UNION CARBIDE

INTERNAL CORRESPONDENCE

love

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Date April 28, 1975
"Calidria" Asbestos

Originating Dept. – TECHNOLOGY DEPARTMENT

Answering letter date

Copy to R. F. X. Fusaro
J. L. Myers
W. C. Thurber
File ✓

Subject Dow Toxicology Literature

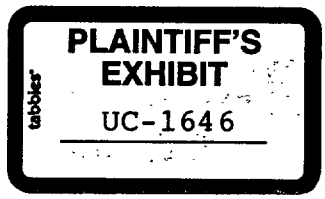
The background information relative to our discussion of the Dow literature of October 16, 1974 is attached as agreed. It includes a formal paper, "Chrysotile Asbestos in Plastics" presented in San Francisco on May 14, 1974 and a script based on the paper Mr. Myers used for his NACE talk in Rochester on October 9, 1974. (The deletions were made for subsequent presentation in Europe and should be ignored). Also included is a brochure "The Safe Use of "Calidria" RG-244, February 1973." This was distributed to customers for a period following the date and we know that Dow had a copy of it.

Mr. Myers states that he does not follow the prepared text verbatim in his presentations of the toxicology subject matter but is always very careful to stating positive conclusions where discussing controversial medical data. He does not touch upon the "nuisance dust" analogy in the second paragraph of the Dow literature. Possibly they extrapolate this from our February 1973 brochure but no such analogy is implied.

H. B. Rhodes

H. B. Rhodes

Enc.
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# CHRYSOTILE ASBESTOS IN PLASTICS

John L. Myers

"CALIDRIA" ASBESTOS

UNION CARBIDE CORPORATION
MINING AND METALS DIVISION
NIAGARA FALLS, NEW YORK

Presented on May 14, 1974 at the 32nd Annual Technical Conference of the Society of Plastics Engineers in San Francisco.


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## INTRODUCTION

Asbestos has received a great deal of attention and publicity in recent years, especially after it was designated a "target health hazard" by OSHA and a "hazardous air pollutant" by the EPA. Many of the articles on asbestos by the press have been emotionally oriented or distorted and in some cases stories have been sensationalized, based on obvious misinterpretation of facts. The use of half-truths or unsubstantiated statements has led to general confusion and the unfair castigation of asbestos and products containing asbestos. The purpose of this paper is to put the matter of asbestos use and asbestos hazards in a logical and practical perspective. In this paper the different types of asbestos and their many uses are discussed along with government regulations controlling the use of asbestos. The health hazards associated with asbestos, both occupational and environmental, and some industrial experience with air sampling and dust control measures are also covered.

## WHAT IS ASBESTOS?

Asbestos is a commerical or generic term used to describe six naturally-occurring "asbestiform" minerals that are fibrous, hydrated metal silicates. The six varieties are divided into two classes, serpentine and amphibole, based on their crystal structure. Chrysotile is the only member of the serpentine class while the amphiboles include crocidolite, amosite, anthophyllite, tremolite and actinolite. Chrysotile is by far the most used variety and accounts for over 95% of U.S. consumption, as noted in Table I.

Crocidolite, also known as blue asbestos, is imported from South Africa. Because of its high mechanical strength and good resistance to acids and alkalis, it is used to reinforce a limited variety of plastics where its pronounced color is not objectionable. Amosite, also imported from South Africa, is used primarily in thermal insulation. Although there are some deposits of anthophyllite in the U.S., most of it is imported from Finland. It is used primarily as a filler for polypropylene and in insulating materials. A comparison of the four varieties of asbestos which are of commercial importance is presented in Table II. It should be noted that there are significant differences between chrysotile and the amphiboles with regard to chemical composition and certain physical properties.

## WHERE IS ASBESTOS USED AND WHY?

Asbestos has served mankind for over 100 years in a broad variety of applications. The general areas in which asbestos is used in the United States are shown in Table III. Based on information from asbestos producers and consumption surveys, it is estimated that the plastics industry uses about 1/3 of the 800,000 tons consumed annually, which makes it the largest single user of asbestos fiber.

The largest uses of asbestos by the plastics industry are in vinyl/asbestos floor tile and in phenolic molding compounds. It is also used in other plastics such as polypropylene, polyester, nylon, melamine, epoxy, silicones and vinyls. Asbestos provides

According to the 33-member Advisory Committee on Asbestos Cancers of the International Agency for Research on Cancer (a division of the World Health Organization):

> "There is evidence of an association of mesothelial tumours with air pollution in the neighbourhood of crocidolite mines and of factories using mixtures of asbestos fibre types. The evidence relates to conditions many years ago. There is evidence of no excess risk of mesotheliomas from asbestos air pollution which has existed in the neighbourhood of chrysotile and amosite mines. There are reported differences on incidence of mesothelioma between urban and rural areas, the causes of which have not been established. There is no evidence of a risk to the general public at present." (5)

The same body quoted above has also concluded that there is at present no evidence of lung damage by asbestos to the general public; and such evidence as there is does not indicate any risk of cancer resulting from asbestos fibers present in water, beverages, food or in the fluids used for the administration of drugs.

While there seems to be general agreement that the public is not in any present danger from asbestos, it is also recognized that excessive, long-term occupational exposure can cause serious health problems. Also, if man-made emissions are not controlled, then environmental contamination could approach harmful levels. During the past two years, significant legislation has been enacted by the Federal Government to reduce and control occupational exposure to asbestos fibers and to minimize fiber emissions to the environment. Additional standards or regulations have been proposed or enacted by many state and local governments.

## SUMMARY OF OSHA REGULATIONS

The Williams-Steiger Occupational Safety and Health Act of 1970 became effective on April 28, 1971, with the following Congressional purpose: "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." The Act established the Occupational Safety and Health Administration (OSHA) within the Department of Labor, which has responsibility for administration and enforcement. Research and related functions are handled by the Department of Health, Education and Welfare (HEW) through the National Institute of Occupational Safety and Health (NIOSH). Five million employers and 60 million of the nation's 80 million workers are covered by OSHA. Specifically excluded from coverage are government employees and operations which are protected under other Federal health and safety laws. In a news release issued January 4, 1972, OSHA announced a Target Health Hazards Program aimed at improving health factors associated with working conditions. The following five substances were designated to be the focus of initial and concerted efforts by OSHA and NIOSH: Asbestos, Cotton Dust, Silica, Lead and Carbon Monoxide.

At the present time new standards have been established only for asbestos; although, of the 8,000 toxic substances on the

exposed. On March 31, 1971, asbestos, along with beryllium and mercury, was identified as a "hazardous air pollutant" by the Administrator of the EPA. National Emission Standards for asbestos were then published by the EPA in the Federal Register, Vol. 38, No. 66 - Friday, April 6, 1973. Although no numerical emission standards were established, operating criteria are prescribed to prevent or limit asbestos emissions to the outside air from asbestos mills, roadways, certain manufacturing operations, building demolition, and the spray-on application of materials used to insulate or fireproof equipment and machinery. The law further requires that spray-on materials used to insulate or fireproof buildings, structures, pipes, and conduits shall contain less than 1% asbestos on a dry weight basis. This should significantly reduce emissions to which the general public may be exposed, especially in large urban areas.

"...the Administrator (of the EPA) has determined that, in order to provide an ample margin of safety to protect the public health from asbestos, it is necessary to control emissions from major man-made sources of asbestos emissions into the atmosphere, but that it is not necessary to prohibit all emissions.

In this determination, the Administrator has relied on the National Academy of Sciences' report on asbestos, which concludes: 'Asbestos is too important in our technology and economy for its essential use to be stopped. But, because of the known serious effects of uncontrolled inhalation of asbestos minerals in industry and uncertainty as to the shape and character of the dose-response curve in man, it would be highly imprudent to permit additional contamination of the public environment with asbestos. Continued use at minimal risk to the public requires that the major sources of man-made asbestos emission into the atmosphere be defined and controlled.'" (7)

## WHAT IS INDUSTRY DOING?

The Asbestos Information Association/North America reports that, during the past 30 years, the asbestos industry has spent millions of dollars to improve mining, milling, and manufacturing methods (8). The establishment of safer working conditions has been a prime target and this work continues unabated and in close association with government agencies and independent medical researchers (9). The ultimate goals of the asbestos industry are:

- Reduction of work-area dust to minimum levels.
- Protection of workers from asbestos-related diseases.
- Maintenance of environmental emissions at levels low enough to preclude public endangerment.

## AIR SAMPLING

In order to comply with OSHA Standards and to determine the need for dust control measures, air monitoring should be conducted in areas where asbestos is regularly handled or used. OSHA Standards require that "all determinations of airborne concentrations of asbestos fibers shall be made by the membrane filter method at 400-450X (magnification) (4 millimeter objective) with phase contrast illumination." (10) The equipment for collecting air samples costs less than $400 and is readily available. A phase

this product serves a fair portion of the asbestos market. Pellets not only reduce dust during conventional handling but they are also available in bulk hopper cars and can be transferred and used in totally enclosed systems. Barring leaks in the system, dust in work areas is virtually eliminated. Used in bulk, asbestos pellets also reduce shipping costs, eliminate warehouse storage and handling, facilitate automation, reduce clean-up, and eliminate bag handling and disposal. The pellets contain no binder and are friable enough to be dispersed in dry form or in aqueous or resinous systems with conventional high-shear grinding equipment (13).

Several types of special packaging are currently available and suppliers consider customer requests for unusual requirements. The floor tile industry can obtain asbestos in plastic bags which can be added directly to the compounding operation. Asbestos in bleached paper bags assembled with water-soluble glue and printed with water-dispersible ink can be added directly to paper-making furnishes or acoustical ceiling tile formulations. Water-proof bags are available to permit slurrying of the asbestos in the bag. Wider use of shrink-filming is being offered to reduce dust during bag handling, transportation and storage.

Although "wetted" asbestos is not generally available, most suppliers are working with customers to provide "dustless" products. When justified by market demand, asbestos can be treated with water, mineral spirits, glycol or other materials compatible with the application or system.

## CONCLUSION

Asbestos is one of industry's many raw materials which involves a potential hazard when not used with reasonable respect and care. Although all forms of asbestos are recognized as hazardous to health when inhaled excessively, there is growing evidence that crocidolite and amosite are more hazardous than chrysotile. Fortunately the plastics industry uses primarily chrysotile asbestos and in most products the fibers are locked-in to prevent airborne contamination. Although asbestos dust levels are generally lower than expected, industry continues to expend large amounts of time and money to further improve the quality of the workplace. Although the general public is not currently in danger, occupational controls are required to prevent future environmental contamination.

Chrysotile asbestos is an important and necessary raw material, vital to the nation's safety and economy; and, with proper control, it can be used safely and in compliance with government regulations. Medical, scientific, government, and industrial personnel must continue to work closely together to establish reasonable exposure limits, provide safe work areas, and eliminate any possibility of public endangerment.

## TABLE I

APPARENT U.S. CONSUMPTION OF ASBESTOS, TONS*

(% of Total Shown in Parentheses)

| Year | Total | Chrysotile | Amosite | Crocidolite |
|---|---|---|---|---|
| 1967 | 720583 | 686044(95) | 12558(1.7) | 14917(2.1) |
| 1968 | 817363 | 775711(95) | 20467(2.5) | 13965(1.7) |
| 1969 | 784321 | 749708(96) | 14618(1.9) | 10558(1.3) |
| 1970 | 728131 | 695770(96) | 14261(2.0) | 8936(1.2) |
| 1971 | 758571 | 729272(96) | 14580(1.9) | 6953(0.9) |
| 1972 | 808554 | 791020(98) | 7125(0.9) | 5374(0.7) |

*Information based on import and production data from United States Bureau of Mines Minerals Yearbooks.

