Chrysotile Asbestos is Harmless

The BLM and the EPA are lying to us so that they can use this as an excuse to restrict our rights. Here are the facts, study them and don’t let the BLM or the EPA continue to feed you the crap about chrysotile being dangerous. Don’t compromise - Chrysotile Asbestos is Harmless – BLM and EPA lies are dangerous.


"this study clearly shows that at an exposure concentration 5000 times greater than the U.S. threshold limit ..., chrysotile produces no significant pathological response in a subchronic inhalation toxicology study."


"Calidria chrysotile cleared from the lung with a half-time of 0.3 days, 7 hours, which is faster than any other commercial mineral fiber."

"These findings provide an important basis for substantiating both kinetically and pathologically the differences between chrysotile and the amphibole tremolite. This has been demonstrated for three different chrysotile samples from Canada, the United States, and Brazil. As Calidria chrysotile has been certified to have no tremolite fiber, the results of the current study together with the results from toxicological and epidemiological studies indicate that this fiber is not associated with lung disease."


"No treatment-related lesions were observed in 9 monkeys maintained for 11.5 years following an 18-month inhalation exposure to short (<5 μm long) chrysotile asbestos at a concentration level of 1.0 mg/m3."

Abstract:

There has been a longstanding debate about the potential contribution of chrysotile asbestos fibers to mesothelioma risk. The failure to resolve this debate has hampered decisive risk communication in the aftermath of the collapse of the World Trade Center towers and has influenced judgments about bans on asbestos use. A firm understanding of any health risks associated with natural chrysotile fibers is crucial for regulatory policy and future risk assessments of synthesized nanomaterials. Although epidemiological studies have confirmed amphibole asbestos fibers as a cause of mesothelioma, the link with chrysotile remains unsettled. An extensive review of the epidemiological cohort studies was undertaken to evaluate the extent of the evidence related to free chrysotile fibers, with particular attention to confounding by other fiber types, job exposure concentrations, and consistency of findings. The review of 71 asbestos cohorts exposed to free asbestos fibers does not support the hypothesis that chrysotile, uncontaminated by amphibolic substances, causes mesothelioma. Today, decisions about risk of chrysotile for mesothelioma in most regulatory contexts reflect public policies, not the application of the scientific method as applied to epidemiological cohort studies.

Conclusion:

Conclusions regarding causation of mesothelioma from chrysotile uncontaminated by identified amphiboles must be based on the application of the scientific method. Observations, hypothesis generation, hypothesis testing, and replication of results (i.e., the scientific method) are the accepted process steps for deriving conclusions about a theory. The basis for determining whether chrysotile asbestos causes mesothelioma should rest primarily on the results of analytic epidemiological studies. Most cohort studies that have been published have the potential for concomitant amphibole fiber exposures. Epidemiological studies investigating mesothelioma risk from exposures of cohort members to chrysotile asbestos fibers not known to be contaminated with amphiboles do not justify a conclusion of causality at this time. Whenever mesothelioma cases have been observed in cohort studies, the presence of amphiboles has not been ruled out. Although the causal hypothesis has been studied intensively for cohorts primarily exposed to chrysotile, the number of mesotheliomas observed has been far fewer than those where amphibole exposures occurred, and the possibility of unidentified amphibole exposures remains in these few individual cases where only exposure to chrysotile asbestos was identified for the entire cohort. Hopefully, risk communications and public policy can be improved by thorough medical review of the literature of human studies spanning most of the last century.
The Health Effects of Chrysotile Asbestos

The famous mortality study led by Corbett McDonald has followed 11,000 Canadian chrysotile miners and millers until 80% were dead; only 33 mesotheliomas were reported and excess lung cancers occurred only at very high exposure levels. Yet that same chrysotile used in textile manufacture in South Carolina was associated with a 50 times greater lung cancer mortality.

