PLAINTIFF'S EXHIBIT

DOW-703

ST0282363

ROBERT N. SAWYER, M.D.

OUTLINE: HEALTH EFFECTS

1. ASBESTOS CHARACTERISTICS - fiber, long/st.
2. ASBESTOS TYPES: (A) SERPENTINE (B) AMPHIBOLES
   - (1) ✕ CHRYSOTILE (80-90% - common)
   - (1) AMOSITE (brown - mines S. Afr.) ANTHOPHYLLITE
   - (2) CROCIDOLITE (blue) ACTINOLITE
   - (3) TREMOLITE - found in crys + talcs
3. INTERDEPENDENT PHYSICAL FACTORS - durable, strong, sm diam.
4. THE ASBESTOS FIBER BUNDLE AND FIBER AERODYNAMIC BEHAVIOR → breaks transv. → fibrils
   - crystal ↓ diameter → aerod. ↑'s - float
5. COMMON ASBESTOS ENCOUNTERS
   - THERMAL SYSTEM INSULATION (HISTORICAL)
   - FIREPROOFING
   - ACOUSTICAL TREATMENT
   - DEBRIS ON BOOKS (A/A BUILDING)
   - DISPOSAL SITE

   friable - mat contain asbestos NOT asb. itself.

   (imprecise) Friable - break by hand when dry. ↳ EPA charac. based on.
6. CHARACTERISTICS AND INTERRELATIONSHIPS
   - (1) DURABLE MINERAL
   - (2) AERODYNAMIC CHARACTERISTICS
   - (3) POTENTIAL HEALTH EFFECTS

   Classif
   (1) friable
   * (2) applic - classif
   - (a) surf trt
   - (b) thermal insul
   - (c) waste
   - (d) replacement

   (3) Quant
   ft² m
   lineal ft
7. BIOLOGIC EFFECTS AND SCOPE OF EFFECTS

   non-malig { EFFUSIONS - lung fluid on
   PLAQUES - X-ray - thickenings of lung linings
   ASBESTOSIS

   malig { LUNG CANCER - asbestos - ↑ incidence w/ CA
   MESOTHELIOMA - chest, abdomen

COOKE - named asbestosis
- linked lung disease + asbestos to occupation

1933 - Eng. Germ - Fed laws to control ast ie - carder

Here not till 1973 Asbestosis - Known from 30's

CO CARCINOGEN w/ smoke - multiplicative 2-4

friable mat use

① Surf trt - * fireproof acoustical - ↓ sound irreg surf
insulat, decoration

② thermal insulation - pipes but metal wears - ↑ temp + disturb insul
before 78
* orig use for asbest lagging (boiler)
asbestos - econ 2° to thermal generation
steam - asbestos insul

③ Prohib 1972 NY - applic - spray prohib
73 EPA insul - Nattional - spray mat covered
78 EPA Comprih. - prohib use asb. mat. in install asbestos
- no had anyth to do w̄ risk
- only handling

1983 - NEHAPS

Surf trt - plenum
- in pipes

thermal insul - ? to call
- inside partially friable
- EPA - interp prob
then say therm insul friable
fibrous glass in traverses
elbows - other mat - asbestos

Duct insulation - air cell - ie Calif - friable inside duct

Debris

* Disposal sites - 99% airborne fiber release from disposal cycle of asb. material

Aerodynamics - fiber P
sm, short leng, narrow float long

ST0282364

8. PHYSICAL FACTORS AND BIOLOGIC EFFECTS

9. LUNG DEPOSITION: ASBESTOS BODIES

FIBER TYPES	lots present AMPHIBOLE v. CHRYSOTILE in body
GENERAL POPULATION	PRESENT IN ALL RANGE TO 20 AB/g
ASBESTOS RELATED DISEASES	
ASBESTOSIS	OVER 2,000 AB/g - N1 up to 20
MESOTHELIOMA	INTERMEDIATE
PLEURAL PLAQUES	LOWEST
LUNG CANCER	VARIABLE
IDIOPATHIC FIBROSIS	NO ASBESTOSIS OVERLAP

ST0282365

1. Roggli, Pratt, Brody. Asbestos content of lung tissue in asbestos associated diseases. BJIM. 43:18-28. 1986.
2. Churg and Wiggs. Fiber Size and Number in Workers Exposed to Processed Chrysotile, Chrysotile Miners, and General Population. AJIM. 9-143-512. 1986.

10. Lung PLEURAL EFFECTS - unique with fibrosilicates
EFFUSIONS - benign; diag (20 yrs), heraldic - remove
implicate asb exp in work pop PLAQUES radiolog* acellular
MALIGNANCIES mesothelioma*
EPIDEMIOLOGY * Epid

asb. body - body rxn to fiber - index of lung loading of asbestos

11. HEALTH EFFECTS: DIAGNOSIS

ASBESTOSIS	HISTORY SYMPTOMS/SIGNS X-RAY (ILO/1980) PFT, DIFFUSION (CO)
MALIGNANCIES	HISTORY X-RAY SYMPTOMS/SIGNS CYTOLOGY BIOPSY
MESOTHELIOMA	PAIN

Probable factors - advise health eff
respirab (<3 μm
size, aspect ratio
durab
flex
chem comp
SA
surf chrg

12. DIAGNOSIS: X-RAY AND PFT 100% asb workers have plaques

Asbest - hist., bilat lung sounds, diffuse opacities PFT, diffusion studies - CO progressive symp