## TABLE II

COMPARATIVE DATA FOR ASBESTOS MINERALS

| | CHRYSOTILE | CROCIDOLITE | AMOSITE | ANTHOPHYLLITE |
|---|---|---|---|---|
| FORMULA | $3MgO \cdot 2SiO_2 \cdot 2H_2O$ | $Na_2O \cdot Fe_2O_3 \cdot 3FeO \cdot 8SiO_2 \cdot H_2O$ | $1.5MgO \cdot 5.5FeO \cdot 8SiO_2 \cdot H_2O$ | $7MgO \cdot 8SiO_2 \cdot H_2O$ |
| COMPOSITION,% | | | | |
| $SiO_2$ | 37-44 | 49-53 | 49-53 | 56-58 |
| MgO | 39-44 | 0-3 | 1-7 | 28-34 |
| FeO | 0-6 | 13-20 | 34-44 | 3-12 |
| $Fe_2O_3$ | 0-5 | 17-20 | - | - |
| $Al_2O_3$ | 0-2 | - | 2-9 | 0-2 |
| $H_2O$ | 12-15 | 2-5 | 2-5 | 1-6 |
| CaO | 0-5 | - | - | - |
| $Na_2O$ | - | 4-8 | - | - |
| $CaO+Na_2O$ | - | - | 0-3 | - |
| CRYSTALS | Fine Fibers | Brittle Fibers | Prismatic Crystals | Prismatic Crystals |
| COLOR | Gray/Green | Blue | Gray/Brown | Gray |
| TEXTURE | Soft/Silky | Harsh | Harsh | Harsh |
| FLEXIBILITY | Very Good | Good | Good | Poor |
| HARDNESS, Mohs | 2.5-4 | 4 | 5.5-6 | 5.5-6 |
| FIBER DIA., Å | 180-300 | 600-900 | 600-900 | 600-900 |
| TENSILE, Mpsi | 800 | 600 | 200 | <4 |
| SURFACE CHG. | Positive | Negative | Negative | Negative |
| RES. TO ACID | Poor | Good | Good | Very Good |
| RES. TO ALK. | Good | Good | Fair | Good |

Source: Modern Plastics Encyclopedia(1972-3), and Encyclopedia of Chemical Technology, Volume 2, p. 136(1948).

# THE SAFE USE OF "CALIDRIA" RG-244

February 1973

## 1. Introduction

Asbestos has received a great deal of attention and publicity in the last several years and has become the first substance covered by new OSHA health regulations. Unfortunately, much of the media treatment of the subject has been emotionally oriented and distorted and in some cases has bordered on the sensational and untrue. Many users of asbestos and products containing asbestos have been mislead regarding the safety of asbestos and what is needed to comply with the OSHA requirements.

This summary has been prepared to present the question of asbestos toxicology in logical perspective. It covers asbestos toxicology in general and the key features of the OSHA regulations. Dust count data are presented for polyester manufacturing plants using RG-244 and for fabricators during the spraying of the resin and the grinding of the resultant laminates. The current status of the silica regulations is noted. Dust control methods are summarized.

## 2. Asbestos Toxicology

Asbestos is a generic term covering six naturally occurring fibrous minerals. It includes chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite. Chrysotile is by far the most widely used variety and accounts for more than 95% of world production. It is the only type produced in substantial quantities in the United States and Canada. Also of commercial importance are crocidolite and amosite from Africa and anthophyllite from Finland.

It is accepted that asbestos, like many other foreign bodies, can cause disabling lung damage which for asbestos is commonly referred to as asbestosis. It is important to note, however, that asbestosis and statistical excess occurrences of bronchogenic carcinoma (lung cancer), the two most common asbestos-related diseases, have occurred only in workers with long-term exposures to massive concentrations of asbestos dust. The risk of this type of exposure is usually in asbestos mines and mills and in large manufacturing operations that use quantities such as 20,000-30,000 pounds per day. Long-term, massive exposures are, of course, not typical of polyester resin manufacturing operations utilizing RG-244 where only 300-400 pounds are dumped a couple of times a day.

Much has also appeared in the public press regarding the relationship between asbestos and mesothelioma, a rare type of cancer of the pleura. In almost all cases where there is a strong statistical relationship between mesothelioma and the inhalation of asbestos, crocidolite and/or amosite have been involved. Where asbestos exposure has been limited to chrysotile asbestos (RG-244 is chrysotile) there is strong evidence that no excess mesotheliomas will occur.

Finally, there is no evidence that the general public is in any danger from the amount of asbestos fiber in the community air. The U.S. National Academy of Science states in an October 1971 publication, "Asbestos - The Need For And Feasibility of Air Pollution Controls:"

> "at present, there is no evidence that the small number of fibers found in most members of the general population affect health or longevity."

This does not, however, preclude the need for definition and control of man-made emissions into the atmosphere. The current OSHA regulations relating to the work area and the forthcoming EPA regulations protecting the atmosphere are intended to provide this control.

3. OSHA Regulations

After extensive hearings, a new standard for Exposure to Asbestos Dust was published in the Federal Register, Volume 37, No. 110 on Wednesday, June 7, 1972. The basic exposure standard is an 8-hour time-weighted average (TWA) of 5 fibers, longer than 5 micrometers, per cubic centimeter of air. The fiber limit is to be reduced to 2 on July 1, 1976. A peak concentration of 10 fibers per cc is not to be exceeded at any time.

Note particularly the use of the time-weighted average over the eight-hour shift. An operator performing one or two short additions of RG-244 per shift, as is typical of polyester producers, would have his exposure during this dumping time averaged with zero (or a low-background level) for the rest of the shift. It is important that this concept be understood for interpreting the effect of intermittent exposures.

Improper interpretation of the regulations has created many misconceptions about the equipment and procedures needed to use asbestos. If exposure limits are not exceeded, there are no further compliance requirements except for medical examinations. Interpreted literally, medical examinations are required for all employees in any "occupation exposed to airborne concentrations of asbestos fibers." Some definition of "exposed" is necessary since evidence indicates that small amounts of asbestos fiber have existed in the atmosphere for millions of years. The source of these fibers would be from the weathering of naturally occurring surface outcrops. In its criteria document on asbestos, NIOSH recommended that "exposed to asbestos" be defined as "average exposures above one fiber per cc or peak exposures above five fibers per cc." A number of large asbestos users have adopted this as a guideline in their operations.

Respirators and special clothing are required in the construction trade for the spray application of insulation and fireproofing materials, and for the removal of such materials. This special protection is not required for any other use of asbestos unless exposure limits are exceeded. This is also true for other items such as specially equipped tools, product limitations, change rooms, clothes laundering and waste disposal.

4. "Calidria" RG-244 in Polyester Resin

During the last six months, Union Carbide has made asbestos dust count measurements at eight major polyester processing plants. Counts have also been made during the spraying of resin containing RG-244 and during the sanding and grinding of parts produced from such resin. In all cases, sampling and counting were done with the equipment and techniques prescribed in the OSHA regulations.



*Union Carbide trial exhibit UC-1646: H. B. Rhodes to J. V. Murray on Dow Toxicology Literature, Transmitting Myer...* Published by AsbestosClaims.Law
ACL Doc 16733 · Page 9 of 27 asbestosclaims.law/library/16733/9

Resin Compounding Operations:

In the manufacture of polyester resin with RG-244 as the thixotropic agent, 10-50 bags of RG-244 are normally dumped into the resin in the thin tank. This gives a concentration in the resin of 0.5-1%. Typically, the dump takes place over a 10-30 minute period several times a day.

The results of dust counts taken in the breathing zone of the operator at eight manufacturing locations are shown in Table I. Samples were collected during the dumping of the bags of RG-244 and represent ceiling concentration (not TWA) fiber counts. Examination of the data shows that in all cases the asbestos dust levels were far below the allowable ceiling concentration of 10 fibers/cc. >5$\mu$ prescribed in the OSHA regulations.

Normally, the operator makes only one such dump in his 8-hour shift so that the peak levels shown would be averaged with much lower values in finding his time-weighted-average (TWA) exposure. For example, if the operator were exposed to the highest level found, i.e., 2.8 fibers/cc., for even as much as one half hour during the dumping operation and to a background level of 0.5 fibers/cc. for the other seven and one half hours of his shift, his time-weighted average would be:

$$\text{TWA} = \frac{(0.5)(2.8) + (7.5)(0.5)}{8} = 0.7 \text{ fibers/cc. } >5\mu$$

This is well below both the current 5 fibers/cc. and the 1976 level of 2 fibers/cc.

The OSHA regulations prescribe special precautions for the disposal of empty asbestos bags and containers if in any reasonably foreseeable use and handling dust levels above the allowable limits will be generated. In two of the plant surveys, dust counts were made during the handling of the empty RG-244 bags. The results given in Table II show levels well below the OSHA limits. As with the dumping data given previously, these values were obtained during active handling of the bags and would represent peak rather than time-weighted average exposure.

All of the data presented in Table I and II indicate that "Calidria" RG-244 asbestos as typically handled in polyester manufacturing, gives dust levels well below OSHA limits. As long as this is true, dust masks, protective clothing, change rooms, warning signs, and special bag disposal are not required. Dust monitoring is required to determine that levels are within the OSHA standards.

Spraying Polyester Resin Containing RG-244:

It would not be expected that spraying a liquid resin containing 0.5-1% of "Calidria" RG-244 would create any airborne asbestos dust. Samples were collected during a spraying operation; and no asbestos fibers were found.



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TABLE I

AIRBORNE ASBESTOS DUST COUNTS(1)
DURING DUMPING OF RG-244

| Plant | Data Reference | Description of Operation: Bags Dumped | Dump Time (Min.) | Sample Time (Min.) | Special Ventilation(2) | CEILING Concentration Fiber Count (Fibers/cc. >5μ) |
|---|---|---|---|---|---|---|
| A | --- | 10 | 10 | 10 | None | 0.7 |
| B | 1929-46-2 | 14 | 9 | 9 | None | 1.2 |
| C | 1929-30-2 | 15 | 21 | 21 | Hood over thin tank opening | 0.7 |
| D | 1929-56-1 | 36 | 12 | 12 | None | 2.4 |
| E | 1929-50-3 | 15 | 8 | 8 | None | 0.5 |
| F | 1929-26-3 | 45 | 20 | 20 | None | 1.6 |
| G | 1929-24-2 | 10 | 24 | 24 | Hood over mixing area | 0.8 |
| H | 1929-16-1 | 28 | 15 | 15 | None | 2.8 |

(1) All samples collected in the breathing zone of the operator dumping the RG-244.

(2) Special ventilation refers to dust collection equipment at or near the dumping area that is specifically intended for dust control during the dumping operation. All plants had varying measures of overall building ventilation.

TABLE II

AIRBORNE ASBESTOS DUST COUNTS
DURING EMPTY BAG REMOVAL

| Plant | Data Reference | Description of Operation | Sample Time (Min.) | Fiber Count (Fibers/cc. >5μ) |
|---|---|---|---|---|
| A | --- | Sample taken 3 feet above waste disposal drum for empty bags. (During dumping.) | 10 | 0.4 |
| B | 1929-40-3 | Directly over empty bag stacking area. Taken during dump. | 23 | 0.6 |
| B | 1929-40-5 | Empty bag storage area. Taken during dump as bags were put in. | 24 | 0.4 |



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ACL Doc 16733 · Page 11 of 27
asbestosclaims.law/library/16733/11

Sanding and Grinding of Polyester Resin Containing RG-244:

The main use of thixotropic polyester resin in the United States is in the manufacture of fiberglass reinforced boats, shower stalls, and other similar large objects. These products contain 10-30% fiberglass and the remainder is mainly resin. The overall laminate thus generally contains only 0.4-0.7% of RG-244.

In the manufacture of such objects, the edges and some portion of the surface are generally sanded or ground with a rotary disc grinder. This generates a cloud of visible dust and it is necessary to determine whether any free asbestos fiber is present in the cloud. To check this, samples were collected at four locations during the sanding or grinding of finished polyester parts. The results, given in Table III, show no free asbestos fibers in any of the operations.

All of these data are based on Millipore filter counts by the OSHA procedure. In addition to this, larger samples of airborne dust were collected during Operation K and were studied by special staining and microscopic techniques with various types of illumination at magnifications up to 1000X. These, too, failed to reveal any free asbestos fiber.

These data essentially confirm that polyester resin containing the usual levels of RG-244 will not yield asbestos fiber counts exceeding the allowable values.

5. Silica Toxicology

Silica, including amorphous silica, is a "target" hazard of the U.S. Occupational Safety and Health Administration. The "Criteria Document," which is the first step in updating the regulations on silica, is in the late stages of preparation by the National Institute of Occupational Safety and Health (NIOSH). The current exposure limit (TLV) for amorphous silica is 20 million particles per cubic foot.

6. Dust Control

Although the data presented herein indicate that RG-244, as it is typically handled in polyester manufacturing, generally gives dust levels within the OSHA standards, asbestos is an emotional subject; and the lowest practical levels are most desirable.

The best control measure for this type of operation is an exhaust collar or duct at the top of the mixing tank, so situated to create a vacuum at the manhole where the thixotrope is added. The exhaust system should be equipped with a filter to prevent the discharge of dust into the atmosphere. A system of this type should also reduce styrene fumes in the work area.

An alternate procedure is an exhaust hood over the dumping port. Union Carbide uses this type of hood in their manufacturing plant bagging operations. A face velocity for the open hood of 300 fpm and duct velocities in the range of 2500-3500 fpm work well for asbestos fibers.



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## TABLE III

## AIRBORNE ASBESTOS DUST COUNTS(1) MADE DURING SANDING OR GRINDING OF POLYESTER PARTS CONTAINING RG-244

| Plant | Data Reference | Description of Operation | Sample Time (Min.) | Special Ventilation(2) | CEILING Concentration Fiber Count (Fibers/cc. > 5μ) |
|---|---|---|---|---|---|
| I (Furniture Molder) | 1929-40-4 | Operator sanding finished polyester furniture parts containing ~0.5% RG-244. | 23 | Hood directly over grinding area. | 0 |
| J (Boat Yard) | 1929-42-7 | Operator edge grinding on hull containing ~0.5% RG-244. (~20% fiberglass) | 12 | None (Outdoors) | 0 |
| K | --- | Operator edge grinding on part containing ~0.7% RG-244, 20% fiberglass. | 13 | None (Closed room 8'x8' 8'.) | 0 |
| L (Furniture Molder) | --- | Operator hand sanding polyester parts containing ~0.05% RG-244. General area sample. | 45 | None | <0.01 |
| L (Furniture Molder) | --- | Large power sander smoothing polyester parts containing ~0.05% RG-244. | 45 | Integral hood | <0.01 |

(1) Unless otherwise noted, all samples collected in the breathing zone of the operator during the sanding or grinding of parts containing "Calidria" RG-244.

(2) Special ventilation refers to dust collection equipment at or near the dumping area that is specifically intended for dust control during the dumping operation. All plants had varying measures of overall building ventilation.



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For small operations, an air- or fluid-operated aspirator with a flexible pickup hose can be used to remove the thixotrope from bags. This would preclude the need for cutting the end of the bag completely open, and would eliminate the subsequent dumping and bag-shaking operation. The dust from the discharge of an air-operated aspirator would, of course, require adequate collection.

Empty bags can be disposed of by packaging them in plastic bags. Each bag of RG-244 is over-slipped with a polyethylene bag which can be used for this purpose. Larger plastic bags are commercially available if the RG-244 bags are not saved. Waste bags can subsequently be burned or given to a regular trash pickup service.

Dust which accumulates on tanks, floors, etc. should be removed with a vacuum hose or washed down with water. Blowing with air can only relocate the dust and may cause airborne concentrations to exceed the prescribed limits.

Excessive dust can be created by poor work or housekeeping practices. Workers should be instructed to handle dusty materials with care and to avoid undue creation of dust by shaking bags, throwing them, etc. Respirators can be worn if desired and should be approved for the dust encountered. Except for special circumstances, respirators cannot be used to achieve compliance with OSHA regulations.

Additional information about the safe use of RG-244 can be obtained by calling 716-278-3376 or writing:

"Calidria" Asbestos
Union Carbide Corporation
Mining & Metals Division
P. O. Box 579
Niagara Falls, New York 14302



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ACL Doc 16733 · Page 14 of 27 **asbestosclaims.law/library/16733/14**

Related to a different audience, in the U.S. Rochester NACE (1)

**FOR PROJECTIONIST** 10/9/74

~~The main portion of~~ my presentation will be concerned with the asbestos/health question. I will attempt to provide you with an objective outlook, although I may be just a little biased. ~~I will also discuss our "Calidria" Asbestos products which are used by the plastics industry for viscosity control, thixotropy and reinforcement.~~

~~First we'll talk about the fact that~~ asbestos has been used safely for years, is being used safely today, and will be used safely in increasing amounts and in many new applications. ~~If I can convince you of this then you'll be more receptive to the commercial message about our Calidria products.~~

All of you have seen airborne dust particles in a shaft of sunlight in a darkened room, and you have probably been surprised at the amount of them. Man can survive in these conditions because of a super-efficient respiratory system, from the hairs in your nostrils to a sticky mucous in the lining of your lungs which continually moves foreign particles to the throat.

Natural and domestic dusts are removed with little difficulty but industrial dusts can produce systemic or local effects which are harmful. Systemic damage to other than the lungs is caused by materials such as lead and mercury. Lung damage is often caused by materials such as silica and asbestos, and is known as lung fibrosis.

○ = slide number

* = when to exhibit slide

(1) Bad Press
(2) Good Press

Session #11 S. L. Myers
Continental South

Θ = Transparency
* = when to put on Tr

True story is in between and I will discuss that phase of the asbestos/health question.

Asbestos has received a great deal of attention and publicity in recent years, especially after it was designated a "target health hazard" by (3) OSHA and a "hazardous air pollutant" by the EPA.* Many of the articles on asbestos by the press have been emotionally oriented or distorted and in some cases stories have been sensationalized, based on obvious misinterpretation of facts.*

Asbestos is a commerical term used to describe six naturally- (4) occuring "asbestiform" minerals* that are fibrous, hydrated metal silicates. The six varieties are divided into two classes, serpentine and amphibole, based on their crystal structure. Chrysotile is the only member of the serpentine class while the amphiboles include crocidolite, amosite, anthophyllite, tremolite and actinolite. Chrysotile is by far the most used variety and accounts for over 95% of U.S. consumption.

* Crocidolite is imported from South Africa and is used to reinforce (5) a limited variety of plastics where its pronounced color is not objectionable. Amosite, also imported from South Africa, is used primarily in thermal insulation. Anthophyllite is imported from Finland and used primarily as a filler for polyprophler and in insulating materials (RG-600 Ref.). A comparison of the four varieties of asbestos which are of commercial importance ~~is presented in Table II~~. It should be noted that there are significant differences between chrysotile and the amphiboles with regard to chemical composition and certain physical properties.

## WHERE IS ASBESTOS USED AND WHY?

Asbestos has served mankind for over 100 years in a broad variety of applica- (6) tions.* The general areas in which asbestos is used in the United States are shown in ~~Table III.~~ Based on information from asbestos producers and consumption surveys, it is estimated that the plastics industry uses about 1/3 of the 800,000 tons consumed annually, which makes it the largest single user of asbestos fiber.

(7) * The largest uses of asbestos by the plastics industry are in vinyl/asbestos floor tile and in phenolic molding compounds. It is also used in other plastics as shown in Slide 3. Important functions of asbestos* in plastics are reinforcement, (8) dimensional stability, heat resistance, flow control and general-purpose filling. Most of the functions are supplied by short fiber chrysotile asbestos fiber, although longer chrysotile fibers and other asbestos varieties are sometimes required for particular properties.


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WHY USE CHRYSOTILE?

(9) Among the several advantages of chrysotile, which set it apart from the amphibole minerals and account for its widespread and increasing usage, are world wide availability, mechanical strength, flexibility, positive surface charge, low iron content, softness and low refractive index. It is conservatively estimated that chrysotile asbestos is used in over 3,000 applications and in most of these applications it is an essential ingredient for which no replacement is readily available.

(10) The information in Slide 10 shows that the use of chrysotile asbestos and its share of the total market are steadily increasing. There is increasing evidence that crocidolite and amosite are more hazardous to human health than chrysotile. Since 1970 the use of crocidolite in Britain has been restricted after a panel of experts "concluded there was sufficient evidence to suggest (10a) other types of fibre should be substituted for crocidolite wherever possible."

WHAT IS THE ASBESTOS HAZARD?

(11) It is readily accepted that asbestos, like many other foreign bodies, can cause disabling lung damage (~~pulmonary fibrosis~~), commonly referred to as asbestosis. This disease and bronchogenic carcinoma (lung cancer) are the two most common asbestos-related diseases. It is important to note that, based on epidemiological data, these diseases have occurred primarily in workers with high, long-term exposures to asbestos dust. It is of further interest that one noted researcher has reported that neither of these diseases is peculiarly related to or caused solely by the inhalation of asbestos fiber (3). Another important consideration is the relation between cigarette smoking and lung cancer as reported by Dr. E. C. Hammond and Dr. I. J. Selikoff (4). In this study they reported that:

> "It seems clear, then, that lung cancer is uncommon among asbestos insulation workers who have no history of cigarette smoking and that if the risk is increased, such increase is not great."

A third disease, mesothelioma, has more recently been associated with persons exposed to asbestos. Mesothelioma is an extremely rare cancer of the lining of the chest (pleura) or the abdominal cavity (peritoneum). Most researchers concur that there is an association between mesothelioma and crocidolite, but not necessarily with chrysotile.

(12) The 33 member Advisory Committee on Asbestos Cancers of the International Agency for Research on Cancer (a division of the World Health Organization) has concluded that there is at present no evidence of mesothelioma or lung damage by

asbestos to the general public; and such evidence as there is does not indicate any risk of cancer resulting from asbestos fibers present in water, beverages, food or in the fluids used for the administration of drugs.

While there seems to be general agreement that the public is not in any present danger from asbestos, it is also recognized that excessive, long-term occupational exposure can cause serious health problems. During the past two years, significant legislation has been enacted by the Federal Government to reduce and control occupational exposure to asbestos fibers and to minimize fiber emissions to the environment. The most important regulations are those issued by OSHA.

(13) The Williams-Steiger Occupational Safety and Health Act of 1970 established the Occupational Safety and Health Administration (OSHA) within the Department of Labor, which has responsibility for administration and enforcement. Research and related functions are handled by the Department of Health, Education and Welfare (HEW) through the National Institute of Occupational Safety and Health (NIOSH). Five million employers and 60 million of the nation's 80 million workers are covered by OSHA. In a news release issued January 4, 1972, OSHA announced a (14) Target Health Hazards Program aimed at improving health factors associated with working conditions. The following five substances were designated to be the focus of initial and concerted efforts by OSHA and NIOSH: Asbestos, Cotton Dust, Silica, Lead and Carbon Monxide.

(15) The new Standard for Exposure to Asbestos Dust was published in the Federal Register, Volume 37, No. 110 on Wednesday, June 7, 1972. The basic exposure standard is an 8-hour time-weighted average (TWA) of 5 fibers, longer than 5 micrometers, per cubic centimeter of air. The TWA limit is to be reduced to 2 fibers per cubic centimeter on July 1, 1976. A peak concentration of 10 fibers per cubic centimeter is not to be exceeded at any time. The first basic requirement of the new standard is monitoring to determine whether or not fiber concentrations are in excess of the exposure limits and that monitoring be repeated as necessary to ensure that employees are not exposed to levels in excess of the exposure limits.

(16) If exposure limits are not exceeded, there are no further compliance requirements except for medical examinations. Medical examinations are required for all employees in any occupation exposed to airborne concentrations of asbestos fibers. The examinations are relatively simple and should cost no more than $50 per year, per employee.

(17) Respirators and special clothing are required in the construction trade for the spray application of insulation and fireproofing materials, and for the removal of such materials. This special protection is not required for any other



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ACL Doc 16733 · Page 18 of 27 asbestosclaims.law/library/16733/18

use of asbestos unless exposure limits are exceeded. This is also true for other items such as specially-equipped tools, change rooms, clothes laundering and waste disposal. Caution labels are required on products containing asbestos except where the fibers have been modified by a bonding agent or other material to prevent dusting during any normal subsequent use or handling. The labeling of a product does not prohibit its use. It should be noted here that in at least 90% of the products containing asbestos, the fibers are solidly locked into the product thereby presenting little danger of dust generation during normal use and handling of the product (6).

## WHAT IS INDUSTRY DOING?

The Asbestos Information Association/North America reports that, during the past 30 years, the asbestos industry has spent millions of dollars to improve mining, milling, and manufacturing methods (8). The establishment of safer working conditions has been a prime target and this work continues unabated and in close association with government agencies and independent medical researchers (9). The ultimate goals of the asbestos industry are:

---- Reduction of work-area dust to minimum levels.

---- Protection of workers from asbestos-related diseases.

---- Maintenance of environmental emissions at levels low enough to preclude public endangerment.

## AIR SAMPLING

In order to comply with OSHA Standards and to determine the need for dust control measures, air monitoring should be conducted in areas where asbestos is regularly handled or used. The equipment for collecting air samples costs less than $400 and is readily available. A phase contrast microscope can be obtained for as little as $600 or an existing microscope can be modified for "counting" the asbestos fibers in compliance with NIOSH criteria (11).

Air samples have been collected and analyzed on a regular basis by the asbestos industry for years. Except for a few applications where dust control is an engineering problem, industry is finding that dust levels are usually within acceptable standards or that minimum changes are necessary to achieve compliance. The summary in Slide 20 is typical of our measurements of dust levels during asbestos handling in various types of plants and operations. The dust levels reported are Ceiling Concentrations and it should be noted that the allowable OSHA level is 10 fibers/cc. Most of the data were collected before the installation of any special dust control measures. Typical microscope views of dust. Monitoring often



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ACL Doc 16733 · Page 19 of 27 asbestosclaims.law/library/16733/19

shows that obviously dusty conditions are caused by materials other than asbestos. This does not preclude the need for controls but it could change their scope and facilitate compliance with government regulations. Because of "bad press", asbestos is frequently ordered out of use without regard to whether or not a hazard actually exists due to air contamination. If acceptable dust levels are feasible, there is no need to replace asbestos at the expense of product quality or ecomomic penalty. Before asbestos is replaced, it should be certain that a safer alternative is available (52).

DUST CONTROL MEASURES

Asbestos producers and users are spending a considerable amount of time and money on various dust control measures. Conventional means to achieve minumum dust levels include: filtered ventilation systems on process equipment, local ventilation for saws and similar tools, conversion to a "wetted" operation, leak-proof packaging, vacuum clean-up, more care in bag disposal and other asbestos waste handling, and automatic bag openers. Unusual innovations include: pelletized asbestos, special packaging, and treated products.

*Only short-fiber chrysotile is available as pellets, but this product serves a fair portion of the asbestos market. Pellets not only reduce dust during conventional handling but they are also available in bulk hopper cars and can be transferred and used in totally enclosed systems. Barring leaks in the system, dust in work areas is virtually eliminated. Used in bulk, asbestos pellets also reduce shipping costs, eliminate warehouse storage and handling, facilitate automatic reduce clean-up, and eliminate bag handling and disposal. The pellets contain no binder and are friable enough to be dispersed in dry form or in aqueous or resinous systems with conventional high-shear grinding equipment (13).


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In concluding this section of my presentation on asbestos and health, I want to remind you that asbestos is a potential hazard if used without adequate precautions. But this is also tru of almost all the materials you use.

Slide 23

Assuming that you do not have a closed mind about using asbestos, I will now present the "commerical message" portion of my talk.

In 1957 Union Carbide discovered an asbestos deposit in central California (slide 24) which is now thought to be the free world's largest single mineral deposit. Without going into any detail I would like to note that this is a very unique deposit:

1. It is all chrysotile
2. It is all short fiber
3. The fibers are random-oriented
4. The fiber content is over 50%
5. It lends itself to conventional strip mining

Because the conventional markets for short fiber asbestos are limited and because of the readily available supply from Canada, Union Carbide decided that specialty products were the only way to capitalize on the unique ore deposit. A proprietary process (slide 26) utilizing hydraulic benefication techniques was developed and a semi-works plant was onstream in 1963. All of the Calidria products currently available have the following important characteristics, many of which are not typical of any other chrysotile asbestos:

IMPORTANT CHARACTERISTICS OF CALIDRIA FIBER

HIGH SURFACE AREA, 60-80 $m^2/gm$

HIGH TENSILE STRENGTH, UP TO 800,000 psi

CATIONIC SURFACE CHARGE

COLLOIDAL FORM, AVERAGE L/D OF 200

EXTREMELY HIGH PURITY, 90-99% FIBER

ESSENTIALLY INERT

HIGH TEMPERATURE STABILITY-TO ABOUT 700°C

LOW REFRACTIVE INDEX, 1.51 - 1.55

8) * We now have a diverse range (slide 28) of products used in many applications, some conventional but most of them not.

Today I will only discuss two of our products and one of them is not shown here. If you have any interest in our product line or want samples or more information about our products or the health question, please complete one of the reply cards and return it to me or mail it in.

RG-600 is the product not shown as it has only recently been introduced and is not yet available in production quantities. We do, however, have small tonnage quantities availabe for large-scale evaluation and expect to have our production facility in operation early next year.


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(P)

RG-600 is A surface-treated, high-purity colloidal asbestos that effectively reinforces thermoplastics and offers unique property combinations. ~~has been introduced by Union Carbide's Mining and Metals Division.~~ In contrast to fiberglass, ~~the next grade of asbestos~~ RG-600 gives excellent molded and extruded surfaces, promotes superior hot-water resistance, and allows extensive reprocessing without fiber breakage.

~~Called "Calidria" asbestos RG-600, this~~ highly liberated Calidria asbestos is surface-treated with a proprietary coupling agent. As a result, the colloidal fibrils disperse quickly and uniformly in thermoplastic resins.

(29) * The establishment of true interfacial activity of the coupling agent is presented in ~~Table I~~ Slide 29 It is seen that the additive ~~in and of~~ itself does not improve the tensile strength or heat distortion temperature (HDT) of either HDPE or PP resins. However, in combination with chrysotile fibers (RG 600), improvements in tensile strengths of 58% and 27% in HDPE and PP resins respectively are achieved over unmodified chrysotile. These improvements, in addition to improvements in HDT of 52% and 63% found in the reinforced HDPE and PP composites, were obtained at the relatively low filler level of 20% by weight./

(30) * "Calidria" asbestos RG-600 improves the properties of a wide range of thermoplastics, including polyolefins, styrenics, vinyls, thermoplastic polyesters, and nylons. Slide 30 In polypropylene, for example, 30% RG-600 increased the tensile strength from 4,500 to 7,300 psi and the flexural strenoth from 6.780 to 12,900 psi. At the same time, the heat-distortion temperature was increased from 58 to 123 degrees C.

(31) * As a reinforcement, "Calidria" asbestos RG-600 allows low-cost upgrading of thermoplastic properties to meet stringent application requirements. For example, as shown in Slide 31, it is possible to reinforce high-density polyethylene so that overall properties match or exceed those of high-impact polystyrene. RG-600 reinforced high-density polyethylene is actually superior to high-impact polystyrene in dimensional stability at elevated temperatures and in resistance to solvents such as oil and gasoline. ~~(See Figure 2 for pictures on dimensional stability.)~~

(32) * Although strength properties of thermoplastics reinforced with fiberglass deteriorate in water, polyolefins reinforced with RG-600 actually show improved properties. Strength, stiffness, and heat-distortion temperature improve after extended immersion in boiling water.

In comparison to reinforcing with untreated chrysotile asbestos, RG-600 reinforced polypropylene and polyvinyl chloride have markedly superior heat-aging characteristics and processing stability. For example, RG-600/polypropylene composites containing normal amounts of antioxidants have excellent heat-aging characteristics. The coupling agent on "Calidria" asbestos RG-600 overcomes the rapid oxidative degredation at elevated temperatures found in untreated asbestos-polypropylene compounds. Similarly, the processing stability of polyvinyl chloride containing RG-600 is markedly superior to compounds made with conventional asbestos.

RG-600

(33) * A special feature of "Calidria" ~~asbestos~~ is its availability as dust-free pellets. These pellets can be handled in bulk with minimum dust. The pellets are also ideally suited for operations using automatic feed equipment. They flow quickly and smoothly through the equipment while generating very little dust. ~~Producers using Banbury mixers will find that the high bulk density of~~ the ~~pellets permits optimum loadings~~.

Conventional mixing equipment can break up the pellets so that the pre-treated fibers disperse quickly and uniformly in thermoplastics. "Calidria" asbestos RG-600 also allows longer mold, screw, and die life than fiberglass. ~~The product has a minimum of magnetite and rock particles that can wear processing equipment. In addition,~~ since the fibers ~~themselves~~ are non-abrasive.

~~In contrast to fiberglass,~~ "~~Calidria" asbestos~~ RG-600 fibers do not fracture during compounding, extrusion, and molding. ~~Thus~~, thermoplastic scrap ~~containing this fiber~~ can be reprocessed without sacrificing properties. RG-600 reinforced thermoplastics also have smooth extruded and molded surfaces without any visible fiber patterns.


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The other Calidria product I want to mention is RG-244, a premium grade thixotrope introduced several years ago as a replacement for pyrogenic silica. Due to worlwide acceptance of RG-244, and in spite of the adverse asbestos publicity, we are currently completing a million-dollar expansion of our facility which will double our production capacity.

RG-244 is also a surface modified fiber originally developed to provide maximum thickening efficiency and thixotropy in polyester spray and hand lay-up laminating resins. The surface modification involves the deposition of a silica coating on the fibers. Slide 35 illustrates the thickening efficiency of RG-244 in a typical general purpose polyester resin system. The performance characteristics of pyrogenic silica are also shown at comparable levels of addition. ~~The thixotropic effect which~~ RG-244 also imparts to the resin ~~is depicted in figure~~. At the higher levels of shear, as in a spraying operation, ~~you will note that~~ there is a marked drop ~~off~~ in viscosity with RG-244 contained resin. ~~Whereas,~~ under static conditions the resin exhibits extremely high viscosity. This characteristic of RG-244 to induce rapid viscosity recovery facilitates anti-sag and the maintenance of a smooth uniform coating in spray applications.

In most systems RG-244 does not contribute to color or opacity. Optimum efficiency, stability, and lowest cost are obtained through the use of sonic dispersers, Cowles or similar high energy mixers. However, RG-244 can be incorporated, especially at low viscosities, with low shear propeller type stirers.

RG-244 exhibits a minimum of dusting and ~~incorporates readily with con-~~ mixes out rapidly. ~~ventional mixing equipment.~~ ~~RG-244 contained~~ with RG-244 polyesters, exhibit excellent viscosity, thixotropic and anti-settling stability over long term aging. Clarity of the resin suspension ~~benefit in application by enabling the operator to visually inspect~~ facilitates visual inspection for air entrapment in the glass-mat. This reduces both production time and resin requirement. Unlike some thixotropes, the thixotropy of RG-244 suspensions is relatively unaffected by the addition of styrene after incorporation of the thixotrope. This allows for more versatility in both production and end use application.

In addition to improved technical aspects, there are significant economic advantages ~~by~~ from the use of RG-244. The amount required is ~~usually~~ less than that of most typical thixotropes to achieve comparable viscosity and thixotropic properties, and the price is lower.

(36) * We have also found RG-244, since its introduction, to be a very effective thickener in vinyl resin sealants, organosols and plastisols. It is currently being used in a wide variety of adhesives, coatings, mastics and sealants.

In closing let me ~~report~~ repeat that chrysotile asbestos is an important and necessary raw material and that it can be used safely and in compliance with government regulations. Its general use will not be prohibited. I appreciate the opportunity to tell you this and to discuss two of our Calidria products for the plastic industry. Now, I have lots of answers provided that you ask the right questions.