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Ill health from exposure to asbestos is directly related to the amount of asbestos fibers inhaled over a period of years. The size of the asbestos fibers and the type of asbestos are also critical in evaluating the risk of acquiring the diseases associated with exposure. Health scientists have determined that asbestos fibers must be more than five microns long and have a length to width ratio of 3 to 1 to be toxicologically significant. There is strong evidence that chrysotile asbestos is much less toxic than the amphibole types of asbestos minerals. The biological process between tissue and asbestos is still not fully understood. Human experience and animal studies have demonstrated that in most cases the physiological changes attributable to asbestos exposure require long term, years, of exposure to concentrations in excess of the response threshold.

Several studies have shown that the two basic types of asbestos minerals, serpentine and amphiboles, are structurally, chemically and toxicologically different. Chrysotile, a serpentine asbestos mineral, is the commonly used type of asbestos. It has long, curly very fine fibers. Amosite is an amphibole asbestos mineral with fibers that are short, straight spikes of greater diameter. Amosite was the asbestos used in shipbuilding during World War II. The chemical compositions are different, with chrysotile being more easily changed than amosite.

Use of asbestos increased from the production of novelty fabrics for royalty in the Middle Ages to routine use in construction, shipbuilding, electrical and heat insulation, coatings, brake linings etc. during the 1940's, 50's and 60's. Occupational physicians and industrial hygienists in asbestos milling and manufacturing were concerned about possible health effects early in this century. The disease asbestosis was recognized as a unique pneumoconiosis due to the inhalation of asbestos fibers, in great quantities, over a prolonged period of years. In 1930 an English physician, Merewether, reported that asbestosis could be controlled by the use of ventilation to reduce the concentration of fibers in the air of work places. In 1934 two other physicians in England wrote that asbestosis was a disease of the past because of the success of controls.

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Industrial hygienists and occupational physicians in the United States continued to study asbestos and its potential for causing asbestosis. In 1938 Dr. Dreessen suggested, as a result of a Public Health study, that a threshold exposure limit of 5,000,000 particles per cubic foot of air seemed to prevent asbestosis.

Almost immediately, the World War II production effort began in the shipyards. Amosite asbestos was specified by the U.S. Navy for all war ships. Dr. Philip Drinker, inventor of the iron lung, a professor of industrial hygiene engineering at Harvard, was commissioned by the Navy to study asbestos levels in the shipyards and to make recommendations for necessary controls. At that time, the Dreessen exposure limit of 5,000,000 particles per cubic foot of air was still considered to be satisfactory for worker protection. In 1946 the American Conference of Governmental Industrial Hygienists adopted this same level in the original Threshold Limits Values (TLV) publication. This guideline remained unchanged until 1968 when ACGIH published a "notice of intended change" to lower the TLV for asbestos to 12 fibers per milliliter of air, a ceiling value. In 1970 ACGIH recommended lowering the asbestos TLV to 5 fibers per milliliter with a ceiling value of 10 fibers per milliliter for limited periods in a work day.

The use of asbestos continued to increase but cases of asbestosis remained rare. Knowledge of the disease was essentially limited to occupational health professionals and the larger producers and users. It was not considered a high priority health item if reasonable controls on dust were used. In 1964 and 1965 Dr. Irving Selikoff and colleagues reported on their studies of insulation workers who had been heavily exposed to amosite asbestos in the shipyards during the Work War II period. Asbestosis was more prevalent among these workers than was expected and further there was a definite link between asbestos exposure and bronchial cancer.

The passage of the Occupational Safety and Health Act in 1970 brought occupational health to the attention of most, if not all, employers. Asbestos was one of the first materials to be regulated by OSHA. In April of 1971 OSHA adopted the 12 fibers per cubic centimeter of air as a federal standard. In December 1971 the agency published an Emergency Temporary Standard of 2 fibers per cubic centimeter (cc) of air for asbestos. This has been followed by several actions to regulate asbestos.

Knowledge developed, up to 1980, by the scientific and medical communities demonstrates that no epidemiological studies among refractories workers or bystanders in the basic steel or other refractories user facilities show enhanced risk of asbestos related disease processes from refractories products. State of the art during this time frame would not have suggested to General Refractories Company that the use of its products, in their expected manner, presented any health hazard to users or bystanders in basic steel plants or the facilities of other refractories users.

Industrial hygiene studies in the 1970's at the Sparrows point steel plant showed that the concentration of asbestos fibers in the air was very low during removal of old refractories and the installation of new. The concentrations were below the standards of that time and through 1980.

The amount of asbestos fibers released from General Refactories Company products was minimal to non-existent. This is based on the properties of the company's products. Asbestos was used in cement,insulating adhesives, castables and as a spacer in steel clad bricks.

Castables and cements were a mixture of dry components that were mixed with water. Insulating adhesives were packaged and sold in a wet state. The resulting material was applied to cracks and crevices. The asbestos fibers in these products were embedded in the matrix and consequently were not available as non-coated breathable asbestos fibers. Even the removal of these materials would not have released non-coated fibers into the environment.

An asbestos containing spacer was used in one of many types of General Refractories Company steel clad bricks. Orders were made to the specifications of the customer. The spacers were 1/16,1/8 or 3/32 inch thick and 1/4 inch less than the dimensions of the side of the brick on which it was to be placed. One spacer was placed on the 3 inch side of the brick. The spacer and the other sides of the brick were covered with a steel plate leaving only the ends exposed. There was very little opportunity for asbestos to be released during shipping, handling on site or during installation.

When asbestos is heated to 1,300 degrees Fahrenheit, chemical and physical changes occur that transform it into a material called fosterite, a non fibrous material. To date there are no indications that fosterite causes lung disease or any asbestos related diseases.

During use General Refactories products were heated to well over 1300 degrees Fahrenheit for several months. Asbestos will not survive, as such, under these conditions. Fosterite does not have the chemical, physical or toxicological properties of asbestos. Regardless of how dusty or dirty removal of refractory materials may have been, asbestos could not have been a problem.

For the reasons discussed and within a reasonable industrial hygiene certainty it is my professional opinion that the use of General Refractories Company products could not have been a cause of asbestosis or other asbestos exposure related diseases. Chrysotile, the type of asbestos used, is the least hazardous available. The amount in the products was small and the availability for release to the work areas was highly limited. Removal of refractories could not create an asbestos problem because conditions (high temperatures) during use transformed chrysotile asbestos into fosterite, a material with none of the chemical, physical or toxicological properties of asbestos. It is inconceivable that General Refractories Company products could have generated asbestos fiber concentrations over a long enough period to have caused asbestosis or other asbestos related diseases.

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