Asbestos is a generic term used to refer to a group of mineral forms that share a unique set of physical properties. Today, the six mineral structures now identified by OSHA and by the mineralogical definition as “asbestos” are those currently regulated in the United States and those that all industries governed by OSHA must keep within permissible exposure limits set out by the agency’s regulations. The authors of this article say NIOSH seeks to revise the definition of asbestos to eliminate the distinction between the asbestiform and the non-asbestiform varieties of the relevant minerals. They say there is a lack of scientific evidence of a significant risk from exposure to the non-asbestiform varieties and argue that expanding the definition of asbestos would be severely economically damaging.

ASBESTOS: BY ANY OTHER NAME, IS IT STILL?

By Robert E. Glenn, Richard J. Lee, Laura M. Jastrem, Kristin L. Bunker, Drew R. Van Orden, Brian R. Strohmeier

Asbestos is a word commonly associated with potential disease, and with litigation. Yet, what asbestos precisely is, and which elongated or fiber-shaped structures should be defined as “asbestos,” is a topic of debate. Currently, the United States regulates six different forms of silicate minerals as “asbestos”: chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos.1 For some time, however, the National Institute for Occupational Safety and Health (NIOSH) has proposed expanding the definition of asbestos to include other minerals with the same or very similar chemical composition but with very different size, structure, and properties than what has traditionally been regulated as “asbestos.”

NIOSH proposes this expanded definition even though the Occupational Safety and Health Administra-

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1 See 57 Fed. Reg. 24,310, June 8, 1992.
tion (OSHA) has concluded that these minerals do not pose the same health risks as those currently regulated as "asbestos" and, therefore, should not be regulated as asbestos. NIOSH's expanded and inaccurate definition could find its way into pending legislation proposing to ban all asbestos-containing materials in this country, the potential effect of which could vary greatly depending on how asbestos is ultimately defined.2

Defining two different minerals with similar chemical composition, but that differ in structure, as "asbestos" is akin to linking graphite with diamond simply because they are both forms of carbon. Similar to the disease causing asbestos, what truly makes a carbon mineral into the sparkling gem commonly recognized as a diamond is the way in which it forms (crystallization) and the physical characteristics under which it was formed (time, very high temperature and extreme pressures)—not the mere fact that it is a form of carbon. Minerals that share similar chemical composition as asbestos, but which grow in different forms and under different physical characteristics, should not be treated the same as asbestos any more than graphite should be considered to be the same as diamond.

To demonstrate how problematic expanding the asbestos definition could be, this article first examines the distinction between the asbestiform varieties of silicate minerals currently defined as asbestos, and the other elongated or fiber-shaped silicate non-asbestiform minerals which NIOSH proposes to bring under the "asbestos" regulation umbrella. Next, this article seeks to address the possible consequences should these different non-asbestiform silicate minerals all become regulated in the same manner. Specifically, aside from flying in the face of basic scientific principles, ignoring the distinctions between asbestiform and non-asbestiform minerals would have a damaging impact on industry and open a Pandora's box of new asbestos-related litigation.

I. What Exactly Is Asbestos?

To understand the difference between the mineral varieties that have historically been regulated as asbestos, and those which have been proposed as new inclusions for asbestos regulation, one must first consider how to define asbestos. It has often been said that the beginning of wisdom is to call things by their right names. Yet, over time asbestos has been called by many different names and defined in a variety of ways. Understanding the differences between these competing definitions is necessary to understand how OSHA came to define asbestos for regulatory purposes, and why NIOSH should define it in a similarly precise manner in order to avoid harmful economic and legal consequences.

