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DUST PRODUCING OPERATIONS

IN THE
PRODUCTION OF PETROLEUM PRODUCTS
AND ASSOCIATED ACTIVITIES

A MEDICO-SAFETY SURVEY

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DUST PRODUCING OPERATIONS IN THE PRODUCTION OF PETROLEUM PRODUCTS AND ASSOCIATED ACTIVITIES

CONTENTS

	PAGE
INTRODUCTION	
PART I - DUST AS A HEALTH HAZARD	
I - WHY IS THE DUST PROBLEM SO IMPORTANT?.....	2
II - WHAT IS MEANT BY "DUST"?.....	2
III - WHAT ARE THE PHYSIOLOGICAL EFFECTS PRODUCED BY	
The Inhalation of Dust.....	3
Silicosis in General.....	4
First National Silicosis Conference.....	4
Silicatosis.....	5
Asbestosis.....	7
IV - WHAT IS THE MAXIMUM PERMISSABLE DUST CONCENTRATION?	
Formula For Determining Maximum Permissible Concentration	
of Silica in The Air Breathed.....	7, 8
Safe Dust Concentrations, Impinger Samples.....	9
V - HOW MAY THE CONCENTRATION AND CHARACTER OF INDUSTRIAL	
DUSTS BE DETERMINED?.....	9
The Impinger Apparatus.....	10, 11
The Zeiss Konimeter.....	11
The Bausch & Lomb Dust Counter.....	11
PART II - DUST PRODUCING OPERATIONS STUDIED	
WHAT ARE THE PRINCIPAL DUST PRODUCING OPERATIONS?	
I - <u>SAND-BLASTING</u>	13-15
II - <u>FILTERING OPERATIONS</u>	15-27
A - <u>Filter Clay or Fullers Earth:</u>	
What is Filter Clay or Fullers Earth?.....	15, 16
How is Filter Clay Mined and Prepared?.....	16, 17
How is Filter Clay Used?.....	17, 18
"Burning" Clay.....	18, 19
Charging Filters.....	19, 20
Dumping Filters.....	20, 21
Composition of Filter House Air Borne Dust.....	21
Control of Filter Clay Dust.....	22
B - <u>Contact Clay:</u>	
Main Constituents of Contact Clays.....	22, 23
What is "Filtrol" and How is it Produced?.....	23, 24
What is the Chemical Composition of Filtrol?.....	24, 25
How is Contact Clay Used?...	

C - <u>Bone Black or Charred Bone:</u>	
How is Bone Black Used.....	26

III - INSULATING OPERATIONS:

A - What Physiological Reactions are Provoked by Insulating Materials?.....	27
B - What Are The Principal Insulating Operations and How Much Dust is Produced During Such Operations?.....	27
Insulating 12" Steam Lines.....	27, 28
Insulating a 750-Pound Cracking Coil Accumulator.....	28
Insulating Treating Plant Acid Suction Line.....	28
Insulating Cracking Coil Hot Oil Lines.....	28
Dismantling or Removing Old Insulation.....	28, 29
Crushing Scrap Asbestos.....	29
Crushing Old Cork Insulation.....	29

IV - GUNITING OPERATIONS:

What Is Gunitite and How Is It Applied?.....	29, 30
Removal of Gunitite Lingins.....	30

V - WELDING AND CUTTING OPERATIONS:

A - Welding Operations:

1. Electric Arc Welding.....	30
What are Coated Electrodes?.....	30, 31
What do These Electrodes Contain and What Products Result From Their Use?.....	31, 32
What is The Amount and What Are the Characteristics of Fumes or Dust Produced By The Various Electric Arc Welding Operations.....	32-35
What Physiological Effects on Welders is Produced by The Use of Coated Electrodes.....	35-37
2. Oxy-Acetylene Welding.....	37
Fumes or Dust Produced by Oxy-Acetylene Welding.....	37

B - Burning or Cutting Operations:

1. With Oxy-Acetylene.....	37, 38
Fumes or Dust Produced by Oxy-Acetylene Burning.....	38
2. With Natural Gas.....	38

C - <u>Health Hazards Produced by Welding and Cutting Operations....</u>	38
--	----

VI - GRINDING OPERATIONS:

What is The Composition of Grinding Wheels?.....	39
Is Abrasive Dust Harmful?.....	39, 40

1 - <u>What are the More Frequently Used Types of Grinders, the Quantity and Character of the Dust they Produce?.....</u>	40
---	----

	PAGE
C - <u>Bone Black or Charred Bone:</u>	
How is Bone Black Used.....	26

II - INSULATING OPERATIONS:

A - What Physiological Reactions are Provoked by Insulating Materials?.....	27
B - What Are The Principal Insulating Operations and How Much Dust is Produced During Such Operations?.....	27
Insulating 12" Steam Lines.....	27, 28
Insulating a 750-Pound Cracking Coil Accumulator.....	28
Insulating Treating Plant Acid Suction Line.....	28
Insulating Cracking Coil Hot Oil Lines.....	28
Dismantling or Removing Old Insulation.....	28, 29
Crushing Scrap Asbestos.....	29
Crushing Old Cork Insulation.....	29

- GUNITING OPERATIONS:

What Is Gumite and How Is It Applied?.....	29, 30
Removal of Gumite Lings.....	30

WELDING AND CUTTING OPERATIONS:

A - Welding Operations:

1. Electric Arc Welding.....	30
What are Coated Electrodes?.....	30, 31
What do These Electrodes Contain and What Products Result From Their Use?.....	31, 32
What is The Amount and What Are the Characteristics of Fumes or Dust Produced By The Various Electric Arc Welding Operations.....	32-35
What Physiological Effects on Welders is Produced by The Use of Coated Electrodes.....	35-37
2. Oxy-Acetylene Welding.....	37
Fumes or Dust Produced by Oxy-Acetylene Welding.....	37

B - Burning or Cutting Operations:

1. With Oxy-Acetylene.....	37, 38
Fumes or Dust Produced by Oxy-Acetylene Burning.....	38
2. With Natural Gas.....	38

C - Health Hazards Produced by Welding and Cutting Operations....

38

RINDING OPERATIONS:

What is The Composition of Grinding Wheels?.....	39
Is Abrasive Dust Harmful?.....	39, 40

1 - What are the More Frequently Used Types of Grinders, the Quantity and Character of the Dust they

	PAGE
A - TANDEM FLOOR TOOL GRINDERS.....	40,41
Dust Produced by Tandem Floor Grinders.....	41,42
B - TANDEM BENCH GRINDERS.....	41
Dust Produced by Tandem Bench Grinders.....	41
Characteristics of Dust Produced by Tandem Bench Grinders.....	42
C - SINGLE FLOOR TOOL GRINDERS.....	43
Dust Produced by Single Floor Grinders.....	43
Characteristics of Dust Produced.....	43
D - UNIVERSAL GRINDERS.....	44,45
Dust Produced By Universal Grinders.....	44
Characteristics of Dust Produced.....	45
E - SURFACE GRINDERS.....	45
Dust Produced by Surface Grinders.....	45
F - LANDIS TOOL GRINDERS.....	45,46
Dust Produced by Landis Tool Grinders.....	45
G - YANKEE DRILL GRINDER.....	46
Dust Produced by Yankee Drill Grinder.....	46
H - AUTOMATIC CIRCULAR SAW SHARPENING MACHINE.....	46
Dust Produced by Yankee Drill Grinder.....	46
I - AUTOMATIC BAND SAW GRINDER.....	46,47
Dust Produced by Automatic Band Saw Grinder.....	47
J - AUTOMATIC BAND SAW LAP GRINDER.....	47
Dust Produced by Lap Grinder.....	47
K - PLANING KNIFE BLADE GRINDER.....	47
Dust Produced by Blade Grinder.....	47
L - LINDERMAN CUTTER GRINDER.....	47
Dust Produced by Cutter Grinder.....	47
M - GANG SAW BLADE GRINDER.....	47
Dust Produced by Gang Saw Blade Grinder.....	47
N - EDGER SAW GRINDER.....	47
Dust Produced by Edger Saw Grinder.....	47
O - CIRCULAR SLAB CUT-OFF SAW GRINDER.....	47,48
Dust Produced by Cut-Off Saw Grinder.....	48
P - "HOG KNIFE" GRINDER.....	48
Dust Produced by "Hog Knife" Grinder.....	48
Q - CUTTER GRINDER.....	48
Dust Produced by Cutter Grinder.....	48