This volume, published in 2001 by The Canadian Mineralogist, reports the papers presented and the ensuing discussion and commentary at a symposium in 1997 called by the Canadian Government to discuss the health issues surrounding the continued production and use of chrysotile asbestos. Can the mineral be used safely? To most uninformed observers, the answer must be a clear no. The true answer is of course not so clear cut. Much of the evidence suggests that chrysotile itself is much less hazardous than the amphiboles and that the serious risks associated with chrysotile are a consequence of its contamination by tremolite, an amphibole that is found in geological intrusions into the chrysotile ore body. These are the issues discussed by the distinguished geologists, mineralogists, epidemiologists, risk analysts, and pathologists who contributed to the symposium. Among them are the last published contributions of two who made great contributions over many decades to investigating the hazards of asbestos and to protecting workers, the late Chris Wagner and Bob Murray. The resolution of this conundrum may seem unimportant to those who live in countries where past exposures have been to mixtures of amphiboles and chrysotile and where use of asbestos has effectively ceased. However, industry continues to need durable fibres and the poor world sees substantial advantages in using cheap asbestos cement for water pipes and roofing material. And the issue is of course important to the Canadian and Russian chrysotile industries and their employees. Anyone who has been involved in the asbestos debate, who gives advice to industry or lawyers on asbestos issues, or who is interested in the complexities of the interface between science and regulation will find much of fascination in this volume.
Most asbestos poses little human risk. Since 1972, EPA has taken a number of steps to limit nonoccupational exposures to asbestos, a family of carcinogenic minerals. These regulations treat all members of the family equally. However, asbestos toxicologist Brooke T. Mossman asserts, human studies published by several researchers in the past two years suggest chrysotile asbestos poses no hazard at levels encountered outside the workplace—and perhaps not even in the workplace these days. Chrysotile has been the type most commonly used in the United States.

Mossman, of the University of Vermont in Burlington, and her colleagues measured mean levels of asbestos in U.S. schools and other buildings. In the Jan. 19 SCIENCE, they report that these exposures are quite low—on a par with outdoor levels—even where asbestos-containing materials appear severely damaged. The researchers recommend that policymakers reevaluate the wisdom of equating chrysotile risks with those of other asbestos fibers and reassess the need to remove it from buildings. Indeed, Mossman says, "our data suggest that if chrysotile is handled properly in the workplace, it does not present a risk to human health."

Chrysotile's curly shape distinguishes it from other asbestos fibers, called amphiboles, which sport a needle-like structure. The serpentine shape may make chrysotile less likely to penetrate lung tissue and more likely to be cleared from tissue. In the past, researchers have cited this as a possible explanation for epidemiologic observations that workers in the chrysotile industry, compared with other asbestos workers, have a lower incidence of life-threatening lung ailments—in particular lung cancer and mesothelioma, a fatal cancer that strikes only those who have inhaled asbestos or another, similar fiber. But more recent studies suggest chrysotile exposure may have induced few if any such cancers, Mossman says. They reveal that the workers who developed these cancers were also exposed to other carcinogens, most notably cigarette smoke and several of the amphiboles.

Chrysotile fibers are more toxic to cells than are amphiboles, Mossman's work indicates. However, she says, the extra toxicity may actually benefit exposed animals by killing damaged cells before they can multiply to spawn a malignancy.

EPA has "yet to reach a definitive decision about one type of asbestos being less harmful," says Tom Tillman of EPA's Office of Toxic Substances. He adds that the agency has officially begun a technical analysis of the new SCIENCE Report.
This report discusses the “disappearance” and subsequent discovery of a significant part of the results from one of the largest asbestos inhalation studies ever done. The data that went “missing” were concerned, for the most part, with two major issues: the potential biological effects of short fibre chrysotile and the ability of a single asbestos exposure to produce a risk of disease for life. The “missing” data are related to the fundamental determinants of asbestos-related disease: fibre type, length and dose. Short fibre chrysotile is ubiquitous being the most common form of asbestos in air (including the atmosphere of buildings, water, soil and lung). Its large atmospheric contribution comes from numerous, naturally occurring outcroppings as well as diverse commercial products such as brake linings, tiles and cement. Therefore, information to scientifically “exonerate” short fibre chrysotile as a human health hazard would have had very major regulatory, socio-economic and legal implications. Indeed, since the start of asbestos litigation, the idea that all forms of asbestos, even in the tiniest doses, are equally harmful has been absolutely central to Plaintiffs’ case and has formed the basis of US regulatory policy for decades.

The US Government was aware these two issues had to be scientifically resolved in the 1970s and decided to fund one of the largest asbestos inhalation studies in an attempt to do so. The “standard” chosen to represent short fibre chrysotile was from the New Idria deposit near Coalinga, California and was called the NIEHS “short” preparation. The protocol chosen to test this short fibre standard was a chronic inhalation assay wherein the animals would be followed for life after 12 months’ exposure to fibre. The “standard” chosen to test the “irreversibility” question regarding the long-term effects of breathing in a single dose of asbestos was chrysotile from the Jeffreys mine in Canada. This “long” fibre preparation was called the “NIEHS Intermediate” standard. To answer the two questions under consideration, the data from the chronically exposed Coalinga–treated and the acutely exposed Jeffreys–treated animals would have to have been examined after long-term follow up nearly towards the end of their lives. Although these analyses appear to have been done, the resulting data from the chronic study never saw the light of day until publication of the short fibre work in 1997 and 1998. The “irreversibility” data from the acute study are still missing.