A. Commercial Definition of Asbestos

People are often surprised to learn that "asbestos" itself is not a mineral, nor a mineralogical definition, but rather a generic term used to refer to a group of mineral forms that share a unique set of physical properties.3 "Asbestos," therefore, is a commercial designation for six asbestiform minerals that have been used in products because of their high tensile strength, flexibility, resistance to chemical and thermal decomposition, high electrical resistance, and ability to be woven.4 Typically, asbestos occurs as fiber bundles composed of extremely long and thin fibers that can be easily separated from one another. The bundles have splaying ends and are extremely flexible. This commercial definition focuses on the economically desirable properties that historically made the different "asbestos" minerals popular for use in a variety of commercial products including insulation, textile applications, asbestos cement products, automotive brakes and fireproofing materials.5 If a mineral encountered in mining and processing of mineral deposits or used in production of products has these commercially desirable properties, then it is deemed "asbestos," while minerals without these properties are not. Thus, the commercial definition by itself does not offer the precision that a mineralogist would use,6 or that would permit precise scientific distinction between what constitutes a true "asbestos" mineral and what does not.

B. Regulatory Definitions of Asbestos

1. OSHA Definition

In 1992, OSHA issued an asbestos standard defining asbestos as "chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered."7 This definition explicitly excluded minerals of the same chemical composition that did not grow in the asbestiform habit, although no distinction between mineral forms was included in OSHA's 1972 asbestos standard.8 OSHA chose not to include these non-asbestiform minerals in its updated regulation because there was not conclusive evidence that these mineral forms posed the same health risks as those growing in the asbestiform habit:

OSHA's determination to remove non-asbestiform ATA [anthophyllite, tremolite, and actinolite] from the scope of the asbestos standards, is based on the insufficiency of evidence to support determinations that their further inclusion would protect exposed employees from a risk of disease which was the equivalent in incidence and gravity to asbestos related disease, and that removing coverage would pose a significant risk to exposed employees. The Agency also finds that the evidence is insufficient to regulate non-asbestiform asbestos as presenting a significant health risk to employees other than as a physical irritant. . . .9

Most importantly, OSHA recognized that asbestos and non-asbestiform actinolite, tremolite, anthophyllite (ATA) were "distinguishable mineral entities" and, that "the characteristics which differentiate them generally appear to correspond to the properties which may dictate

2 See "House Committee Considering Asbestos Ban That Would Be Broader Than Senate Bill" (38 OSHR 182, 3/6/08).
3 See NIOSH Safety and Health Topic: Asbestos, available at http://www.cdc.gov/niosh/topics/asbestos
6 See id.
9 Id. at 1.
biological response.” In other words, OSHA recognized not only that a different structural form of the same mineral made it distinguishable for identification purposes, but also that the different structural forms had different potential health consequences. OSHA concluded that the available toxicological evidence relating specifically to non-asbestiform ATA was either negative or inconclusive regarding the health effects from exposure. For the human evidence, OSHA relied on three different cohort studies of mine workers exposed to non-asbestiform cleavage fragments to determine if they had increased mortality from lung cancer and mesothelioma. The three cohorts were of workers exposed to (1) a grunerite-cummingtonite ore in the Homestake gold mine in South Dakota; (2) grunerite and other non-asbestiform amphiboles in the Minnesota taconite mines; and (3) non-asbestiform tremolite and anthophyllite in an industrial talc mine in New York.

Indeed, OSHA found that most of the studies of non-asbestiform ATA failed to show a statistically significant positive response to exposure. Therefore, OSHA determined that from a regulatory perspective, the evidence was insufficient to support regulating non-asbestiform ATA as presenting a risk similar in kind and to the extent of asbestos. Further, OSHA determined that workers exposed to non-asbestiform varieties of regulated asbestos would not face a significant risk if these varieties were excluded from the asbestos standard. Moreover, follow-up studies following the 1992 OSHA rulemaking in the Homestake gold mine cohort and the New York talc mine cohort have failed to show a positive relationship between exposure to non-asbestiform cleavage fragments and either lung cancer or mesothelioma. OSHA did not conclude that the non-asbestiform varieties should not be regulated at all, but rather that these varieties should be regulated under OSHA’s standard for particulates presenting a risk as a physical irritant (fifteen milligrams per cubic meter total dust or five milligrams per cubic meter respirable dust), instead of under the asbestos rubric. OSHA decided that due to the lack of evidence that non-asbestiform ATA should be regulated in the asbestos standard, or in a separate health standard based on specific related disease endpoints, the workers would not be subjected to a risk greater than those caused by particulates not otherwise regulated.