	PAGE
Control of Dust from Grinding Wheels.....	48
VII - <u>HANDLING POWDERED OR PULVERIZED MATERIALS:</u>	
A - LIME:	
(1) Hydrated Lime.....	49,50
(2) Lump Quick Lime.....	50,51
What Physiological Effect is Produced by Lime Dust.....	51
B - METALLIC ZINC DUST:	
Typical Screen Analysis.....	51
Dust Produced.....	51
What Physiological Effect is Produced by Zinc Dust:.....	51
C - ASBESTOS "FLOAT":	
Dust Produced.....	51,52
Physiological Effect of Asbestos Particles.....	52
D - GROUND MICA:	
Dust Produced.....	52
Physiological Effect of Mica Dust.....	52
E - SULPHUR:	
(1) Sulphur Flour.....	52
(2) Crude Sulphur.....	52,53
Physiological Effect of Sulphur.....	53
F - LITHARGE:	
Dust Produced.....	53
Necessary Precautionary Measures When Handling Litharge.....	53,54
G - SODA ASH:	
Dust Produced.....	54,55
H - TALC or "SOAPSTONE":	
Dust Produced.....	55
Physiological Effects Produced by Talc Dust.....	55
I - GRAPHITE:	
Dust Produced.....	55,56
J - SLATE FLOUR:	
Dust Produced.....	56
Effect of Slate Flour on the Lungs.....	57
K - GRINDING DERRIS ROOT:	
Dust Produced.....	57
To What Extent is Derris Toxic?.....	57
L - GRINDING PYRETHRUM FLOWERS:	
Dust Produced.....	57,58
M - MIXING AND PACKING "FLIT" POWDER:	
Dust Produced.....	58

CLEANING TUBES AND DRUMS:

I - CRACKING COIL SOAKING DRUMS:	
Dust Produced.....	58, 59
II - CRACKING COIL TUBES:	
Dust Produced.....	59
III - WATER HEADERS AND BOILER TUBES:	
Dust Produced.....	59
Composition of Dust from Front Water Wall Header.....	60

FOUNDRY OPERATIONS:

A - POURING MOLTEN METAL INTO SAND MOULDS.....	60, 61
B - "SHAKING OUT" CASTINGS.....	61
C - CLEANING CASTINGS:	
(a) Preliminary Cleaning.....	61
(b) Tumbblast.....	61, 62
(c) Sly Tumbling Mill.....	62
(d) Tumbling Barrels.....	62
(e) Air-Blasting.....	62, 63
(f) Rough Snagging Wheels.....	63
(g) Fine Snagging and Polishing Wheels.....	63, 64
(h) Cone Grinding Wheels.....	64
Average Dustiness of Cleaning Room Air.....	64
D - CORE MAKING.....	64, 65
E - SEPARATION OF BRASS FOUNDRY SKIMMINGS.....	65

MASON'S OPERATIONS:

I - TEARING OUT STILL FIRE BOXES.....	65
II - CHIPPING OR CUTTING CONCRETE.....	65
III - CHIPPING MORTAR FROM BETWEEN BRICK.....	65, 66
IV - CRUSHING FIRE BRICK.....	66
V - SHAPING FIRE BRICK ON EMERY WHEEL.....	66
VI - DISMANTLING MASONRY.....	66