... discovery of these data was unfortunate since full publication when it was first completed may have caused the Agencies to “de-list” short fibre chrysotile as a carcinogen following inhalation and may also have caused them to reconsider their views on dose and threshold.

... full publication of the long-term follow-up of the acute short-term (high concentration) exposure data would have demonstrated that a single high dose exposure to long fibre chrysotile would not result in long-term, progressive, irreversible scarring.
Regulatory Conclusions

Various US Agencies have concluded that the New Idria deposit contains exclusively chrysotile. The Agency for Toxic Substances Disease Registry (ATSDR) has said that “only chrysotile is of importance to the Atlas and the JM Coalinga mill site”. Woodward Clyde Consultants under contract to EPA Region IX prepared an inventory of potential asbestos sources in the New Idria Coalinga Study Region for the Atlas and the Coalinga Superfund Sites (US EPA Contract: 68–01–6939; Doc. No. 239-R11-RT-EYJX: 15 September 1987, Appendix A) and stated: “Chrysotile asbestos is the only asbestos mineral found in the (New Idria) region.”

Conclusions

Direct analytical studies using the most sensitive methods, conducted over almost 50 years, have failed to find amphibole asbestos in Coalinga chrysotile. Very rare examples of amphiboles have been found in the New Idria region but these were not asbestiform, located outside the ore zone in very limited, narrow zones, selvages, or mono-mineralic rinds most commonly found along the outer rims of tectonic blocks. The chance that these could contaminate the mined ore or become incorporated into milled Coalinga chrysotile is extremely remote. If it ever occurred, incorporation into milled ore would result in a level of contamination amounting to less than a few ounces of amphibole in many thousands of tons of chrysotile. Moreover, the non-asbestiform nature of the amphiboles means they would lack biological potential and be of no biological consequence. Indirect evidence related to the manner in which the New Idria deposit forms and the physical and chemical determinants of tremolite largely explain why Coalinga chrysotile does not contain amphibole asbestos and also why tremolite does not naturally contaminate all chrysotile deposits.

Further evidence that Coalinga chrysotile does not contain amphibole asbestos comes from human observations of workforces that mined and milled this material and of populations living on and near the ore body. To date, there has not been any evidence of an attributable excess of pleural plaques or mesothelioma in any of these individuals. Since pleural plaques and mesothelioma are causally associated with exposure to amphibole asbestos, their absence is therefore also consistent with the view that Coalinga chrysotile is not contaminated by asbestiform amphibole.

Conclusions:

We found no measurable excess risk of death due to lung cancer among women in two chrysotile-asbestos–mining regions. The EPA’s model overestimated the risk of asbestos-induced lung cancer by at least a factor of 10.
False alarms over asbestos rack up costs. (unwarranted concern over health risks from asbestos in school buildings and other structures)

Abstract:

Malcolm Ross, a member of the US Geological Survey, has been studying the health effects from asbestos in building materials since 1971. He has leaned that there are major differences among the three kinds of asbestos. Chrysotile, the kind used in buildings, does not have a health risk.

Full Text:

San Francisco radio shows went into panic mode in early December over a report that bags of construction debris containing asbestos had fallen off a truck on the Bay Bridge, which connects the city with Oakland.

The asbestos spill happened at 6:40 a.m., just as rush hour was starting, and health authorities immediately closed the bridge, sending thousands of commuters scurrying for alternate routes. The San Francisco Chronicle called the resulting mess the "worst traffic snarl in years." Consumer activists warned residents to shut their windows and take showers if they felt that any of the asbestos might have blown off the bridge and contaminated them.

But was this asbestos panic really necessary? During the day, a radio talk show reporter called one of the federal government's leading experts on asbestos. "What should we do?" she asked excitedly. The expert replied: "Bring out the fire hoses and wash the mess into the bay and go about your business. This asbestos spill is about as dangerous as sunshine. It isn't going to hurt anyone."