In so doing, OSHA rejected NIOSH’s recommendation that it regulate the non-asbestiform ATA as “asbestos.” Specifically, NIOSH urged that cleavage fragments from non-asbestiform minerals be considered as equally hazardous as the same size fragments from asbestiform minerals. OSHA found no evidentiary basis to support NIOSH’s contention. Indeed, OSHA noted that “available data show that asbestos containing dusts have a much greater potency than non-asbestos containing dusts. Nor is there direct evidence showing fiber equivalency for asbestos and asbestiform ATA.”

Today, OSHA continues to preserve this distinction by excluding non-asbestiform minerals from its definition of asbestos. Notably, OSHA’s current definition (the same as the one established in 1992) closely tracks the definition that is based upon mineral-crystallographic studies noted below. Indeed, OSHA chose to clarify its prior 1972 standard in part to conform with the mineralogically correct definition adopted by other federal agencies such as the Mine Safety and Health Administration and the Environmental Protection Agency. Today, the six mineral structures now identified by OSHA and by the mineralogical definition as “asbestos” are those currently regulated in the United States and those which all industries governed by OSHA must keep within permissible exposure limits set out by the agency’s regulations.

10 Id. at 2.
16 See id.; Id. also see John Kelse, The Long and Short of It: Flawed Arguments Dog Asbestos Identification, INDUS. MINERALS 66-74 (Feb. 2008).
18 See Kelly F. Bailey et al., The Asbestosiform and Prismatic Mineral Growth Habit and Their Relationship to Cancer Studies 6 (Mar. 2004).
20 See 29 C.F.R. 1910.1001(b)-(c).
2. NIOSH (Proposed) Definition

In contrast to the current OSHA definition, the NIOSH definition seeks to eliminate the distinction between the asbestiform and the non-asbestiform varieties of the relevant minerals. NIOSH has defined asbestos, for purposes of its recommended exposure limits as:

Particles that, when examined using phase contrast microscope, have: (1) an aspect ratio of 3:1 or greater and length greater than [five micrometers]; and (2) the mineralogical characteristics (i.e., the crystal structure and elemental composition) of the asbestos minerals (chrysotile, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos) or their non-asbestiform analogs, the serpentine minerals antigorite and lizardite, and the amphibole minerals contained in the cummingtonite-grunerite mineral series, the tremolite-ferroactinolite mineral series, and the glaucophanieriebeckite mineral series.22

As is apparent from the above, NIOSH’s definition is far more inclusive than the current OSHA definition. NIOSH sought to define asbestos as all the minerals with such an underlying chemical composition, even when they do not grow in the asbestiform habit. Moreover, NIOSH seeks to expand this definition by adding other fibrous minerals and “fiber-like cleavage fragments of non-asbestiform amphiboles.”23

NIOSH itself recognizes that “whether other fibrous minerals, amphiboles and zeolites, should also be included . . . [and] whether the inclusion of fiber-like cleavage fragments of non-asbestiform amphiboles is appropriate” was a question of some controversy.24 Nevertheless, for the last fifteen years the organization apparently has failed to consider why OSHA was justifi|

II. NIOSH’s Definition and Pending Legislation

The debate over the proper definition of “asbestos” has also spilled into the legislative arena. Sen. Patty Murray (D-Wash.) has made several attempts in the past six years to pass a ban on asbestos-containing products.25 Senator Murray’s latest proposal, S.B. 742, “Ban Asbestos in America Act of 2007,” which the Senate approved in October 2007,26 calls for NIOSH to conduct a study on the health effects of other non-asbestiform minerals and elongated mineral particles not currently included in the ban.27 The report is to include “regulatory decisions” and “information obtained from the National Institute for Occupational Safety Asbestos Research Roadmap.”28

Yet, it is this very NIOSH roadmap which already proposes expanding the definition of asbestos to include the other fibrous materials to be studied pursuant to the Senate bill. Indeed, the former acting director of NIOSH, Dr. Richard Lemen, has served as a witness in support of the bill and has spoken to the press in favor of its passage.29 In so doing, Dr. Lemen has urged that “any asbestos definition should include all respirable asbestiform minerals including cleavage fragments.”30

