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NAIMA
NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

# The Facts on Rock and Slag Wool

## Information from NAIMA

**Other fact sheets are available from NAIMA concerning the health aspects of man-made vitreous fibers.**

PUB# N 020

The mineral wool form of man-made vitreous fiber (MMVF) was initially developed in the late 1800's by melting rock and spinning it into insulation for use in homes and industry. Over the past century, mineral wool manufacturing has evolved into a large and diversified industry as more and more products containing this useful material have been developed.

The term "mineral wool" actually encompasses two materials similar in chemical and physical properties — rock wool and slag wool — that use different raw materials in their manufacture. Rock wool is made from natural rocks like basalt or diabase. Slag wool is made primarily from iron ore blast furnace slag.

As with any product capable of producing airborne dust, concerns regarding the health and safety effects of rock and slag wool are understandable. However, few materials have been studied as extensively as mineral wool and still found to be safe when handled appropriately. Additional information on this subject is provided in this brochure.

### Properties of Rock and Slag Wools

Rock and slag wool fall within a group of man-made materials historically referred to as man-made mineral fibers, but more accurately called man-made vitreous fibers (MMVF's). Vitreous means the substance is glassy and non-crystalline.

Rock and slag wool are extremely useful. They are non-combustible and will not rot or absorb moisture or odors. They also will not support the growth of mildew, mold, or bacteria. Rock and slag wool fibers are dimensionally stable and have high tensile strength.

In addition to providing insulation, rock and slag wools absorb sound and, with a vapor retarder, help control condensation.

### Major Applications of Rock and Slag Wool

The physical and chemical properties of rock and slag wool are major factors in their utility. Because the fibers are non-combustible and have melting temperatures in excess of 2,000°F, they are used to prevent the spread of fire. As a primary constituent of ceiling tile, rock and slag wools supply fire protection, as well as sound control and attenuation.

The excellent thermal resistance of these wools is a major factor in their use as residential and commercial insulation, pipe and process insulation, insulation for ships, mobile homes, domestic cooking appliances, and a wide variety of other applications. In addition, the use of rock and slag wool as a horticultural growing medium has increased in recent years.

### Benefits of Rock and Slag Wool Insulation

Rock and slag wool insulations play a significant energy-saving role in the United States and other nations by minimizing energy use, thereby helping to reduce heating and cooling costs. These insulation materials help protect the environment and conserve scarce resources by reducing the amount of fossil fuels consumed or other non-renewable materials.

### Manufacturing Rock and Slag Wool Insulation

Rock and slag wool insulations are produced by a centrifugal wheel process. Natural rocks or iron ore blast furnace slag are melted and the hot, viscous material is spun into fiber by pouring a stream of molten material onto one or several rapidly spinning wheels. As droplets of the melt are thrown from the wheel(s), fibers are generated. As the material fiberizes, its surface is generally coated with a binder and/or de-dusting agent (e.g., mineral oil). The fiber is then collected and formed into batts or blankets for use as insu-

lation, or baled for use in other products, such as acoustical ceiling tiles and panels for sound-control applications.

Due to the nature of the manufacturing process, individual rock or slag wool fibers vary in their thickness or diameter. Typically, individual fibers range between 1 and 15 microns in diameter with an average diameter of 3 to 7 microns. (A micron is 1/1,000,000 of a meter or 1/25,400 of an inch.) By comparison, a human hair is about 70 microns in diameter.

When viewed under a microscope, rock and slag wool fibers resemble single rods. If these fibers break, they break across their long axis, resulting in shorter fibers of the same diameter. They do not split lengthwise into smaller diameter fibers.

## Industry Recommended Work Practices

Rock and slag wool fibers may temporarily irritate the skin, eyes and respiratory tract. Accordingly, manufacturers recommend work practices to assure the comfort and safety of persons who handle or install rock and slag wool or finished products.

Among the recommended work practices of NAIMA member companies are:

- *Use respirators when appropriate.* Consult individual manufacturers for specific recommendations on the type and use of respirators. It is important that respirators be used properly. In industrial situations, an appropriate training and fit-testing program must be incorporated into a respiratory-protection program.
- *Wear loose clothing.* Wear long-sleeved shirts that are loose at the neck and wrists, along with caps and long pants, to help protect sensitive skin areas from coming into contact with rock and slag fibers. Loose clothing helps prevent the fibers from rubbing against the skin. Depending upon the job conditions, gloves may also be necessary.
- *Protect your eyes.* Wear safety glasses with side shields, or goggles, or a face shield whenever handling or using rock and slag wool materials.
- *Don't rub or scratch your eyes.* If rock and slag particles and fibers accumulate on exposed skin, don't rub or scratch that area. Remove the particles by washing your skin thoroughly, but gently, with warm water and mild soap. Using a skin cream or lotion after washing may also help.
- *Wash your work clothing separately.* Wash clothing that has been worn while handling or using rock and slag wool separately from other household laundry. This will prevent fibers from being transferred to other clothes. Rinse your washing machine thoroughly before using it again. If there are many fibers on clothes, it is best to presoak and rinse the garments prior to washing.
- *Keep your work area clean.* Avoid unnecessary handling of scrap rock and slag wool materials by keeping waste-disposal equipment as close to the work area as possible. Don't let scrap material or debris pile up on the floor or other areas. Do not use a compressed air line to clean the work area — it generates airborne dust and stirs fibers. Use a filtered vacuum or wet sweeping technique. Follow an organized housekeeping program at all times.
- *Prevent airborne dust.* Dust collection systems should be used whenever rock and slag wool exposures may exceed recommended levels. In particular, workers engaged in operations such as sawing, machining and/or blowing rock and slag wool have a greater potential for high fiber exposures.

Rock and slag wools are safe to manufacture, install, and use when recommended work practices are followed. Consult your NAIMA member company's Material Safety Data Sheet (MSDS) and other company literature for appropriate recommendations.

The U.S. Occupational Safety and Health Administration (OSHA) is currently reviewing rock and slag wool to establish a workplace Permissible Exposure Limit (PEL). NAIMA is working with OSHA to examine all health related research in mineral wool. NAIMA has recommended that OSHA adopt a 1 fiber per cubic centimeter (1 f/cc) PEL. This recommendation is based on prudence and not significant risk.

## Skin and Eye Irritation

Rock and slag wool fibers may irritate the skin of some workers in manufacturing plants as well as some people working with or using materials containing these fibers. This irritation is a reaction of the skin to the ends of these fibers that have rubbed against or become embedded in the skin's outer layer. Generally, the thicker the fiber, the more likely it is to cause skin irritation.

Skin irritation is a temporary condition that can be relieved by washing the exposed area gently with warm water and mild soap. The vast majority of workers can control the irritation by following recommended work practices.

Irritation of the eyes is not common. However, rock and slag wool may be deposited in the eye by workers' fingers or through fibers in the air. If this should happen, do not rub the eyes. Flush them with warm water and consult a doctor if irritation persists.

## Upper Respiratory Irritation

If recommended work practices, as described above and detailed in each company's MSDS and other literature, are not followed, some workers may experience temporary upper respiratory irritation if large amounts of airborne rock or slag wool fibers are released into the air during fabrication or handling.

Like skin irritation, upper respiratory irritation is a temporary reaction to the fibers, not an allergic reaction, and the irritation should not persist.

Exposures to high airborne concentrations of rock and slag wool fibers may also result in temporary coughing or wheezing. These effects will subside soon after the worker is removed from exposure and should have no further impact on health and well being.

Careful attention to good housekeeping and recommended work practices, including the use of approved respiratory protection when necessary, can effectively control exposure to concentrations of airborne fibers and upper respiratory irritation.

NAIMA
NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

# Health and Safety Research on Rock and Slag Wool

## Information from NAIMA

**Other fact sheets are available from NAIMA concerning the health aspects of man-made vitreous fibers.**

PUB# N 021

### Introduction

The mineral wool form of man-made vitreous fibers (MMVF) was developed in the late 1800's by melting slag and spinning it into insulation for use in homes and industry. Mineral wool insulation today is an important energy-saver and helps protect the environment by reducing the need to burn fossil fuels.

The health effects and safe use of rock and slag wool have been examined for many years. Numerous studies have found no consistent evidence of any association between exposure to these fibers and any disease. This pamphlet provides an overview of these studies.

### Uses of Rock and Slag Wools

Rock and slag mineral wool fall within a group of man-made materials historically referred to as man-made mineral fibers (MMMF's), but more accurately called man-made vitreous fibers (MMVF's). (Vitreous means the substance is glassy and non-crystalline.) While similar in both chemical and physical properties, rock and slag wool are made from different raw materials; rock wool is made from natural rocks like basalt or diabase; slag wool from iron ore blast furnace slag.

Rock and slag wool have many extremely useful characteristics. They will not burn, rot, or absorb moisture or odors. They do not support the growth of mildew, mold or bacteria. Rock and slag wool fibers are dimensionally stable and have high tensile strength. In addition to insulating, rock and slag wool absorb sound and, with a vapor barrier, help control condensation. Because the fibers are non-combustible and have melting temperatures in excess of 2,000°F, they are frequently used to prevent the spread of fire.