His answer startled her. "But that would cause cancer!" she responded. The expert started to laugh, explaining that the rock formations at the bottom of San Francisco Bay have already put far more asbestos into its waters than could come from the small amount of spilled construction debris. The danger, he said, was so small it was almost nonexistent. He added that San Francisco residents faced far more danger trying to commute on unfamiliar roads than they would from the asbestos spill.

Because of a technical glitch, the asbestos expert never got on the air, and some lanes on the bridge were closed until after midnight.

What a great example of how the media don't do their job. The fact is that casual exposure to small amounts of asbestos poses no risk to human health. This has been stated time and again by objective scientists who have studied the subject.

The U.S. Geological Survey's Malcolm Ross, a former president of the Mineralogical Society of America, has been studying asbestos since 1971, when a scare arose over the possible health effects of chrysotile asbestos in dust from a quarry in the Washington suburbs. Local television stations introduced their stories with the skull-and-cross bones symbol.

Given that panic, Ross wondered what could happen on the national level. He did his research and found there are extreme differences between the health effects of the three major types of asbestos: chrysotile, amosite and crocidolite. He found that chrysotile, the
type most often found in schools and other buildings, poses no health risk. He began arguing this view to the federal government in the 1970s and published numerous papers on asbestos. He argued that a proposed asbestos abatement program for schools not only would be costly, but also would release asbestos into the environment that was not there before.

Ross won the Interior Department's highest honor, the Distinguished Service Award, for his work on asbestos. However, Congress ignored his conclusions and mandated the abatement program. As Ross told the journal Nonrenewable Resources recently, "Since the [abatement] program started in 1985, well over $50 billion has been spent to remove asbestos from schools and other buildings. In 1992, asbestos abatement cost the nation nearly $9 billion, an amount as large as the 1992 budget for the U.S. National Institutes of Health." He called this spending "entirely unnecessary and, in fact, counterproductive" from a health standpoint.

In June 1990, William Reilly, then head of the Environmental Protection Agency, reversed government policy on asbestos, stating that it was usually unnecessary to remove asbestos from buildings. Nonetheless, our media -- and many public officials -- continue to go into a frenzy at the sound of the word asbestos.

The Bay Bridge scare in San Francisco was not unique. There was a similar panic last August, when New York City school officials found that some asbestos that was supposed to have been removed from school buildings remained. The media whooped up a scare that forced officials to delay school openings for two weeks, leaving more than a million kids out on the dangerous streets.

The media have helped perpetuate the fear of asbestos from coast to coast. The cost has been enormous in money and in increased risks.


Abstract:

Exposure to asbestos minerals has been associated with a wide variety of adverse health effects including lung cancer, pleural mesothelioma, and cancer of other organs. Many of the regions of Turkey have asbestos deposits. People in Doganlı village – one of these regions – have been environmentally exposed to chrysotile asbestos since they were born. In this study the effects of asbestos on micronucleus (MN) frequencies of inhabitants exposed to chrysotile asbestos have been examined. Thirty subjects who had been environmentally exposed to chrysotile asbestos and living in Doganlı village, and 25 controls were studied to assess the MN frequency. The control group was selected from healthy individuals with no exposure to asbestos and living in similar geographic conditions to Doganlı village. Peripheral blood samples were collected from each subject and cultured for MN assay. Cytochalasin-B was added to lymphocyte cultures for evaluation of MN in binucleated (BN) cells. The differences between those exposed to chrysotile asbestos and controls were not statistically significant in terms of BN cells with MN (p>0.05). There was not a significant relationship between MN frequencies and age, sex, smoking, both in chrysotile asbestos-exposed subjects and in controls (p>0.05). Although the detection of calcified pleural plaques found in the inhabitants has indicated environmental exposure to chrysotile asbestos, our results show that chrysotile asbestos was not an inducer of MN in subjects exposed to chrysotile asbestos.
Recent Research on Chrysotile Exposure and Mesothelioma Risk

The question of whether or not chrysotile exposure is a risk factor for mesothelioma is a matter of ongoing debate, and there are some relatively recent published papers that have reviewed the epidemiological evidence and reached conclusions on this issue. Some researchers support the proposition that chrysotile exposures theoretically might cause mesothelioma, but that the epidemiological weight of evidence is and Chatfield, 1998; Yarborough, 2006; Dunnigan, 1988). For example, Yarborough (2006) recently analyzed the results of 71 asbestos-exposed cohorts studies, and concluded that “Epidemiological review of cohorts does not support the hypothesis that exposures to chrysotile fibers, uncontaminated by amphiboles, cause mesothelioma” (p. 180). It should be noted that the “chrysotile-only” cohorts considered by Yarborough suffer from the same study design limitations as those considered here (i.e., lack of case-control methodology for a relatively rare disease).