Because of the timetable set out by the current version of the Senate bill, the NIOSH roadmap is likely to have undue weight over any new findings or clarifications. The new NIOSH study is commissioned so that it must be completed approximately one and half years after the bill’s passage, yet proposed regulations are to be promulgated one year after the bill’s passage, taking effect two years and two months after its passage.31 Thus any new information gathered about the health effects of other fibrous minerals would not be provided in time for the initial regulation draft, and would only be present eight months prior to the final rules becoming law. As such, the other fibers and non-asbestiform minerals already recommended for inclusion in the asbestos definition by the NIOSH roadmap would be highly likely to become part of the comprehensive ban, regardless of any health findings, like those in the past, which have tended to distinguish the health effects of such particles from traditional asbestos.

III. A Mineralogical Definition of Asbestos

As mentioned above, there are six minerals which have the potential to crystallize as “asbestos,”32 the variety with commercially desirable properties. The six minerals that can crystallize as asbestos belong to two groups: serpentine and amphibole. The asbestos member of the serpentine group is chrysotile. The five amphibole group minerals regulated as asbestos are asbestos, riebeckite (crocidolite), amphibole cummingtonite-grunerite (amosite), asbestos tremolite, asbestos actinolite, and asbestiform anthophylite.

23 Id.
24 Id. at iii, 1.
26 See “Supporters of Asbestos Ban Seek to Broaden Scope as Bill Moves From Senate to House” (37 OSHR 1012, 11/15/07).
28 See S.B. 742 § 222(a)(1)(B) (ii)-(iii).
30 See supra note 24.
31 See S.B. 742 § 222(a)(2), § 232(a).
32 Since the 1970s, and perhaps before, mineralogical terms such as “asbestos,” “asbestiform,” “fibers,” “cleavage fragments,” and others have been assigned different meanings by various concerned groups (mineralogists, medical scientists, government regulators, industry, etc.) when describing asbestos. The proper use of mineralogical terms for fibrous minerals, and problems that have arisen from improper use, have been discussed in many reports. See supra notes 2, 3, 29; see infra notes 31, 32.
Importantly, both serpentine and amphibole minerals can crystallize in (1) an asbestiform or fibrous structure or (2) a non-asbestiform “habit,” or nonfibrous structure. Only the former can truly be considered “asbestos” from a mineralogical perspective. “Asbestiform” refers to the crystallization habit of a mineral where the crystals are thin, hair-like fibers with unique properties. The term “fibrous” is a broad term that refers to fibrous appearing crystals that resemble organic fibers (without any implication regarding special properties implied by the term asbestiform). Asbestiform describes a special type of fibrosity. Asbestos minerals are fibrous but not all fibrous minerals are asbestiform.33

Unlike many other chemical substances that have a fixed chemical structure (for example benzene or toluene), asbestiform and non-asbestiform particles comprise a group of minerals that have a range of chemical composition and crystal structure, sizes, shapes, and properties. As such, precise terminology is even more

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essential when describing asbestiform and non-asbestiform particles. The mineral tremolite, for example, can crystallize into a variety of different “habits” termed prismatic, acicular, fibrous or asbestiform but only if it were to crystallize into an asbestiform habit would it be considered asbestos (See Sidebar).

Asbestos can be identified with the aid of a microscope by examining bulk samples that have been ground. For the serpentine asbestos mineral (chrysotile) the identification of asbestiform and non-asbestiform varieties is relatively straightforward because even finely ground samples of chrysotile will retain their distinct particle shape when compared to the non-asbestiform varieties (antigorite and lizardite). The same is not true, however, for the amphiboles, thus the distinction of asbestiform and non-asbestiform habit is not as clear-cut. This is because the amphibole particles have a range of shapes from blocky to prismatic to acicular to asbestiform (See Sidebar). In addition, amphiboles break (or cleave) into smaller particles. It is these “long cleavage fragments” that can resemble and be mistaken for asbestos fibers. While the microscopic differences between asbestos fibers and non-asbestos particles have long been recognized, only recently have analytical procedures been written to differentiate between the two forms.

Table 1 lists the regulatory name, mineral group, and the asbestiform and non-asbestiform mineral names for these six minerals.