WOODWORKING OPERATIONS:

A - BOX SHOOK MANUFACTURE	
(a) Resawing.....	67
(b) Ripsawing.....	67
(c) Cut of Sawing.....	67
(d) Planing.....	67, 68
Dustiness of Shook-Factory Air.....	68
B - BELT SANDERS, SAND DISCS AND SPINDLES OR CYLINDERS:	
(a) Belt Sanders.....	68
(b) Sand Discs or Wheels.....	68, 69
(c) Sand Spindles or Cylinders.....	69, 70
C - MAKING WOODEN CRATES:	
(a) Band Saws.....	70
(b) Railroad Saws.....	70

ROCK EXCAVATION:

A - DRILLING.....	70
B - BLASTING.....	71
C - MUCKING.....	71
D - DUST CONTROL MEASURES:	
(a) Wet Drilling and Wetting Down Rock Walls and Muck Piles.....	71
(b) General Ventilation.....	71
(c) Dust Exhaust Hoods on Drills and Other Mucking Operations and Local Sources of Dust.....	71, 72
(d) Personal Protection by Means of Respirators and Positive - Pressure Masks.....	72

PART III - MEASURES FOR REDUCTION OF THE DUST HAZARD

HOW CAN THE DUST HAZARD BE REDUCED?

A - DESIGN PLANT FOR DUST CONTROL.....	74
B - PROVIDE BUILDING VENTILATION.....	74
C - STORE DUSTY MATERIALS IN DUST-TIGHT BINS.....	74
D - ENCLOSE MATERIAL HANDLING EQUIPMENT.....	74
E - ISOLATE DUSTY PROCESSES.....	74
F - PROVIDE WET METHODS OF OPERATION.....	74
G - DESIGN EQUIPMENT TO CONTROL DUST.....	75
H - PROVIDE EXHAUST SYSTEMS.....	75
I - ESTABLISH MAINTENANCE AND GOOD HOUSEKEEPING PROCEDURE...	75
J - PROVIDE RESPIRATORS.....	76
(a) Air Purifying Types of Respirators.....	76, 77
(b) Supplied Air Respirators.....	77
The Air Line Respirator.....	78, 79
Abrasive Blasting Respirator.....	79
(c) Acceptance and Use of Personal Respiratory Protection by Workmen.....	79, 80
(d) Use, Maintenance and Care of Respirators.....	80

WHAT MEDICAL CONTROL SHOULD BE EXERCISED IN THE SELECTION
AND SUPERVISION OF MEN WORKING ON DUSTY JOBS?..... 80, 81

PHYSICAL EXAMINATIONS.....	80
DESIRABLE PHYSICAL QUALIFICATIONS.....	81
RE-EXAMINATIONS.....	81
THE LIMITATIONS	

CONCLUSION.....	81, 82
-----------------	--------

to silicate dust.

Asbestosis - According to authorities cited by Drinker & Hatch in their book "Mineral Dusts", the pathology produced by asbestos is not like that of silicosis. U. Gardner of Saranac Lake is of the opinion that the asbestos fibers group the neck of an alveolus and shut it off, causing what is known as "Atelectasis". There is no definite migration or transportation of the dust particles to the lymph nodes and no fibrous nodules. As the atelectatic areas increase the reduction in lung area causes serious dyspnea or laborered breathing. Dr. A. J. Lanza (U.S. Health Dept., 50; 1 - 1935) suggests that the enlarged hearts noted frequently in his cases of second stage Asbestosis may be due to the increased load on the heart. It takes more work to pump blood through the fibrosed than through the normal lung. Recent pathological studies from human lungs from cases of asbestosis have indicated a diffuse type of interstitial fibrosis with a certain amount of emphysema.

