FILE NAME: CERAMICS (CER)

DATE: 1932 Oct

DOC#: CER002

DOCUMENT DESCRIPTION: Trade Journal Article - Dust Hazard in Rock Products Industry

Dust Hazard in Rock Products Industry

Only Dusts Containing Silica Are Dangerous—Digest of Papers and Discussion at the National Safety Congress

THE RECENT National Safety Congress at Washington, D. C., included a symposium on the dust hazards to health in industry, a subject of particular interest to some rock products producers at this time because of the activity of a certain type of lawyer in promoting lawsuits for damages, running (in the aggregate) to millions of dollars

Dr. Leonard Greenburg, Yale University, New Haven, Conn., presided as chairman. The first paper by Dr L. U. Gardner, director of Trudeau Laboratory, Saranac Lake, N Y., dealt with the kinds of dust encountered in industry and their effect upon the lung tissues The second paper by J. J. Bloomfield, U. S. Public Health Service, Washington, D C, followed with a discussion of the methods of determination of dust as to particle size and concentration in the air The third paper by Dr. A. E. Russell, U S. Public Health Service, Washington, D C., discussed clinical and statistical studies in various dusty trades. In the fourth paper, Theodore Hatch, of the Harvard School of Public Health, Boston, Mass., discussed the various methods of dust control in industrial plants, and in the fifth paper, Prof Philip Drinker, Harvard School of Public Health, outlined the various methods for protecting the worker against dust inhalation.

Dr. L. U. Gardner said in part "At first it was thought that all dusts were capable of producing disease, but with further study it became obvious that different types of dust produced different effects. With further study it became obvious that dusts containing silica were particularly harmful and that they produced definite changes in the lung tissues Today we recognize silicosis as a form of disease which is quite definite There are other forms of changes in the lung tissues which are produced by the inhalation of dust about which we know little

"We know many of these dust conditions are associated with a factor of infection in the lung Some believe that silicosis can not exist without a background of latent infection However, this is an extreme view, as we know we can produce experimentally a true silicosis in animals by the inhalation of silica alone

"Much has been written about coal miners and the factor of infection due to inhalation of dust. Pneumonia rates are excessive among coal miners, but probably the tuberculosis rate is lower than in other industries This seems to end with different groups, and much more work must be done before we can talk definitely

Lime Dusts Not Injurious

ROCK PRODUCTS took an active interest in the dust problem in its industries as early as 1921, when the editor heard from various producers that lime and limestone dust had been regarded in the industry for generations not only as not harmful, but actually helpful in the treatment of tuberculosis. In the January 14, 1922 issue is a 6-page article on "Lime and Tuberculosis" containing a symposium of the experience and opinions of numerous lime manufacturers and a summary of existing literature on the subject.

The subject has been continuously discussed in Rock Products since that time. In the June 28, 1924, issue is a 5-page article on the use of both lime and gypsum dusts as possible preventives and cures for tuberculosis. These articles received wide notice and Dr. Miriam Izzard was led to make her thesis for her medical degree at Johns Hopkins University on the subject. Her conclusions were not very specific as to the effect of these dusts as cures or preventives, but were quite definite that lime and gypsum dusts were not causes of tuberculosis, or silicosis, as are dusts containing silica.

In the course of these 10 years Rock Products collected and published much information in regard to experience and experiments with lime, limestone and gypsum dusts which should be very helpful to any producer faced with lawsuits as a result of alleged injury to health due to exposure to these dusts. The great preponderance of evidence is that the "lime salt" dusts are dissolved in the lungs and provide calcareous material to heal the lesions of tuberculosis.—The Editor.

"All dust, when inhaled, mechanically injures the lung tissues, and the small particles injure the cells We know that the type of injury varies with the nature of the dust particle."

Dr Gardner showed a number of lantern slides illustrating the effect of dust on the lung tissues: "If coal dust is present in excessive quantities and silica in relatively insignificant amounts, we have a distribution which is comparable to that of pure coal If silica is in excess and coal not abundant, we have a nodular type similar to silicosis

"As far as asbestos is concerned, we do not know the whole story An autopsy report of an individual dying of asbestosis has shown a tuberculosis complication. Until we have more statistics of people working in asbestos dust we should not say too much about the part played by tuberculosis in association with this condition."