Table 1. The regulated asbestos minerals and their non-asbestiform counterparts.

<table>
<thead>
<tr>
<th>Mineral Group</th>
<th>Regulatory Name</th>
<th>Mineral Name of Asbestos Variety</th>
<th>Non-asbestiform Mineral Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serpentine</td>
<td>Chrysotile</td>
<td>Chrysotile</td>
<td>Antigorite, Lizardite</td>
</tr>
<tr>
<td>Amphibole</td>
<td>Crocidolite</td>
<td>Riebeckite Asbestos</td>
<td>Riebeckite</td>
</tr>
<tr>
<td>Amphibole</td>
<td>Amosite</td>
<td>Cummingtonite-Grunerite Asbestos</td>
<td>Cummingtonite-Grunerite</td>
</tr>
<tr>
<td>Amphibole</td>
<td>Tremolite Asbestos</td>
<td>Tremolite Asbestos</td>
<td>Tremolite</td>
</tr>
<tr>
<td>Amphibole</td>
<td>Anthophyllite Asbestos</td>
<td>Anthophyllite Asbestos</td>
<td>Anthophyllite</td>
</tr>
<tr>
<td>Amphibole</td>
<td>Actinolite Asbestos</td>
<td>Actinolite Asbestos</td>
<td>Actinolite</td>
</tr>
</tbody>
</table>

Figure 1 illustrates both the asbestiform habits of the six minerals regulated as asbestos, and the non-asbestiform serpentine and amphibole counterparts of these six minerals which should not be considered “asbestos.”

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IV. Particle Measurement Definitions and Confusion Between Asbestos and Other Fibers

For purposes of measuring and setting safe asbestos exposure levels, techniques have been developed to identify and count asbestos fibers found in a given environment. Prior to the mid-1960s, the hazard level from asbestos exposure was measured using an impinger method. The impinger method collected particles in water or isopropyl alcohol, and an aliquot of the liquid was allowed to settle in a cell of known volume. All settled particles were then counted under 100 power magnification and expressed as million particles per cubic foot. During the same time period, a new membrane filter method was developed. This method captured airborne particles on a membrane filter, and asbestos fibers were then categorized according to a minimum length and width with results expressed as fibers per cubic centimeter of air (f/cc). The membrane filter method counted fibers meeting a dimensional criteria because these parameters seemed to better relate to health effects from asbestos exposure. By the early 1970s, the impinger method had been discarded and the membrane filter method with fiber counting using phase contrast microscopy ("PCM") was in wide use.37

To determine what size particles to count under the membrane filter method, some counting rules were established. It became conventional to count elongated fibers that were at least three times as long as wide, defined as the aspect ratio, and longer than five micrometers to obtain some consistency among those counting asbestos fibers. Unfortunately, the counting rules have been used by some people to identify or define asbestos. This is improper since many particle shapes that are not asbestos can share these dimensions.38

For example, as discussed above, amphibole minerals can crystallize into other forms and structures (blocky, prismatic, or acicular) besides asbestiform habits. Moreover, particles from non-asbestiform habits can be elongated particles that meet the 3:1 aspect ratio and longer than five micrometers criteria. In addition, the serpentine minerals antigorite and lizardite crystallize as platelets, and while not as easily misidentified, if a platelet is standing on edge it is possible to mistake it for a chrysotile fiber. Consequently, if the particles being measured are taken from a work environment that contains amphibole minerals with both asbestiform and non-asbestiform elongated particles, or a non-asbestiform amphibole alone, by adhering to the strict counting rules of an aspect ratio of 3:1 and longer than five micrometers, these elongated particles will likely be counted as if they are “asbestos” even though they are not.

Unfortunately, how a given analyst applies the terms “fibrous,” “asbestiform,” “acicular,” and “cleavage fragment” in identifying and counting asbestos fibers depends on his or her individual training and experience. As can be seen in the rock specimens depicted in Figure 1, dissimilarities in the asbestos minerals as compared to their non-asbestiform counterparts are readily apparent to the naked eye. Microscopically, the differences are even more well-defined. The characteristic properties of asbestos include asbestiform habit with parallel fibers occurring in fiber bundles, fiber bundles exhibiting split or splayed ends, in which fibers show some separation from adjoining fibers, fine thin flexible fibers showing curvature and possessing high tensile strength. All asbestos minerals separate readily into long fibrils (or thinner bundles of fibrils) with diameters generally less than 0.5 micrometers and with fibers often longer than five micrometers having a mean aspect ratio from 20:1 to 100:1.

Unlike asbestos, the non-asbestiform counterparts do not grow parallel in one direction but exhibit multidirectional growth patterns, and as mentioned above can crystallize into a range of non-asbestiform shapes from blocky to prismatic to acicular. Because of the low tensile strength of the non-asbestiform amphiboles and serpentine minerals, when pressure is applied as takes place in milling and crushing of these minerals, the crystals fracture easily resulting in a reduction of the particle length and width (aspect ratio). Unlike asbestos, under the microscope these elongated cleavage fragments will exhibit stair-stepped sides and relatively small aspect ratios. Moreover, these cleavage fragments do not exhibit splayed ends characteristic of asbestos, in which fiber bundles show some separation from adjoining fibers.

While these cleavage fragments are elongated and some will meet the simplistic counting criteria (3:1 aspect ratio and greater than five micrometers in length), on average the widths of cleavage fragments will be much greater than asbestos fibers of the same length. The problem with misidentification of asbestiform fibers and cleavage fragments can be seen in Figure 2.

In Figure 2, a cleavage fragment is identified as tremolite asbestos even though the width of the particle is 3.4 micrometers with a length of twenty-two micrometers (6:1 aspect ratio; asbestos fibers are generally less than 0.5 micrometers in width). In contrast, the characteristic width and length of a true tremolite asbestos fiber can be seen in the photomicrograph in Figure 3.

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40 See supra notes 1, 8.

41 See supra notes 1, 7; see also Ross M, The ‘Asbestos’ Minerals: Definitions, Description, Modes of Formation, Physical and Chemical Properties, and Health Risk to the Mining Community, Nat’l Bureau of Standards Special Publication 506, Proceedings of the Workshop on Asbestos: Definition and Measurement Methods held at NBS, Gaithersburg, MD, July 18-20, 1977, pp. 49-63.

42 See supra notes 6, 8.

43 See supra note 6.

44 See supra notes 2, 3.


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Figure 2. Scanning electron micrograph of a 3.4 µm width ‘asbestos’ fiber.

From reference 36.
Yet, despite this difference, the laboratory which incorrectly identified the cleavage fragment as asbestos is certified for performing identification and quantification of samples for asbestos.46

Despite the potential for confusion in identifying asbestos fibers, and the variety of ways “asbestos” has been defined, the common theme that these variety of definitions share is that true asbestos minerals have unique properties which make them different from not only other minerals, but other forms and structures of the same mineral. The current regulation of six mineral forms as “asbestos” is grounded upon this notion, not merely because of the distinctions in physical properties, but because the physical properties and potential health effects are linked.

V. Impact of Expanding the Definition

If the NIOSH definition of asbestos is adopted in legislation, thus bringing non-asbestiform minerals under

46 See Kelse, supra note 16.
Asbestos regulations, the consequences will be far reaching. Proponents might urge that such an expanded definition simply creates expanded protection, but this view fails to recognize the potentially negative impact on industry and the court system in this country. Moreover, as OSHA has recognized, these negative consequences would not result in any established reduction in health risks due to exposure.

A. A New Map

One of the dramatic effects of expanding the definition to include non-asbestiform minerals and other minerals of different chemical composition would be to vastly increase the number of locations in the United State where the newly-defined “asbestos” occurs. The six mineral forms currently regulated as asbestos occur rarely in nature. Should the definition of asbestos be expanded beyond these six mineral forms, “asbestos” would become far from rare. As illustrated in Figure 4, igneous or metamorphic rock can be found over vast regions of the country.47

Figure 4.