IV - WHAT IS THE MAXIMUM PERMISSABLE DUST CONCENTRATION? - There appears to be a wide variation in the maximum concentration of dust which might be inhaled without subsequent injury to workmen. Some dusts (as lead) are determined by chemical methods and the concentrations in air are recorded gravimetrically as milligrams per cubic meter. However, the available information on the amount of lead dust that is harmful and the methods of determining lead are better and more accurate than those for silica dust. It is rather well agreed that an intake of about 1.5 milligrams of lead a day, whether this is acquired by breathing dust or by drinking water that contains lead, is the maximum allowable quantity. Others (as silica, where size is a factor in determining dangerous particles), are usually given by count. Neither method tells the whole story, but in both cases it may be possible to secure the information necessary for the purpose.

The maximum silica dust concentration considered permissible in the air breathed by a workman at any point in the normal breathing zone has not been definitely established. There is considerable difference of opinion regarding the range of particles that are counted when using the Public Health Service technique and light field illumination. Bloomfield of the United States Public Health Service and Brown of the United States Bureau of Mines contend that they count particles from one micron and upward, or even 0.7 micron and upward. The Industrial Commission of Wisconsin and its Advisory Committee, composed of both employers and scientists, however, agreed in 1932 on a tentative figure of 15 million countable particles under 10 microns in longest dimension with free silica content of 35 per cent in a cubic foot of air as determined by United States Public Health Service technique. Variations in free silica content will make proportional inverse changes in this standard. In the case of practically pure silica, the permissible dust count should probably never exceed 5,000,000 countable particles. By countable particles is meant those particles between 0.5 to 10 microns in the longest dimension. Particles of this size are the ones that are believed to cause the greatest damage and form no visible cloud. Dust particles smaller than 0.5 microns in the longest dimension are not ordinarily countable. Dust particles larger than 10 microns in longest dimension do not ordinarily reach parts of the lung where they can produce injury of a respiratory nature. Most industrial dusts have but few particles above two or three microns in size. They are usually about 90 to 95 per cent. below two or three microns and 50 per cent. below 0.5 to 0.7 microns. An exception to this would be a dust sample taken close to the point of generation of dust and before the larger particles had time to settle out of the air.

In South Africa the figure is 1 milligram per cubic meter (or 300 particles per cubic centimeter, or approximately 8.5 million per cubic foot.) Dr. Lanza found in 1917 in the Joplin, Missouri district that with good engineering practice, a figure of 1 milligram per 100 liters of air could be attained. This value attributed to Lanza appears too high in comparison with the South African standards. As there

III - INSULATING OPERATIONS

Insulation plays an important part in the processing of petroleum products. The two types of insulating material most frequently used are "Sponge Felt" (asbestos with ground sponge to give dead air space and thus increase the effectiveness of the insulation) and a mixture of 85% magnesia and 15% asbestos. Rock wool is used to a considerably lesser degree. In the ordinary commercial form, Rock Wool, as used at our refineries, does not present a dust hazard. It is also used for home insulation, and is available in small nodule form which can be blown into place. "85% magnesia" is a mixture of magnesia and granulated asbestos and pressed into blocks of various sizes and shapes (usually 16" x 18" x 1-1/2"). The most dust comes from dismantling old insulation and grinding scrap material for use as a plaster or "ganister". The average service of men engaged in insulating operations is about fifteen years. Most of these men have been transferred from the Common Labor Department. They work nine out of fourteen eight-hour shifts, in gangs of from two to six men, and are actually exposed to dust for less than sixty per cent. of their working time. Goggles are sometimes provided, and occasionally MSA "Comfo" Respirators, but this equipment is not used as much as it should be. Generally speaking, about 85% of their work is with sponge felt and 15% with 85% magnesia insulation. At one of the larger southern refineries about 300,000 square feet of sponge felt and 50,000 square feet of 85% magnesia are handled a year.