Conversely, others have concluded that the evidence is clear that chrysotile alone can cause mesothelioma. For example, in an analysis conducted by Smith and Wright (1996), 25 asbestos cohort studies were examined, and the authors stated that “Since asbestos is the major cause of mesothelioma, and because chrysotile constitutes 95% of all asbestos used worldwide, it can be concluded that chrysotile asbestos is the main cause of pleural mesothelioma in humans” (p. 252). In a more recent analysis, Li et al. (2004) reviewed the evidence from 26 different cohorts and concluded that chrysotile asbestos exposure alone can cause both mesothelioma and lung cancer. According to the authors, “Only cohort studies on cancer mortality among workers exposed to chrysotile alone were incorporated into the meta-analysis” (Li et al., 2004, p. 460). However, at least half of the cohorts included in this analysis were known or suspected to have some degree of amphibole exposure (Dement et al., 1994; Hughes et al., 1987; McDonald et al., 1983b, 1984; Peto et al., 1985; Piolatto et al., 1990; Newhouse and Sullivan, 1989; Liddell et al., 1997; Germani et al., 1999; Raffn et al. 1996; Gardner et al., 1986; Thomas et al., 1982; Ohlson and Hogstedt, 1985). While the exposure-response summary described in this article cannot directly address the general question “Is chrysotile a risk factor for mesothelioma under any circumstances?” due to the presence of amphiboles in most of the mesothelioma cohorts considered here, it does seem to indicate that low occupational exposures to chrysotile (e.g., exposures historically experienced by vehicle mechanics) are unlikely to cause mesothelioma. Our findings suggest that a thorough understanding of chrysotile exposures that might occur in a given setting (e.g., estimated exposures that might occur during manufacture or use of microelectronics with synthetic chrysotile fibers) will provide assistance in reaching conclusions regarding the relative safety of such activities.

Abstract:

In contrast to amphibole asbestos, chrysotile asbestos fails to accumulate in human lungs. The reason for this phenomenon is not known. To examine this problem, we extracted chrysotile and tremolite fibers from the lungs of 11 chrysotile miners and millers whose last exposure was within 2 years of death and 12 chrysotile miners and millers whose last exposure was greater than 12 years (7 with last exposure 12-15 years and 5 with last exposure 22-25 years) before death. Fibers were extracted by bleach digestion, and concentrations, compositions, and sizes were determined by analytical electron microscopy. Native UICC Canadian chrysotile was used as a composition standard. Compared to the standard, there was minor loss of magnesium at 2 years and additional very slight loss after 12 years. The ratio of chrysotile to tremolite concentration did not change with time. There was also no evidence of increasing fiber length with time from last exposure. These data indicate that accumulation of amphibole compared to chrysotile in human lungs does not reflect either long-term dissolution of chrysotile or long-term preferential clearance of chrysotile compared to amphibole. Contrary to results of animal studies, fiber length in humans does not increase with time since last exposure. These findings imply that the failure of chrysotile to accumulate in human lungs reflects events that occur early after exposure rather than long-term clearance mechanisms.


Abstract:

Primary malignant mesothelial tumours were recognized by pathologists before asbestiform minerals (chrysotile, crocidolite and amosite) were mined commercially. The discovery, 40 yrs ago, of a causal link with crocidolite and the wide-ranging epidemiological studies which followed are the subject of this review. Early case-control and descriptive surveys, supplemented by cohort studies in insulation workers and chrysotile miners, quickly demonstrated major occupational and geographical differences, with high risk in naval dockyard areas and in the heating trades. In the 1980s, reliable cohort surveys showed that in mining and in the manufacture of asbestos products the mesothelioma risk was much higher when exposure included crocidolite or amosite than chrysotile alone. However, qualitative and quantitative information on exposure was too often inadequate for this evidence to be conclusive. Well-controlled lung fibre analyses have reduced these deficiencies and demonstrated the probable implications of the greater biopersistence of amphibole fibres. Chrysotile for industrial use often contains low concentrations of fibrous tremolite, which may well explain the few cases of mesothelioma associated with this type of asbestos.
In 1960, Wagner et al. reported 33 cases of a malignant tumor known as mesothelioma, which he attributed to crocidolite exposure. The discovery focused attention on the question of asbestos fiber type and disease. This rare tumor was the last of the three major asbestos-related diseases to be identified. The potency of chrysotile to induce this tumor in humans remains a subject of considerable controversy. It also is clear that exposure to crocidolite asbestos, actinolite/tremolite asbestos, and grunerite asbestos produce considerably higher incidence of this disease, sometimes even after exposures that are considered quite low. The patterns of mesothelioma depending on asbestos fiber type are strikingly different in that a high mortality for mesothelioma is never found among individuals exposed only to chrysotile asbestos, although from time to time, individuals present with pleural mesothelioma and high concentrations of chrysotile are found to be present in the pulmonary tissue by lung content analysis.
Conclusions

The New Idria asbestos-bearing serpentinite mass is a unique geologic phenomenon created by plate tectonic evolution of Western North America. Transform faulting along the San Andreas fault system has produced shortening of the former continental margin manifested by sub-parallel thrusting and folding. Continued wedging of the Franciscan ophiolite peridotites into the continental crust developed a chain-reaction serpentinization accompanied by expansion. Thousands of tectonic events acting on the serpentinite have produced a huge deposit of short-fiber asbestos by tectonic milling and recrystallization. Erosion of this tectonized serpentinite since Miocene (15 ma) has introduced asbestos bearing clastic material to all of the sediments deposited along the flanks of the serpentinite dome. The present configuration and drainage patterns around the serpentinite mass show stratigraphic evidence in stream terraces that Holocene deposition of asbestos-bearing serpentinite has been continuous and pervasive up to the present time.

Inert bureaucratic applications of EPA's charter has resulted in the designation of two small asbestos mines as superfund sites as the point source for all the toxic asbestos discovered in the California aqueduct waters and the Arroyo Pasejaro ponding basin. This mistake needs to be re-examined as the usual EPA Superfund Site procedure designates a responsible party who is then liable for clean up with the usual harvest of litigation expense even before any clean-up begins. Continued expense of taxpayers money to remediate this "phantom risk" of the Atlas and J-M mine should be exposed by a public hearing. At such a hearing the scientific evidence as well as the interests of local land owners, ORV enthusiasts, BLM, EPA, and other local government agencies involved in regulation of public lands should be discussed and brought into perspective.

Careful geologic, ecological, and land use studies should always be made at all superfund sites so that the role of nature is understood and can be utilized for common sense remediation. The initial studies of any superfund site should also seek the input of local citizens or industry, who often retain important historical records of their land use. Had this been done in the early stages of the CCMA by BLM and EPA it is possible that a less expensive and safe solution could have been created some time ago.

"Improper analysis of nonconstruction materials for asbestos content often results in the misidentification of non-asbestos amphibole particles as asbestos fibers."

"Crushing or grinding of prismatic amphibole crystals may produce elongated particles that morphologically appear similar to asbestos, but do not possess the same unique physical properties."

"Combined with laboratories’ limited experience with amphibole asbestos, this has created the impression that true non-asbestos, nonfibrous, prismatic amphibole particles are asbestos and, as a result, they are often counted as such."

"The EPA has recently concluded that very long, thin fibers have the highest potential for carcinogenicity. The basis for this revised consideration is a study by Berman and Crump which showed that tumor generation is related to the concentration of fibers longer than 40 mm. This information was then incorporated into a new risk model in which the concentration of fibers longer than 10 mm and thinner than 0.4 mm was considered to be the most relevant. This risk model did not differentiate between asbestos and non-asbestos fibers, but did acknowledge that an aspect ratio of 20:1 or greater should eliminate most of the non-asbestos particles."

"In many laboratories the standard operating procedure is to identify as asbestos any particle that meets the aspect ratio specified in the method and is consistent with the chemistry of the regulated mineral, making the aspect ratio the de facto definition of asbestos. Many laboratories and industrial hygienists also employ a non-scientific theory, ‘If in doubt, count it,’ under the misguided assumption that false positives are less significant than false negatives."

"When non-asbestos minerals are crushed, fragments are cleaved away from the main crystal mass, a process that produces ‘cleavage fragments’. ... These cleavage fragments may have a similar microscopic appearance to that of true asbestos fibers. ... However, there has not been a well-defined method for discriminating between individual asbestos and non-asbestos particles in the TEM."

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EPA, Sampling and Analysis Plan for Asbestos Air Sampling Clear Creek Management Area San Benito County, California, 2004, p. 1-3

PCM, the historical technique for asbestos analysis, is cheaper, but is unable to distinguish between asbestos and nonasbestos fibers. p. 1-3

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