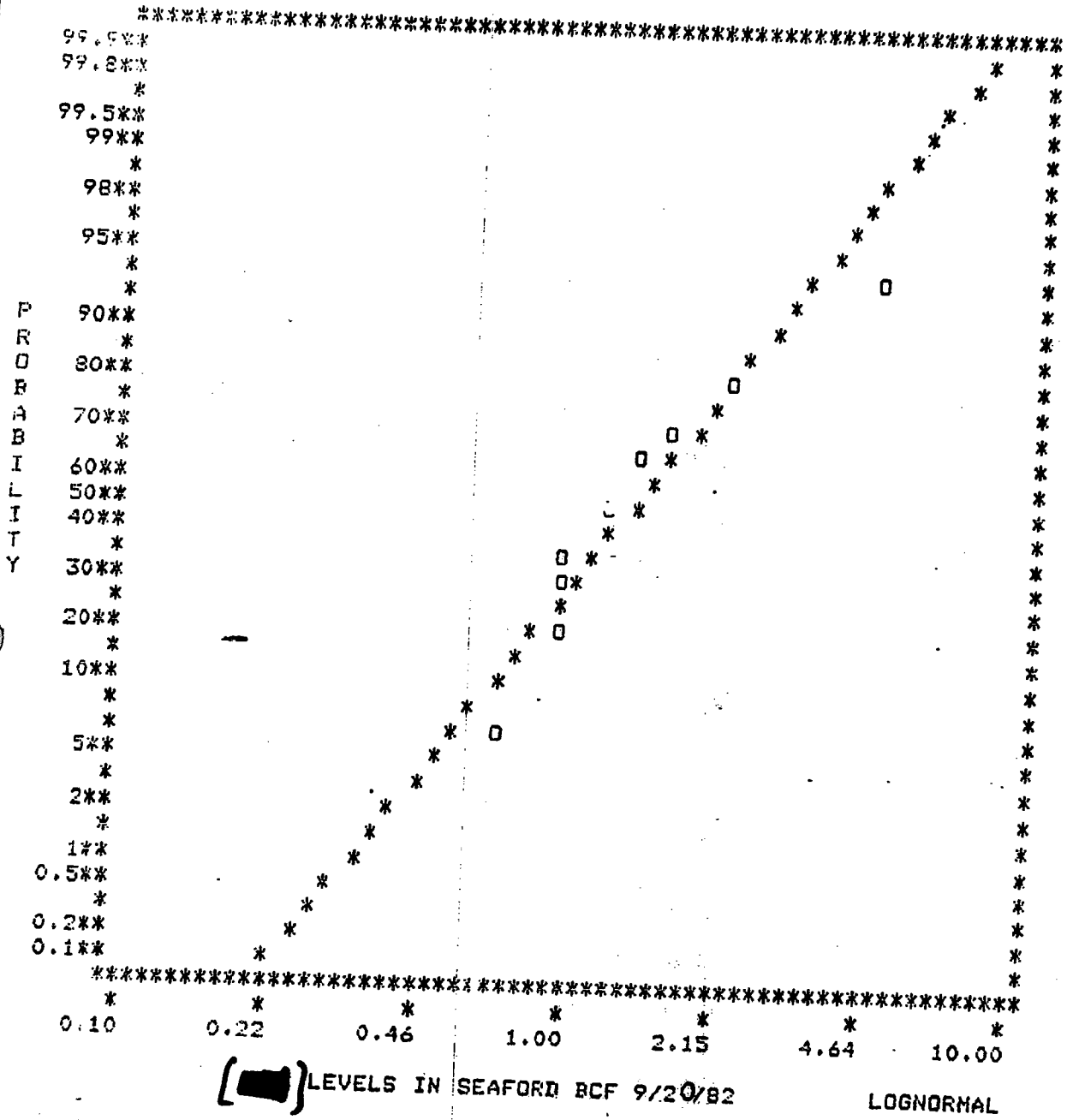
APPENDIX I

Lognormal Probability Plot of the Personnel Eight-Hour TWA Exposures and the Area Samples Collected Around Spinning Machine 35



- Data is log normal.
- Probability of exceeding 5 mg/m^3 is less than 5%.

APPENDIX II

24) **Time-weighted average exposure (TWA)**

To determine the time-weighted average exposure of an individual to airborne contaminants, a detailed description of "Where he is when" must be obtained, as described earlier. In addition a sufficient number of air sampling measurements at the breathing zone-level at positions occupied by employees, under various plant operating conditions are necessary.

In a typical work environment, the employee may be exposed to several different short-term average concentrations during the workshift due to changes in job assignment, workload, ventilation conditions, processes, and the like). The time-weighted average (TWA) exposure evolved as a method of calculating daily or full-shift average exposure by weighting the different short-term average concentrations by exposure time. It is the equivalent of integrating the concentration values over the total time base of the TWA. It may be determined by the following formula:

25)

26)

$$TWA = \frac{C_1 T_1 + C_2 T_2 + C_n T_n}{8 \text{ hr}}$$

Where TWA = time weighted average concentration, usually ppm or mg/m^3.

C = concentration of contaminant during the incremental exposure time.

T = Time, T_1, T_2, T_3 . . . T_n are the incremental exposure times at average concentrations C_1, C_2, + C_n

Eight hours is used as the denominator since OSHA standards and TLVs are based on an eight-hour work day.

Or:

$$\frac{\sum_{i=1}^{i=n} (T_i) \cdot (C_i)}{T_{total} \text{ work time}} = TWA$$

Time-weighted average concentration (TWA) for this particular material.

Where:

T_i = Duration of incremental exposure.

C_i = Concentration of a specific air contaminant during the incremental time period T_i

T_{total} = Total work time per shift eight-hour workday

Several samples (equal or unequal time duration) are obtained during the entire period appropriate to the standard. The total time covered by the samples must be a minimum of seven hours for the needed eight-hour TWA.

EXAMPLE: Personal samples for particulates are collected on a foundry worker as follows:

Sample No.	Time
1	7:00 a.m. (start of shift) to 8:00 p.m.
2	8:00 a.m. to 9:30 a.m.
3	9:30 a.m. to 11:00 a.m.
4	11:00 a.m. to 1:00 p.m. (turned off and covered for 30 minutes during lunch
5	1:00 p.m. to 3:30 p.m.

The measurement obtained is a full period consecutive sample measurement because it covers the entire time period appropriate to the TLV and the OSHA standard (eight hours) and the samples are taken consecutively (or serially).

17—Methods of Evaluation

EXAMPLE: A personal sampling pump with a respirable dust sampling head is attached to an employee at the start of his shift at 8:00 a.m., turned off from 11:30 a.m. to 12:00 noon (lunch) and turned on again from 12:00 noon to 4:30 p.m. The sample collected constitutes a full period sample for the determination of respirable dust exposure because it covers the entire time period appropriate to the TLV or OSHA standard (eight hours).

In some cases it is impossible, because of limitations in measurement methods as with direct-reading meters or charcoal tubes, to collect a series of consecutive samples whose total duration approximates the period for which the standard is defined. In this case, grab samples are taken over some number of short periods of time arranged to be representative of the entire work shift.

EXAMPLE: It is necessary to obtain an exposure measurement for benzene using charcoal tubes. Each charcoal tube sample takes 30 minutes to collect. It is intended to collect 10 samples out of the possible sixteen 30-minute periods in the eight-hour period. These ten 30-minute duration samples constitute 10 grab samples of the worker's exposure on the given day. The estimate of the eight-hour TWA exposure obtained from analyzing the readings of the 10 tubes would be a grab sample measurement.

For example, suppose a worker is exposed as follows:

Time of exposure (T_i)	Average exposure concentration (ppm) (C_i)
1 hour	350
3 hours	200
4 hours	150
Total T = 8 hours	

Then the TWA for the eight-hour workday will be

$$TWA = \frac{(1\ hr)(350\ ppm) + (3\ hr)(200\ ppm) + (4\ hr)(150\ ppm)}{8\ hr}$$

$$= \frac{1550\ ppm}{8\ hr} = 194\ ppm$$

In general, in using this formula, the time spent by a worker at various jobs should be determined to the nearest thirty-minute interval. If there is considerable variation in the level of air contamination, shorter time intervals will have to be used.

EXAMPLE: For example, assume that an employee spends the first four hours of an eight-hour shift in the vicinity of a heat-treating operation where the measured carbon monoxide concentration in air at his breathing zone level is fairly constant at 50 parts per million.

For the remainder of the shift (four hours), assume that the operator worked in a different part of the plant where his exposure to carbon monoxide was essentially zero.

What is his time-weighted average exposure to carbon monoxide?

Solution:

$$\frac{(4\ hr)(50\ ppm) + (4\ hr)(0\ ppm)}{8\ hr} =$$

$$\frac{200}{8} = 25\ ppm\ (TWA)$$ for carbon monoxide.

EXAMPLE: In another case assume that a machine operator (working the 7:00 a.m. to 4:00 p.m. shift) tending an automatic screw machine was exposed to average levels of oil mists as indicated below:

Time	*Average Level of Oil Mists (mg/m³)*
7:00- 8:00	0
8:00- 9:00	1.0
9:00- 10:00	1.5
10:00- 11:00	1.5
11:00- 12:00	2.0
12:00- 1:00	0.0*
1:00- 3:00	4.0
3:00- 4:00	5.0

*lunch period, no exposure