Many uses have been discovered for slag and rock wool: primarily for commercial and industrial insulation and in acoustical ceiling tiles, but also as a horticultural growing medium. The excellent thermal resistance of rock and slag wools is a major factor in their use in residential and commercial insulation, pipe and process insulation, insulation for ships, domestic cooking appliances, and a wide variety of other applications.

### The Mineral Wool Industry's Dedication to Research

Few products have been studied to the extent of rock and slag wool. Manufacturer funding of health and safety research spans decades, at leading laboratories and universities in the United States and abroad. Studies have examined workers employed in the industry, animals exposed to mineral wool, and levels of airborne fibers encountered in manufacture, installation and use.

The human studies have not found any dose-response relationship between lung cancer or other respiratory disease and exposure to rock or slag wool. Animal inhalation studies with massive exposures to rock or slag fibers, and animal injection studies with commercial fibers, have also been negative. The animal experiments also show that inhaled rock or slag wool fibers dissolve and fragment and are thus cleared rapidly from the lung. Scientists consider this rapid dissolution advantageous in preventing adverse health effects (EEC 1990).

At the same time, human studies have reported some lung cancer excesses among mineral wool manufacturing workers; and, in a few studies where experimental, noncommercial rock wool fibers were injected into animal lungs, tumors developed. These results have prompted some concerns that rock and slag wools could, under certain conditions, be associated with cancer.

The rock and slag wool studies have been evaluated by the

International Agency for Research on Cancer (IARC), an arm of the World Health Organization (WHO); the International Labour Organization (ILO); the International Programme on Chemical Safety (IPCS), a joint effort of the ILO, WHO and United Nations (UN) Environmental Programme; and various U.S. government health agencies, including the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA). Each, although expressing concern about health effects at the high exposures of the past, has reached conclusions consistent with manufacturer findings that modern uses of mineral wool are safe.

Rock and slag wool fibers are regulated by OSHA as a "particulate not otherwise regulated" with an 8-hour time-weighted average (TWA) of 15 mg/m3 for total dust and 5 mg/m3 for the respirable fraction. Both manufacturers and labor unions (AFL-CIO 1991) have recommended to OSHA that a new 1 fiber per cubic centimeter (1 f/cc) Permissible Exposure Limit (PEL) be adopted in a planned comprehensive OSHA update of exposure limits for construction and other industries.

Manufacturers of rock and slag wool products control exposures in their own plants and recommend prudent work practices for installation activities to maintain exposures below 1 f/cc (IPCS 1989; ILO 1989). These practices are described in Material Safety Data Sheets (MSDS's) supplied by manufacturers. The MSDS's from suppliers should be consulted for current and specific product safety and health information.

## Occupational Exposure to Rock and Slag Wool Fibers

Rock and slag wool fibers can become airborne during manufacture or installation. Numerous industrial hygiene surveys have determined airborne concentrations during such activities.

Several thousand occupational exposure samples have been taken over the past five years in more than thirty manufacturing and fabricating plants in North America and Europe. Average airborne concentrations have been found to be typically less than 0.4 f/cc (NAIMA 1990).

Recent monitoring of rock and slag wool product installations at 34 locations found a mean concentration of 0.2 f/cc (NAIMA 1990). Other studies have shown that some field installations in enclosed or confined spaces (such as blowing wool in attics) can generate higher exposure levels (IPCS 1989; ILO 1989). These data have led manufacturers to recommend respiratory protection or careful work practices and engineering controls to reduce exposures.

## Indoor Air Exposure to Rock and Slag Wool Fibers

Once rock or slag wool products are installed, no significant fiber release occurs. The majority of airborne fiber levels in buildings containing one or more rock or slag wool fiber products are in the non-detectable range, generally less than 0.01 f/cc. The ILO/WHO/UN International Programme on Chemical Safety (1988) report found that at such low levels "the possible risk for the general population of lung cancer is very low, if there is any at all, and should not be a cause for any concern ..."

## Health and Safety Studies

Mineral wool health and safety effects have been studied through surveillance of workers, through animal experiments, and through studies of the fate of fibers in the body. Each type of study has contributed to the consensus that these products can be manufactured and used safely.

### Human Morbidity Studies

Morbidity studies look for unusual or unexpected patterns of disease in a living study population. Both U.S. and European mineral wool worker studies have found no adverse health effects.

An on-going study of workers in slag wool plants by Dr. Hans Weill of Tulane University, found, when first reported (Weill 1984) that the "prevalences of respiratory symptoms ... are not increased" and there was "no coherent pattern of symptoms in relation to exposure..." The recent update of this study (Weill 1990) again found no lung abnormalities that could be attributed to slag wool fiber exposure. Evaluations of chest X-rays and lung function tests indicated a generally healthy population; any observed abnormalities were found to be related, as expected, to smoking habits.