Were the expanded definition of “asbestos” to be applied, these vast regions of mere rock could suddenly be become categorized as regions containing asbestos. Entire mines, previously mining what is now considered a non-asbestos mineral, would suddenly find themselves in the business of mining “asbestos,” with a whole new host of associated regulatory requirements.48 The current infrastructure built with these aggregates containing non-asbestiform minerals would likewise be “asbestos” contaminated. It is no surprise then, that the U.S. Bureau of Mines has reported that expanding the definition of asbestos would have a significant impact on mining, and industries that use mined materials like construction, refractories, smelters, ceramics, and paint manufacturers.49

B. New Exposures

Were asbestos to go from rarely occurring, to frequently occurring, simply by a change in its definition, human exposure to “asbestos” would logically become more frequent as well. In addition to those individuals working in re-categorized asbestos mines or construction sites, any workers using the resulting products would also be considered exposure risks. With such vast expanses of land being deemed to contain “asbestos,” farmers and foresters who previously would be unlikely to work in areas with the environmental conditions likely to create asbestos might suddenly find themselves on land deemed to contain “asbestos” minerals. The economic consequences of such re-categorizations, and compliance with the related regulations, could be staggering.

C. New Litigation

Another potentially dramatic consequence of expanding the definition of asbestos would be to expand

47 See supra note 18 at 2.
48 See, e.g., 29 C.F.R. 1910.1001(b)-(c).
49 See Kelly F. Bailey, supra note 18, at 2.
the potential pool of plaintiffs seeking damages for alleged exposure-related injuries. Under the current, less expansive definition, courts have already faced a backlog of unanticipated and harmful proportions. As noted by the Third Circuit Court of Appeals, “[f]or decades, the state and federal judicial systems have struggled with an avalanche of asbestos lawsuits.” Indeed, the United States Supreme Court has described the asbestos litigation in this country as a “crisis.” The result of this “crisis” has been that approximately 730,000 claims had been filed through 2002, and at least eighty-five employers have been forced into bankruptcy, with devastating impacts on defendant corporations, employees, retirees, affected communities, and the economy. The asbestos litigation crisis has not remained isolated to asbestos manufacturers, but instead has spread to peripheral defendants in what has been described by one well-known plaintiffs’ attorney as the “endless search for a solvent bystander.” Over 8,500 defendants have been named.

If the definition of asbestos were to be expanded to the extent proposed by NIOSH, the “avalanche of asbestos lawsuits” would be likely to grow exponentially. As discussed above, the expanded definition would result in new “asbestos” mines, construction sites, exposed workers including those on what is now considered farm or forest land, and a host of downstream consumers in industry and possibly at home of “asbestos” containing products. The scope of peripheral defendants, or “solvent bystanders” that could potentially be sued would grow almost as dramatically as the number of people who could claim exposure. For a court system still struggling with an asbestos litigation “crisis,” the end result could be crippling notwithstanding the lack of regulatory or health findings in connection with non-asbestiform materials.

**Conclusion**

The impact of expanding the asbestos definition would be severely economically damaging to an extent merely touched upon here. Yet, while the negative impact of changing the definition is a reason for keeping it the same, the more compelling reason is the one already identified by OSHA. OSHA excludes non-asbestiform minerals from its asbestos definition not because of the potentially negative economic impact, but rather because of the lack of scientific evidence demonstrating a significant risk from exposure to non-asbestiform minerals or any benefits to worker health by including them. Thus, if NIOSH is correct that the non-asbestiform minerals of certain dimensions produce the same disease endpoints and at equal potency as asbestos, NIOSH should consider abandoning its guilt by association strategy and instead develop a health-based recommendation for those minerals with appropriate mineralogical terminology.

To do this, NIOSH needs to concentrate on a review of studies of workers exposed for the most part to non-asbestiform fibrous particles and mineral cleavage fragments for comparison to cohorts exposed to commercial asbestos or to minerals containing a significant percentage of asbestos. If such studies of workers exposed to non-asbestiform fibrous particles and cleavage fragments are not available or are inconclusive (despite OSHA’s apparent reliance on current data as sufficient), then NIOSH needs to set about to define appropriate cohorts of such workers with acceptable exposure information to examine exposure-response relationships for the disease endpoints of interest and in turn develop quantitative risk assessments to demonstrate that not regulating such mineral entities would pose a significant risk to exposed workers. Only if a particular exposure risk is established (though this would be contrary to currently existing evidence) can accurate and appropriate remedies be applied, and only then can the negative consequences of lumping such vastly different mineral forms under one definition be avoided.