Analyses of Mineral Industry Dusts

J. J. Bloomfield said in part: During the past nine years he had made numerous investigations of the dust hazard in many industrial establishments. He presented a summary which showed that the highest dust exposure was in talc mines, slate finishing mills, quartz (silica) grinding plants, coal mining and granite cutting operations. Owing to the high percentage of silica present in the dust of quartz grinding and granite cutting plants he found these to be the most hazardous of the occupations which he had studied

"A knowledge of the dust content of the industrial atmosphere is required," said Mr Bloomfield, "not only for the purpose of determining the extent of the hazard involved in various manufacturing processes, but it is also useful in measuring the efficiency of protective devices which may be used in the elimination of the dust hazard"

In discussing the health hazard, he said "It is now well established that the inhalation of certain types of dust, such as granite dust, will in time produce fibrosis of the lungs, at times associated with tuberculosis. In other cases exposure to dust may result in the production of a far less degree of fibrosis without notable tendency toward subsequent tuberculosis; this is true of cement dust. And finally, there are certain types of dust as typified by marble dust, which in the quantities and lengths of exposure so far observed produce little lung fibrosis In general it has been found that those dusts which are high in silica content are the ones which produce a disabling fibrosis of the lungs most readily. Hence, the necessity for knowledge concerning the chemical and mineralogical composition of a dust is obvious

"With reference to the quantity of dust present in the air of a workroom, it is apparent that when the dust concentration is high the exposed person will inhale a greater quantity in a given period of time than he will when the dust concentration of the atmosphere is relatively low, and since the rate of production of the disease is partially dependent upon the rate at which the dust is inhaled, this latter fact plays an important role in predicting the relative danger of different environments Hence the need for the evaluation of the quantity of dust in the industrial atmosphere is obvious

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"In general, it has been found that the harmfulness of a quartz-containing dust is in direct proportion to its quartz content. For this reason, in attempting to evaluate the harmfulness of a dust, it is of the utmost importance to ascertain its exact mineralogical composition. It has been our experience that to determine accurately the exact mineralogical composition of a dust one must resort to a combined chemical and petrographic analysis. It is our practice to have such an analysis made by an expert in petrographic geology."

Dr. Bloomfield displayed a table which indicated the percentage of quartz content of dust obtained in the various industries which he had studied, as follows:

Rock drilling dust (bituminous coal mine)	54.0%
Granite cutting dust	35.2%
Rock drilling dust (anthracite coal mine)	31.0%
Brass foundry dust	19.0%
Dust from raw mills in cement plant	6.5%
Slate mill dust (Vermont red slate)	3.0%
Silverware polishing dust	1.7%
Anthracite coal dust	1.5%
Bituminous coal dust	1.2%
Cement dust	1.0%
Slate mill dust (Vermont green slate)	trace
Talc mill dust	none
Marble cutting dust	none

"It is evident," said Dr. Bloomfield, "from this table that rock drilling occupations in the coal mining industry and certain occupations in the granite cutting industry and in brass foundries would be in the hazardous class as judged by the proportions of quartz in the atmospheric dust."

Silica Dust the "Arch Offender"

Dr. A. E. Russell said in part: "The dust which produces the greatest damages are inorganic dusts, and silica is the arch offender. I have seen workers in dusty trades where silica is almost absent. Exposure to dusts will produce fibrosis of the lungs. A statement recently appeared in the 'Cement Bulletin' that fibrosis in one case is not comparable to another.

"I have visited marble workers. The men are apprenticed, going into the industry for a life work. I was anxious and very glad to see this group of workers. Dust counts revealed that marble workers are exposed to a smaller amount of dust than granite workers. We found that quite a number had more fibrosis than usual. Some had signs of tuberculosis. Dr. Rogers of Vermont State Sanitarium stated that he did not have marble workers as patients at his hospital unless they had previously worked in granite. We found no active cases of tuberculosis among this group in the marble industry.

"Considering silica, it has been my experience that one of the first and last complaints is that it shortens the breath. A patient described it to me recently, saying that he had lost his second wind and did not have the usual reserve. Tuberculosis complicates the cases in the various stages. A child can not live around an adult case without being infected. They developed silicosis much more rapidly than those who did not have this infection.

"Silicosis is one of the foremost diseases. People all over the country are worked up over it. Many cases are coming before the juries. I believe in time they will have to subsidize hospitals in the larger cities and in most manufacturing cities. Diagnostic service should be provided. This proposition of submitting the evidence to lay juries is dangerous."

Dr. Russell then presented several slides showing the results of coal, slate, marble, cement, asbestos and granite dusts on lung tissues.

Physical Examination of Employes Necessary

Theodore Hatch said in part: "The health hazard associated with exposure to industrial dusts varies with the industry and depends upon a number of factors, chief of which are the physical characteristics of those exposed, the chemical and physical properties of the dust, and its concentraton in the atmosphere of the work places.

"The evaluation of the hazard in a given industrial plant must therefore be based upon a thorough investigation of the factory conditions and a careful interpretation of the results. The investigation should include physical examinations of the men and a study of morbidity and mortality statistics, chemical examination of the dust, and determinations of its physical properties such as particle size.

"The most direct means of controlling the hazard is by reducing the dust concentration to which the workers are exposed. The efficiency of the required dust control depends upon the allowable concentration in the atmosphere, which in turn is determined by the toxicity of the dust and the tolerance of those exposed. The standard of permissible dustiness may be increased by careful selection of the men, by means of physical examination, and limiting their exposures through a system of rotation of employment. It may be further increased by reducing the percentage of toxic material in the dust and otherwise controlling its chemical and physical characteristics.

"In the absence of definite knowledge, the safe course is to consider all dusts dangerous until proved innocent.

"The dusty processes encountered in industry differ widely and exhibit a considerable variation in the restrictions placed upon the design and operation of the devices for the control of the dust. No single method of control can be universally applied; on the contrary a number of methods have been developed to meet the needs of the dusty trades and the choice of method must be based upon a thorough study of local conditions. The common methods follow:

"*Substitution of Non-hazardous Processes:* The silicosis hazard has been reduced in a number of industries by substituting for the dusty process one which is dust-free or which produces a relatively harmless dust. In the granite industry the surfacing machine, a heavy dust producing tool, has been replaced to some extent by the gang saw and the artificial abrasive wheel. These are wet processes and have reduced the dust concentration associated with the surfacing of the stone to a figure well below the hygienic face limit.

Control of Dusty Operations

"*Isolation of the Hazardous Process:* It is possible to isolate the dusty process in many cases. This may consist merely in confining the hazardous stages of manufacture to a separate building or room, thereby reducing the number of men exposed to the dust (and these men may be protected by masks), or it may mean complete isolation from the workers in an enclosed space.

"*General Ventilation:* In a few instances of generalized dust production throughout the factory the use of general ventilation may prove satisfactory as a means of dust control. Under such conditions the introduction of large quantities of dust-free air serves to reduce the dust concentration by simple dilution. This method is used in certain mining operations, also for purposes of removing heat and toxic gases as well as dust. In general it involves the installation of large fans and is expensive to operate. This method should be looked upon as an adjunct to other methods of control rather than an independent method.

"*Control of Dusts at the Origin:* Effective control of the dust at the point of generation prevents it from reaching the breathing zone of the worker and hence offers a positive means of reducing the dust hazard. It may be effected by the use of water or other liquids for capturing the dust or by means of local exhaust ventilation. The use of water for laying dust is an old method of control. It undoubtedly reduces the dust concentration, but investigations have shown that it does not always give the high degree of protection required. Local exhaust ventilation consists in removing the dust through a suction hood placed close to the point of generation. This method of control is widely used in industry and is most effective when applied to a stationary dust-producing machine or when it is attached to a moving tool, thus keeping it at a fixed distance from the point of dust origin. Its general application has been recognized and most states have incorporated specifications for the design of local exhaust systems in their industrial code."

Protective Devices for Workers

Prof. Philip Drinker said in part: "Painful as the cure may be, it consists of two perfectly definite steps: (1) Medical examinations of new employes and routine examinations of all persons exposed to dangerous dust concentrations, and (2) reduction of dust concentrations breathed by workers to what are considered [illegible]

"If dustiness can be controlled by local exhaust fans and dust-collecting equipment, protective devices such as respirators or positive pressure helmets have no place except as emergency equipment. However, many processes like abrasive (sand or steel) blasting, paint and enamel spraying, porcelain manufacture, stone cutting, sand grinding, and the like, will not, in all probability, be made reasonably dust free for some years to come. In work of this type, respirators and other protective devices have an important place. The safety man should understand thoroughly what can be expected of protective devices and, above all, should be able to check and observe whether the workmen are getting the protection they require.

"One sees occasionally statements to the effect that respirators have no place in industry because they filter out only large particles and let pass the small ones which are always the more harmful. Against this is the indisputable fact that the dust catching efficiency of several makes of respirators exceeds 90% on silica dust with particles less than two microns. A careful measurement of the size of dust particles entering and leaving respirators shows a slight but unimportant reduction in average size of the dust particles."

Professor Drinker reviewed the specifications for respirators which have been formulated by the U. S. Bureau of Mines and paid glowing tribute to the high caliber of its work and its importance to the safety movement. Also he outlined the requirements for testing sand blast helmets and paint spray masks.

"The manufacture of protective equipment," he said, "should be allowed all possible license in modifications and improvements having to do with appearance, obstruction to vision, comfort, ruggedness and practicability of his equipment. If the manufacturer desires his product to be certified as to its performance under the conditions for which he designed and built it, the prospective purchaser and safety engineer is equally desirous of knowing the performance data."

Discussion

Discussion was withheld until all papers were read. Chairman Greenburg then called upon various people for comment. Following this the meeting was thrown open for general discussion and then the original speakers called on for replies.

Dr. Pancoast, pathologist, University of Pennsylvania, said in part: "I have been interested in silicosis for a number of years. We have the very best way of finding out what changes are taking place in the lungs by x-rays. There can be no dispute to that question. We also have one of the best ways of determining the incapacity of the individual, but most of these examinations are not carried out thoroughly and the information is not given. The x-ray examination is only one small part, and that is something that is overlooked so frequently. A physician who has little knowledge of the subject will present x-ray pictures—and diagnose silicosis as the cause! It takes all of the ability of many witnesses who know something about the subject to counteract the few words he may say. Many here know that. We must know the kind of dust, dust counts, chemical constituents of the dust, clinical aspect of the case, time of work, how long he works each day, whether he is breathing the general atmosphere of the room or a more concentrated atmosphere. Previous occupation is often overlooked. All of these different sides to the question must be taken into consideration in every instance in which a man is charged with lack of capacity for work."

Dr. McConnell, Metropolitan Life Insurance Co., said: "Dr. Russell made a very important point in calling our attention to the necessity of having authority to decide cases. This is a matter of considerable interest to the meeting, and much thought should be given to it."

Mr. Cunningham said. "The whole situation has been presented very thoroughly. Two things have occurred to me: (1) Those stone cutters who have cut limestone for 15 or 20 years and who have tuberculosis, in each case have cut sandstone previously. Whether a short exposure a long time ago is important 20 years later is important. (2) Examination of workers who have been exposed simultaneously to silica and alkali. Reports have been made showing silicosis may develop rapidly. I am interested in the presentation of the situation regarding the control of dust because it is the real problem ahead of us."

Dr. Lloyd, U. S. Bureau of Standards, said: "Dr. Drinker told us how they test the respirator and pointed out the impracticability of using positive air pressure as a dust eliminator. A definite opinion is desired as to what type of respirator is adequate under bad dust conditions and within acceptable operating limits for protecting a man."

Dr. Drinker: "I certainly do not consider respirators adequate under such circumstances. Supposing you have a dusty atmosphere of, say, 50,000,000 count and you want to reduce it to 20,000,000. If your respirator is 90% efficient it would get the dust concentration down to 5,000,000, but eight hours a day constant use will be objectionable. In jobs in places like foundries, mines, sand blasts, etc., the exposure is not continuous. In such cases the respirator is not worn continuously."

Dr. Knutsen, Wisconsin Industrial Commission, said: "Two or three of the speakers made mention of the decision of claims which are made as the result of men becoming incapacitated in working in dusty occupations.

"This, to me, has been one of the most interesting sections I have attended in over 10 years of Safety Council meetings. The problem of silicosis and tuberculosis has been before us in Wisconsin since 1917, because of the fact that at that time our compensation law was amended providing compensation benefits for any disease or disability resulting from an occupation. I appreciate that one or two states have such provisions. I suggest one way of deciding a case is to have compensation laws amended covering all diseases of occupations so that claims may be decided by the industrial commission rather than by juries as the result of civil claims being filed.

"I will relate briefly difficulties we have. I do not wish to make a statement reflecting on the medical profession. The difficulty is this: Oftentimes a claim is presented to us for compensation by some individual because of a disability allegedly resulting from silicosis. In many of those cases we have members of the medical profession testify in behalf of the clients, who we personally are satisfied are not specialists or competent along those particular lines. The discouraging thing to us is that in hearing the evidence we have men before us who have specialized for years in lung diseases, men who are engaged in private practice and are at the head of tubercular institutions, testifying one group on one side, that the results of physical findings and x-rays show that the patient is disabled as a result of silicosis. Others equally qualified testify to the contrary. We have had some of these cases when we heard testimony and the individual didn't have long to live. We withheld our decision until the individual passed away and suggested an autopsy. We can not force an autopsy, but we are privileged to withhold our decision. After the autopsy, these two groups of doctors take specime examining them microscopically, and we hear them taking the same position that they had in the first hearing. That, I want to say, is mighty discouraging."

Dr. Roach, compensation commissioner for the state of New Jersey, said in part: "I am very much interested in the subject, because silicosis is a thing that we are very much concerned about in New Jersey at the present time. I might say that we have some experience in compensation cases in the state parallel to that described by Commissioner Knutsen from Wisconsin. It doesn't require much evidence to prove that certain quantities of silica are harmful to the human system. After an exposure continuous over a period of time long enough, permanent physical damage is bound to result, maybe to the point of the extinction of the individual. There are certain things that I am very much concerned about in connection with this subject of dust. To find some workable productive device that will safeguard the men who are exposed in 60 or 70 different industries to silica dust. It is not easy. It may be that in the laboratory ex-