Results from two European studies of rock wool workers are consistent with Dr. Weill's findings. Skuric and Stahuljak-Beritic (1984) observed no excess change in measured indices of lung function that could be associated with worker exposure to rock wool fibers for at least five years. Malmberg (1984) similarly observed no abnormalities in lung function and found normal chest X-rays among workers with more than ten years experience in rock wool production.

### Human Mortality Studies

Mortality studies look at patterns of death. Two major decade-long, on-going cohort mortality studies of rock and slag wool workers, one in the U.S. and one in Europe, have found no dose-response relationship between cancer, or other pulmonary disease, and exposure to wool fibers. A more recent U.S. case-control study of nearly 5,000 workers at nine plants found no association between slag wool and lung cancer.

The most recent update of the U.S. mortality study (Marsh 1990), like the earlier report (Enterline 1987), found no increased incidence of mesothelioma (a rare cancer of the lung or stomach linings associated with asbestos exposure) among 1,846 production workers at U.S. mineral wool plants. The study found a small, statistically significant increase in lung cancer for mineral wool workers. This increase was not associated with fiber levels, duration of employment, or other measures of exposure-response relationships — as would be expected if wool fibers were a cause of lung cancer. As the AFL-CIO (1991) noted: "[C]lear and consistent dose-response relationships are lacking, which are critical to supporting a causal relationship."

The European mortality study (Simonato 1987) of seven

rock/slag wool plants also found no increased mesothelioma or deaths due to nonmalignant respiratory disease. The study reported an excess of lung cancer among rock and slag wool workers employed during an early technological phase before the introduction of dust suppressing agents. During the modern period, however, the lung cancer rates for rock and slag wool workers (even among workers exposed more than 20 years ago) were lower than the general population.

The absence of any evidence of increased mesotheliomas in both large studies has been noted in both the IARC (1988) and IPCS (1988) reviews. Attention has thus been focused on the lung cancer findings. Worker exposures to asbestos fibers and other possible carcinogens, including arsenic, formaldehyde, phenol, and polycyclic aromatic hydrocarbons, and worker smoking habits, are the most plausible explanations for the small excesses in lung cancer observed in the study populations. The likelihood of an asbestos effect is strengthened by a recently published report by McDonald (1990) that found no slag wool fibers in lung tissues obtained from eleven deceased workers who were members of the U.S. study population, while four of six workers had significant amosite asbestos fibers in their lungs. Summing up the U.S. study, its author (Enterline 1990) noted that there "are no excesses in rock wool plants" and that "[p]robably, however, fibers do not play the major part in the excess of cancer among slag wool workers."

In addition, the increase in lung cancers in the European study population was entirely among workers with less than five years employment in MMVF production. This short-term worker factor parallels what was observed in the U.S. study. A recent review by a team of independent British, Australian and American experts (Brown 1991) noted: "These [short-term worker] findings are the reverse of what would be expected if the fibers were causing lung cancer."

A recently completed case-control study of U.S. workers (Wong 1991) compared rock/slag wool exposures among workers who had died of lung cancer to workers in the same plants who had died of other causes. The study found no association between lung cancer and exposure to fibers. Neither duration of, nor cumulative exposure to, mineral wool fibers was associated with lung cancer. As the authors reported: "Consistently, no relation was detected in any of these analyses." By contrast, all lung cancer cases were found in smokers; and there was a clear dose-response relationship between amount of smoking and lung cancer.

Updates of the U.S. and European mortality studies are anticipated in 1993. Each will include case-control studies to further explore worker exposures to asbestos fibers, arsenic and other carcinogens, worker smoking habits, and the short-term worker effect.

### Animal Studies

Animal studies support the results from the human morbidity and mortality studies.

Inhalation studies are the preferred method for assessing fiber carcinogenicity as they simulate the route of exposure experienced by humans (IPCS 1988). Several lifetime inhalation studies of laboratory animals exposed to high levels of rock or slag wool fibers have found no significant malignant or nonmalignant respiratory disease (Wagner 1984; Le Bouffant 1987; Smith 1987). As IPCS (1988) and EPA (1988), respectively, concluded: "In the majority of the inhalation studies conducted to date, there has been little or no evidence of fibrosis of the lungs;" and "long-term studies have not provided evidence of pulmonary or mesothelial carcinogenicity in rats or hamsters exposed to mineral wool fibers by inhalation."

Manufacturers initiated additional inhalation experiments in 1990, in Geneva, Switzerland, exposing rats to concentrations many hundreds of times greater than those found in the workplace. The experiments also will look at deposition, dissolution and clearance of fibers from the animals' lungs. The studies are scheduled to be completed in 1993.

Researchers have also surgically implanted mineral wool fibers into the pleura (chest), abdominal cavities, and tracheae of animals. Such methods do not simulate human exposure conditions, by-pass normal animal defense systems, and are generally considered of limited value to assessing human risk. Implantation or injection studies of commercial slag and rock wool did not produce significant tumors (Wagner 1984; Stanton 1977; Pott 1987). Positive results were obtained in three injection or implantation studies with non-commercial, experimental rock wool fibers that may have been coated with amines that could have been converted to carcinogenic nitrosamines within the animals (Pott 1987). EPA (1988) noted: "Caution must be exercised in extrapolating" these findings to humans as "the results from such studies may not be predictive of inhalation hazard."

## International Reviews of Rock and Slag Wools

The International Agency for Research on Cancer (IARC) classified rock and slag wool fibers in 1988 as "possibly" carcinogenic to humans — a category into which IARC has also placed saccharin, styrene, gasoline engine exhaust, and over 150 other substances. IARC found "limited" human evidence and "limited" (for rock wool) and "inadequate" (for slag wool) animal evidence of carcinogenicity. IARC has two more severe rating categories, "probable human carcinogen" and "known human carcinogen." IARC evaluations are not workplace risk assessments but are intended to assist health authorities and corporations in formulating decisions regarding regulatory or preventive measures. IARC's actions have led most manufacturers to use warning labels and/or Material Safety Data Sheets (MSDS's) to inform product users that mineral wool has been classified as a "possible" cancer hazard and to identify measures for safe product handling and installation.

The United Nations Environmental Programme, the International Labour Organization

(ILO), and the World Health Organization (WHO) also evaluated rock and slag wool in recent years. Each found these materials can be used safely.

The ILO (1989) concluded: "Available [human and animal] data on disease incidence and mortality in populations exposed to respirable fiber concentrations in the manufacture and use of insulation wools (rock, slag and glass) indicate that with the adoption of appropriate control and preventive measures ... any risks associated with production and use of the insulation wools should be minimal."

The WHO/ILO/UN report (1988) similarly concluded that, because "airborne MMMF fibre concentrations present in workplaces with modern control technology are low," the lung cancer risk would not be expected to be elevated and exposures in buildings with in-place rock and slag wool products "should not be a cause for concern."

## Conclusion

More than 50 years of research and evaluation have found no consistent evidence that exposure to rock or slag wool fibers is associated with disease. Rock and slag wool fibers are safe to manufacture, install and use when recommended work practices are followed.

## For More Information

For the latest update on medical and scientific information on rock and slag wool, call or write:

**NAIMA**
**44 Canal Center Plaza**
**Suite 310**
**Alexandria, VA 22314**
**TEL 703/684-0084**

In addition, contact any manufacturer of rock and slag wool to obtain Material Safety Data Sheets for specific and current health and safety information.

**NAIMA MEMBER COMPANIES INCLUDE:**

Celotex Corporation
*Tampa, Florida*

CertainTeed Corporation
*Valley Forge, Pennsylvania*

Knauf Fiberglass
*Shelbyville, Indiana*

Owens-Corning Fiberglas Corporation
*Toledo, Ohio*

Partek Insulations, Incorporated
*Peachtree City, Georgia*

Rock Wool Manufacturing Company
*Leeds, Alabama*

Roxul Incorporated
*Milton, Ontario*

Schuller International, Incorporated (a subsidiary of Manville Corporation)
*Denver, Colorado*

USG Interiors
*Chicago, Illinois*

U. S. Mineral Products Company
*Netcong, New Jersey*

Western Fiberglass Incorporated
*Salt Lake City, Utah*

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NAIMA is a trade association of North American manufacturers of fiber glass, rock wool, and slag wool insulation products. NAIMA's role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation products and to encourage safe production and use of insulation products.

## Product Labeling

The International Agency for Research on Cancer (IARC), part of the World Health Organization, periodically evaluates the potential health effects of the many substances to which humans are exposed. IARC classifies substances as "known," "probably," "possibly," "not classifiable" or "probably not" carcinogenic. These evaluations are not workplace risk assessments but are intended to assist health authorities and corporations in formulating decisions regarding regulatory or preventive measures.

Saccharin, styrene, gasoline engine exhaust, and over 150 other substances, as well as mineral wool, are currently classified as possible carcinogens. IARC's actions have led to the use of warning labels and/or Material Safety Data Sheets (MSDS) to inform product users that mineral wool has been so classified and to identify measures for safe product handling and installation.

The U. S. Occupational Safety and Health Administration (OSHA) through its Hazard Communication Standard or "HAZCOM" regulation, requires that employers have health and safety information available, including labels that warn of possible health effects, for all materials used in their workplace. Additionally, HAZCOM requires employers to train all workers in the safe methods for handling and working with these substances, plus other requirements.

## Health and Safety Research

The safety of rock and slag wool has been studied exhaustively over the past 50 years. Since 1987, several major scientific reviews have been published by the International Agency for Research on Cancer (IARC), the U. S. Environmental Protection Agency (EPA), the International Labour Organization (ILO), the International Programme on Chemical Safety (IPCS), and the World Health Organization (WHO).

Three areas of research have been especially important: animal experimental studies; health assessments of current production employees; and analysis of former production employees' death rates and causes.
The results of these studies and reviews by independent researchers have determined no cause-and-effect relationship between rock wool and/or slag wool exposure and disease.

### Animal Experimental Studies

Numerous animal studies involving inhalation, injection and implantation of rock and slag wool fibers have consistently found that either no tumors have been produced or the number of tumors produced were not statistically significant. Tissue reactions noted in the inhalation studies were predominately confined to cellular reactions consistent with normal lung reaction to exposure to large amounts of any kind of dust. In one injection study, positive results were obtained with an experimental rock wool material that had a surface coating which is now known to be a carcinogen. The fiber has never been marketed.

Several of these studies also suggest that rock and slag wool fibers have a reduced persistence in the lung, an observation that may help explain the absence of adverse health effects.

### Current Production Worker Studies

Studies of current production workers also support the conclusion that rock and slag wool fibers do not present a significant risk of respiratory disease. A 1983 study of employees at two slag wool plants concluded that the "prevalence of respiratory symptoms are not increased in the population and no coherent pattern of symptoms in relation to exposure to MMVF [Man-Made Vitreous Fibers] emerges." A 1990 follow-up of the study similarly concluded that lung abnormalities observed were not attributable to slag wool exposures. These findings are consistent with European studies of rock wool manufacturing workers.

### Former Production Worker Studies

Two mortality studies of former production employees have not demonstrated evidence of a dose-response relationship between occupational exposure to rock wool or slag wool and any cause of death. A U. S. study of 1,846 workers at six U. S. slag wool plants found no increased risk for mesothelioma, a cancer of the lining of the lung or abdominal cavity. A small, statistically significant increase in lung cancer was observed but was not associated with slag wool exposure levels, duration of employment, or other measures of exposure-response relationships. The possible role of confounding factors, e.g., asbestos, arsenic and polycyclic aromatic hydrocarbon exposures and the role of large numbers of short term workers in the study are being examined through further follow-up. A European mortality study of 10,115 production workers in seven rock and slag wool plants found no increased risk of lung cancer or nonmalignant respiratory disease after the introduction of dust suppressing agents. Updates of these U. S. and European studies are anticipated in 1993.

Taken together, the production worker studies and animal studies on rock and slag wool fibers indicated to the 1989 International Labour Organization expert group that "with the adoption of appropriate control and preventive measures ... detectable risk with production and use of the insulation wools should be minimal."

This conclusion is consistent with a recent study of workers in nine slag wool plants, including two ceiling tile manufacturing plants, that found no association between lung cancer and exposure to rock and slag wool fibers.

## Safety of In Place Products

In 1990, the World Health Organization's Working Group on Indoor Air Quality reviewed all available scientific studies and concluded: "Current airborne man-made mineral fiber concentration in indoor environments are considered to represent an insignificant risk." IARC, EPA, OSHA and others continue to review the health and safety of these products.

## Summary

Rock and slag wools are safe to manufacture, install and use when recommended work practices are followed. Some work practices and exposure guidelines vary among manufacturers. Consult your NAIMA member company's MSDS and other company literature for work practice guidelines. Completed research, interim results from ongoing studies and comprehensive research reviews by scientific organizations and independent researchers have found no evidence of significant health risk when rock and slag wool products and systems are properly designed, installed, operated and maintained. The results of these studies have been, and will continue to be, made available to employees, customers and appropriate government and regulatory agencies.

## For More Information

For a more detailed overview of the latest medical/scientific research on rock and slag wool, refer to the NAIMA brochure, "Health and Safety Research On Rock and Slag Wool." Or write:

**NAIMA**
**44 Canal Center Plaza**
**Suite 310**
**Alexandria, VA 22314**
**TEL 703/684-0084**

**NAIMA MEMBER COMPANIES INCLUDE:**

Celotex Corporation
*Tampa, Florida*

CertainTeed Corporation
*Valley Forge, Pennsylvania*

Knauf Fiberglass
*Shelbyville, Indiana*

Owens-Corning Fiberglas Corporation
*Toledo, Ohio*

Partek Insulations, Incorporated
*Peachtree City, Georgia*

Rock Wool Manufacturing Company
*Leeds, Alabama*

Roxul Incorporated
*Milton, Ontario*

Schuller International, Incorporated
(a subsidiary of Manville Corporation)
*Denver, Colorado*

USG Interiors
*Chicago, Illinois*

U. S. Mineral Products Company
*Netcong, New Jersey*

Western Fiberglass Incorporated
*Salt Lake City, Utah*

NAIMA is a trade association of North American manufacturers of fiber glass, rock wool, and slag wool insulation products. NAIMA's role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation products and to encourage safe production and use of insulation products.

NAIMA
NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

# Mineral Wool Facts

## Manufacturing

The mineral wool form of man-made vitreous fiber (MMVF), also known as man-made mineral fiber (MMMF), was developed in the late 1800's. The term "mineral wool" actually encompasses two materials similar in physical and chemical properties. Rock wool is made by melting natural rock, such as basalt, and centrifugally spinning it into fibers. Slag wool is similarly manufactured from iron ore blast furnace slag.

## Properties and Uses

Rock and slag wool have extremely useful properties: excellent insulation and sound absorbency, non-combustibility, high tensile strength, and dimensional stability. They do not rot, absorb moisture or odors, or support the growth of mildew, mold or bacteria.

As a primary constituent of ceiling tile, rock and slag wools provide both fire protection and sound control. Their superior thermal resistance accounts for widespread usage as insulation in homes and buildings, as well as in chemical processing industries, ships, mobile homes, cooking appliances and other applications. Rock and slag wool insulation reduce heating and cooling costs, thereby conserving energy and energy resources worldwide. In recent years, rock and slag wool usage as a horticultural growing medium has steadily increased.

## Product Labeling

The International Agency for Research on Cancer (IARC), part of the World Health Organization, periodically evaluates the potential health effects of the many substances to which humans are exposed. IARC classifies substances as "known," "probably," "possibly," "not classifiable" or "probably not" carcinogenic. These evaluations are not workplace risk assessments but are intended only to assist health authorities and corporations in formulating decisions regarding regulatory or preventive measures.

Saccharin, styrene, gasoline engine exhaust and over 150 other substances, as well as mineral wool, are currently classified as a possible carcinogen. IARC's actions have led to the use of warning labels and/or material safety data sheets (MSDS) to inform product users that mineral wool has been classified as a possible carcinogen and to identify measures for safe product handling and installation.

The U.S. Occupational Safety and Health Administration (OSHA), through its Hazard Communication Standard or "HAZCOM" regulation, requires that employers have health and safety information available, including labels that warn of possible health effects, for all materials used in their workplaces. Additionally, HAZCOM requires employers to train all workers in the safe methods for handling and working with these substances, plus other requirements.

As part of a Construction/General Industry Standard, OSHA is currently reviewing mineral wool to establish a workplace permissible exposure limit (PEL). TIMA is working with OSHA to examine all health-related research on mineral wool. In the meantime, NAIMA's Board of Governors has recommended that OSHA adopt a 1 fiber per cubic centimeter (1 f/cc) PEL for mineral wool. This recommendation is based on grounds of prudence and not significant risk.

## Industry Recommended Work Practices

Rock and slag wool fibers may temporarily irritate the skin, eyes and respiratory tract. Accordingly, manufacturers recommend work practices to assure the comfort and safety of persons who handle or install rock and slag wool or finished products.

- Use properly-fitted respirators when appropriate; consult individual manufacturers' recommendations on the type and use of respirators.
- Wear safety glasses with side shields or goggles or a face shield whenever handling or using products made with rock or slag wool.
- Wear loose clothing. Wear long-sleeved shirts that are loose at the neck and wrists, along with caps and long pants, to help protect sensitive skin areas from coming into contact with rock and slag wool fibers. Loose clothing helps prevent the fibers from rubbing against the skin. Depending upon the job conditions, gloves may also be necessary.
- Avoid rubbing or scratching skin if rock or slag wool particles accumulate on exposed skin.
- Prevent dust by using local exhaust ventilation whenever the rock or slag wool exposure may exceed established dust standards or recommended fiber levels.
- Keep work areas clean and clean up surfaces by wet wiping or filtered vacuuming.
- Wash work clothing separately to prevent fibers from being transferred to other clothes.

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NAIMA's recommendations for handling, fabricating and applying mineral wool products are intended as general guidelines. Work practices and other data are described in material safety data sheets (MSDS) and other literature provided by manufacturers.

## Health and Safety Studies

The safety of rock and slag wool has been studied extensively over the past 50 years. Three areas of research have been especially important: animal experimental studies; health assessments of current production employees; and analyses of former production employees' death rates and causes. The results of these studies and reviews by independent researchers have determined no cause-and-effect relationship between rock wool and/or slag wool exposure and disease.

## Animal Experimental Studies

Numerous animal studies involving inhalation, injection and implantation of commercially-produced rock and slag wool fibers have consistently shown no statistically significant incidence of fibrosis or tumors.[1] Animal studies also suggest that rock and slag wool fibers have a reduced persistence in the lung, an observation that may help to explain the absence of health effects in animals.

## Current Production Worker Studies

Studies of current production workers also support the conclusion that slag and rock wool fibers do not present a detectable risk of respiratory disease. A 1983 study[2] of employees at two slag wool plants concluded that the "prevalences of respiratory symptoms are not increased in this population and no coherent pattern of symptoms in relation to exposure to MMVF [man-made vitreous fibers] emerges." A 1990 follow-up study[3] similarly concluded that lung abnormalities observed were not attributable to slag wool exposures. These findings are consistent with European studies[4,5] of rock wool manufacturing workers.

## Former Production Worker Studies

Two mortality studies of former production employees have not demonstrated evidence of a dose-related relationship between occupational exposure to rock wool or slag wool and any causes of death. A U.S. study[6] of 1,846 workers at six U.S. slag wool plants found no increased risk for mesothelioma, a cancer of the lining of the lung or abdominal cavity. A small, statistically significant increase in lung cancer risk was observed but was not associated with slag wool exposure levels, duration of employment, or other measures of exposure-response relationships. The possible role of confounding factors, e.g., asbestos, arsenic and polycyclic aromatic hydrocarbon exposures, and effects due to the large number of short term workers are being examined through further study. A European mortality study[7] of 10,115 production workers in seven rock and slag wool plants found no increased risk of lung cancer or nonmalignant respiratory diseases after the introduction of dust-suppressing agents. Updates of these U.S. and European studies are anticipated in 1993.

Taken together, the earlier production worker studies and animal studies on rock and slag wool fibers indicated to the 1989 International Labor Organization expert group that "with the adoption of appropriate control and preventive measures... detectable risk with production and use of the insulation wools should be minimal."[8]

This conclusion is consistent with a recent study[9] of workers in nine slag wool plants, including two ceiling tile manufacturing plants, that does not demonstrate an association between lung cancer and exposure to rock and slag wool fibers.

## Safety of In-Place Products

In 1990, the World Health Organization's Working Group on Indoor Air Quality reviewed all available scientific studies and concluded: "Current airborne man-made mineral fiber concentration in indoor environments are considered to represent an insignificant risk."


**For additional information write to:**

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*The North American Insulation Manufacturers Association (NAIMA) is the trade association of North American manufacturers of fiber glass, rock wool and slag wool insulation products. NAIMA's role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool and slag wool products and to encourage safe production and use of insulation products.*

*NAIMA member companies are: Celotex Corporation, CertainTeed Corporation, Knauf Fiber Glass, Schuller International, Inc. A Subsidiary of Manville Corporation, Owens-Corning Fiberglas Corporation, Partek Insulations Incorporated, Rock Wool Manufacturing Company, Roxul Incorporated, USG Interiors Incorporated, U.S. Mineral Products Company and Western Fiberglass Incorporated.*

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The manufacture of mineral wool involves the heating of slag (the type of slag depends on the source of slag closest to the facility manufacturing the mineral wool) and rock in a cupola furnace charged with blast-furnace slag, silica rock, and coke. The charge is heated to a molten state at about 3000°F (1650°C). The material is then transferred to a blowchamber which fiberizes the molten material. There are two methods for fiberizing mineral wool which are used exclusively in the U.S. The Downey process involves releasing the molten material on a concave spinning rotor; the Powell process involves forcing the molten material through rotors revolving rapidly.

After the blowchamber, the mineral wool may then be granulated and packaged for shipment or conveyored to an oven for curing which adds structural rigidity to the insulation. After curing, the mineral wool is then transferred to a cooler, where blowers force air at ambient temperatures through the wool blanket (the curing oven and cooler may not be present at all mineral wool manufacturing facilities). The cured and cooled fiber blanket may then be cut into batts and covered with a vapor barrier of treated paper or foil.

The major source of emissions in mineral wool manufacturing is the cupola or furnace stack. Its discharge consists primarily of condensed fumes and particulate matter that have volatilized from molten charge and gases such as $SO_2$, $NO_x$, CO, and fluorides. Minor sources of particulate emissions include the blowchamber, curing oven, and cooler. Sources of VOC emissions include the blowchamber, curing oven and cooler. Other sources of $NO_x$ include the curing oven.