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50 In re Combustion Eng’g Inc., 391 F.3d 190, 200 (3d Cir. 2005).
54 See Joseph F. Stilgitz et al., The Impact of Asbestos Liabilities on Workers in Bankrupt Firms, 12 J. BANKR. L. & PRAC. 51 (2003); see also Mark A. Behrens, Some Proposals for Courts Interested in Helping Sick Claimants and Solving Serious Problems in Asbestos Litigation, 54 BAYLOR L. REV. 331 (2002); Paul F. Rothstein, What Courts Can Do in the Face of the Never-Ending Asbestos Crisis, 71 Mich. L.J. 1 (2001).
55 Medical Monitoring and Asbestos Litigation — A Discussion with Richard Scruggs and Victor Schwartz, 17:3 MEALEY’S LITIG. REP.: ASBESTOS 5 (Mar. 1, 2002) (quoting Mr. Scruggs); see also Steven B. Hantler et al., Is the Crisis in the Civil Justice System Real or Imagined?, 38 LOW. L.A. REV. 1121, 1151-52 (2005).
long, thin, flexible, strong fibers when crushed or processed. Asbestos has the properties high tensile strength, flexible, and resistant to chemical and thermal decomposition. Included in the definition are: chrysotile, crocidolite, asbestiform grunerite (amosite), anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.

Aspect ratio the ratio of the length of a particle to its diameter.

Cleavage fragments mineral fragments bounded by cleavage planes. Cleavage refers to the preferential splitting of crystals along planes of structural weakness (cleavage planes). Minerals with one cleavage plane will produce platy fragments. Minerals with two distinct cleavage planes will produce prismatic or acicular fragments, and minerals with three or more cleavage planes form polyhedral fragments. The strength and flexibility of cleavage fragments are approximately the same as those of the crystals from which they are derived. Cleavage cannot produce the high strength and flexibility of asbestiform fibers.

Fiber the smallest elongated crystalline unit that can be separated from a bundle or appears to have grown individually in that shape, and that exhibits resemblance to organic fibers. A fiber cannot be separated into smaller components without losing its properties or appearance. The term “fiber” is not limited to asbestos. However it is distinct from “acicular” because it resembles organic fibers.

Fiber-like cleavage fragment a cleavage fragment which meets the criteria specified above for a fiber. In contrast to a population of asbestos fibers, a population of fiber-like cleavage fragments does not exhibit fibrillar bundling of the particles at any level of examination.

Fibril an individual fiber of asbestos, usually a single crystal.

Fibrous refers to single crystals that resemble organic fibers such as hair or cotton, and large crystals or crystalline aggregates that look like they are composed of fibers (that is, long, thin, needlelike elements). The apparent fibers do not need to be separable. If the fibers are separable, strong, and flexible, then they are asbestiform. If they have the normal strength and brittleness of the mineral they are acicular.

Habit (or Crystal Habit) the actual shape assumed by a crystal or aggregate of crystals and the terms used to describe the particular habits of minerals and mineral habits that can be found in many mineral textbooks. Habit does not imply a particular crystal structure or chemical composition. Many minerals, including the asbestos minerals, crystallize in a variety of habits depending on the environment in which the mineral forms. Therefore, habit alone cannot be used to identify a mineral.

Mineral a homogenous naturally occurring inorganic and crystalline substance with distinct crystal structure and a limited variation in chemical composition.

Mineral Group minerals that have essentially the same structure but have different cations (positively charged ions) in secondary structural position (for example, amphiboles). All mineral groups have names and for some the name is the name of a common or important member of the group (for example, serpentine).

Mineral Series two or more members of a mineral group in which the cations in the secondary structural position are similar in properties and can be present in variable, although frequently limited ratios (for example cummingtonite-grunerite).

Pseudofiber (Apparent fiber) a term applied to single crystals or polycrystalline aggregates that have a fibrous appearance but are not composed of separable fibers.