PLEURAL PLAQUE - x-ray, calcif, schonheitsfehler, differen dx, x-ray v autops

ASBESTOSIS - no quick dx

plaque - DON'T remove dx w/ x-ray

PFT TRACING

LUNG CA } hx, x-ray, symp, cytology, biopsy

MESOTHELIOMA → effusion, pain, x-ray, biopsy - expire <1 year

13. MESOTHELIOMA SURVIVAL

PFT FVC ? air hold / FEV - ? fast dump air

	Rx	NO Rx	
STUDY 1	9	10	MONTHS
STUDY 2	12	16	MONTHS

14. ASBESTOS DISEASE EPIDEMIOLOGY ODD's making "Jimmy the Greek"

ASBESTOS RELATED DISEASES - ea acts separately

ASBESTIFORM MINERALS

ASBESTOS EXPOSURES

15. MILESTONES OF EPIDEMIOLOGY

ASBESTOSIS (COOKE)	1924, 1927
OCCUPATIONAL ASBESTOSIS	1930 - 1940
LUNG CANCER - rare in 1930's	1935 1955 - Dr. Doll study - ↑ lung CA shipyard worke
CA: ASBESTOS v. SILICA	1940 - 1950
OCCUPATIONAL LEVELS	1940 - 1985
CANCER, OCCUPATIONAL	1955
MESOTHELIOMA	1960 - 1970 mining + crocydolite Selikoff - insulators got also - not just in factory
DISEASE IN TRADES	1964
SMOKING, LATENCY	1968
PARAOCCUPATIONAL	1965 - 1975

16. PROBLEMS OF ASBESTOS EPIDEMIOLOGY - loss of records, memory, people

LATENCY AND FOLLOWING POPULATIONS

METHODS OF MEASUREMENT

MIXED FIBER EXPOSURES

UNDERSTANDING RISK MODELS

ST0282366

Defects in indust studies

1. info bias
2. sm cohort sizes
3. link meas to exp
4. modif in data base
5. Def - cigarette smoking

Air sampling

now - asbestos fiber counting (TEM, direct)
bef. find fiber vol x p
now - * # fibers + size cts in exposure
by direct transfer EM

Longer - looked at crysotile properties
must be considered
- mineral type
admixtures (tremolite Ao reverse when die - lots tremolite
process - heat can change friability
environm effects

SMR - textiles bad
fiber year - pack/da x YR
OSHA - 2 fibers/cc x YR = Fiber Yr.

USA thinks single value for PEL.

ST0282367

2105823 65

17. LATENCY: APPROXIMATIONS ONLY

PLAQUES	10 YEARS
ASBESTOSIS	20
CANCER	30
MESOTHELIOMA	40

18. FIBER DEFINITION: THREE TO ONE RATIO; LONGER THAN 5 MICRONS

19. MINERALOGY OF ASBESTOS: MINERAL TYPE AND PROCESS POSITION

20. EXPOSURE LIMITS BY FIBER TYPE IN VARIOUS NATIONS

CROCIDOLITE	0.1 TO 0.2 f/cc
AMOSITE	0.2 TO 1.0 f/cc
CHRYSOTILE	0.2 TO 2.0 f/cc

21. CHRYSOTILE SWEDISH STUDY – Good tracking system

POPULATION	1,790 CEMENT WORKERS (1% LOSS)
FIBER TYPE	CHRYSOTILE*
FINDINGS	20 FIBER-YEARS NO EXCESS HEALTH EFFECTS

Ref: Ohlson & Hogstedt. Lung cancer among asbestos cement works. BJIM. 42:397-402. 1985.

22. ASBESTOS EXPOSURES

HIGH LEVEL, INDUSTRIAL

LOW LEVEL, INTERMITTENT

BACKGROUND

23. ASBESTOS DISEASES, PUBLISHED STUDIES

HEAVY/OCCUPATIONAL	NUMEROUS
MODERATE/PARAOCCUPATIONAL	FEW
LOW/NONOCCUPATIONAL	ESSENTIALLY NONE
BACKGROUND	FEW

24. RELATIVE RISK (O/E) = $\frac{Ro}{Re}$

SIGNIFICANCE OF VALUES EQUAL TO, GREATER THAN, and LESS THAN 1.0

having an effect (bad) ↓ protects

ST0282368

25. RELATIVE RISK: LUNG CANCER

NORMAL POPULATION	1
ASBESTOS, TRADES	5
SMOKING, 40 PYRS/D	10
ASBESTOS/SMOKING	50

26. OSHA ESTIMATES OF LUNG CANCER INCIDENCE PER 100,000 (RATES EXTRAPOLATED TO LOW LEVEL)

	EXPOSURE ESTIMATES	
	0.001	0.005 fibers/cc
CANCER FROM NONOCCUPATIONAL EXPOSURES: 45 YRS	0.4-15	2-75 deaths

27. RISK AND STRUCTURAL MATERIAL DISTURBANCE
- DIRECT EPIDEMIOLOGIC DATA LACKING
- INFERENCE FROM OTHER SOURCES
  - EXTRAPOLATION FROM OCCUPATIONAL DATA
  - PARAOCCUPATIONAL EPIDEMIOLOGY
  - MATERIAL DISTURBANCE AIR DATA

28. SEMILOG PLOT OF AIR DATA V. OSHA PEL

29. AIR SAMPLING: POTT'S CURVES AND TEM DATA

30. EPIDEMIOLOGY: RISK MODELS
- ASBESTOS IN STRUCTURES
- STEADY STATE STRUCTURAL USE
- DISTURBANCE OF MATERIALS

31. CONDITIONS VS RISK:

STEADY STATE	QUESTIONABLE TO VERY LOW RISK
DISTURBANCE	VARIABLE RISK DOSE RELATED

32. CONTROL: REASONABLE GOALS:
- MINIMIZE CONTAMINATION
- MINIMIZE EXPOSURES

33. PROTECTION OF PERSONNEL
- PROTECTION OF ENVIRONMENT
- RESPIRATORY PROTECTION
- TRAINING
- DECONTAMINATION

ST0282369