A - What Physiological Reactions are Provoked by Insulating Materials? According to Dr. Leroy U. Gardner (Journ. Indust. Hyg. Mar. 1937, Vol. 19, No. 3, P. 121) asbestos dust with its fibrous particles does not seem to be readily handled by the protective mechanism of the lungs. Quoting from his article:

"They are not removed to the lymphoid tissue but remain in contact with the delicate walls of the air spaces. They become surrounded by an iron-containing coating that fractures and gives rise to the peculiar structures known as 'asbestosis bodies'. The fibers are irritating, perhaps because of their form, and they excite a fibrosis which begins about the terminal bronchioles and spreads to form diffuse patches in the parenchyma. Often the distribution is sub-pleural. In the presence of infection, the reaction to asbestos dust is much more severe than that caused by the dust alone."

There is nothing in the pertinent literature, nor does the Bureau of Mines know of any evidence, which would demonstrate magnesite (a natural magnesium carbonate) to be harmful. It would fall in the class of "nuisance dusts" such as gypsum. While many of the so-called "nuisance dusts" have never been found to be harmful, it is the opinion of most investigators in the field of industrial hygiene that no worker should be exposed to any dust in a concentration exceeding 75 or 100 millions of particles per cubic foot of air.

B - What are the Principal Insulating Operations and How Much Dust is Produced During Such Operations? There is, of course, a wide variation in the amount of insulation work and the amount of dust produced. A few examples, however, will give a good general idea:

INSULATING 12" STEAM LINES: 6" x 18" x 1-1/2" blocks of 85% magnesia are tied on the steam line with 14-gauge galvanized wire and covered with roofing paper to make it waterproof. Often times this work is performed on scaffolds twelve to fifteen feet above the ground, with men lying on their backs under the line part of the time.

considerable dust (as high as 18,124,800 particles of less than ten microns per cubic foot) results from tapping the blocks into place. Samples taken during the entire operation had an average concentration of 6,881,760 particles per cubic foot. About 90% of these dust particles were slightly angular, crystalline in appearance and above five microns or less in size (as seen under the Konimeter Microscope); 5% were rounded opaque, ten microns or more in size; and 5% were opaque scale-like, five microns or more in size. Samples taken while applying asbestos sponge felt to a 12" steam line had a dust concentration as high as 23,788,800 particles of ten microns or less in size per cubic foot. The average was 12,574,080 particles per cubic foot. These dust concentrations are considered too high for working without adequate protection.

INSULATING A 750-POUND CRACKING COIL ACCUMULATOR: 6" x 36" blocks of Johns-Manville "Fire Felt" are first applied and plastered with extra AA Rubberoid Asbestos Cement and waterproofed with Johns-Manville "Insulkote". The dustiness of handling these materials has been considerably reduced since the manufacturers began shipping the "Fire Felt" in cardboard cartons containing thirteen or twenty blocks, and the plaster in hundred-pound paper bags. Samples taken during this operation had an average dust concentration of 4,502,880 particles, ten microns or less in size per cubic foot. About 75% of these dust particles were slightly angular in appearance, five microns or less in size; 10% were scale-like; opaque; and 15% were rod-like and fibrous.

INSULATING TREATING PLANT ACID SUCTION LINE: Sections of "Sponge Felt Pipe Cover" are cut to fit pipe lengths with an ordinary carpenter's hand saw. This operation produces on an average 821,280 particles of dust, ten microns or less in size, per cubic foot. Under the Konimeter Microscope all of these particles are slightly angular, crystalline in appearance, and five microns or less in size. The blocks or sections of the pipe cover are held in place by wrapping #16 gauge galvanized wire about each one.

INSULATING CRACKING COIL HOT OIL LINES: All hot oil lines at cracking coils are insulated with 2" asbestos tubing (85% magnesia and 15% asbestos) held in place by fine copper wire. Sections of the tubing are cut to fit particular areas by means of an ordinary carpenter's hand saw. This produces 7,788,000 particles of dust, ten microns or less in size, per cubic foot. Under the microscope, 90% of these dust particles appeared to be rounded crystalline and about three microns or less in size. Each section of tubing is pounded into place with the open hand so that it fits snugly against the pipe, and then wired into position. The dust produced from both of these operations averages about 3,379,520 particles per cubic foot. Under the microscope, approximately 80% or 90% of the dust particles appear crystalline, more or less angular, and five microns or less in size; the remaining 10% or more are rounded in appearance, and over ten microns in size.

DISMANTLING OR REMOVING OLD INSULATION: As a general rule, the dismantling or removal of old insulation is a more dusty operation than the application of new insulation. The old insulation is chopped or cut with a hatchet or small hand-axe, and pried loose and pulled off with the hands. This produces dust concentrations as high as 5,890,560 particles, ten microns or less in size, per cubic foot. In

...tling an old cracking coil 4" tar line, the average dust concentration was 2,322,240 particles per cubic foot. In appearance these particles were clear crystalline, rather rounded, and five microns or in size. No fibres were observed in any of the dust samples from mantling operations. After a few weeks or months service, insulation on hot lines dries out and appears to disintegrate. This is probably due to the fact that such insulation is usually covered with a weather-proof material which prevents absorption of moisture from the air.

CRUSHING SCRAP ASBESTOS: Scrap asbestos insulation, usually the 85% magnesia type, is crushed in a belt-driven Williams crusher to pass through a screen with one-inch holes or slots, and is then mixed with new asbestos to make insulating plaster. This operation, which is a very dusty one, is performed by two men, with an average service credit of about twelve years. Goggles and MSA "Comfo" or Willson Dust Respirators are worn. Considerable dust is produced in breaking up the scrap insulation by hand prior to crushing (10,195,200 particles, ten microns or less, per cubic foot), and also when feeding the crusher which is done by shovelling the broken-up pieces into the hopper and poking them down with a short wooden stick (14,839,680 particles per cubic foot). Dust counts as high as 27,527,040 particles per cubic foot were found in samples taken from over the hopper. These dust concentrations are dangerously high. About 95% of these particles are sharply angular, crystalline in appearance and five microns or less in size; 5% are opaque scale-like, six microns or more in size. Crushing scrap asbestos is not a steady routine operation, the exposure varying from eight hours a month to about twelve hours a week.

CRUSHING OLD CORK INSULATION: This operation is performed approximately twice a year and takes about twenty or thirty minutes. The insulation is crushed on a belt-driven Williams crusher, by the same men who crush the scrap asbestos. This crushed cork is used for insulating lines in the cold settling plant. The average amount of dust produced is 20,016,178 particles, ten microns or less in size per cubic foot. About 80% of the particles are slightly angular, crystalline, in appearance, and five microns or less in size; 20% are round, semi-opaque, ten microns or more. There are also a large number of very small black or dark gray specks.

IV - GUNITING OPERATION

What is Guniting and How is it Applied? - Guniting is a mixture of approximately one part (one 94 pound bag) of Portland Cement and two parts (twelve scoop shovels) of sharp sand. The sand and cement are mixed dry, shoveled into the hopper of the guniting machine, using water under about 40-pounds per square inch pressure and compressed air at thirty to ninety pounds per square inch. It is applied under pressure as a semi-fluid, against the surface to be protected (usually process equipment, cracking coil soaking drums and storage tanks). In practically every case where guniting is done, it follows immediately, after the sand blasting job used to clean the surface. In most cases, the work is performed by the same crew. The individual holding the guniting nozzle is provided with the same protection as is the operator of the sand blast nozzle, and the men tending the guniting machines are provided with respirators and are required to use them while actually handling the sand and cement. This involves mixing the materials and charging them into the machines (two dustiest parts of a guniting job). Samples taken during these operations show the following dust counts of particles ten microns or less in size: