

Chalk Dust: Mitigation & Source Control

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Dealing with chalk dust is something that climbing gyms are entirely too familiar with; everywhere there are climbers, there's chalk. Most gyms implement chalk mitigation strategies, whether it's a never-ending cleaning and vacuuming circuit, installing a chalk eater, or a state of the art HVAC system.

The father of modern bouldering, John Gill, who had a background in gymnastics, is credited with introducing chalk to climbers at Stone Mountain, Georgia, in 1954. While its effectiveness at increasing friction was immediately apparent, climbing purists objected to chalk and considered it an ethical dilemma. Not only was the use of chalk to improve grip and keep hands dry considered to be a questionable ethical advantage, it, additionally, builds up on holds and permanently discolors the rock.

While today the use of chalk is considered par for the course, in climbing gyms, chalk presents issues as it gets onto practically every available surface and the airborne particles affect air quality. The standard acceptance of chalk use places gym owners and managers in constant reactive mode, which means that in order to implement a successful mitigation strategy, the gym has to stop being reactive and become proactive. This is easier said than done.

What is Chalk?

The main ingredient in chalk is magnesium carbonate, also known as [MgCO₃ · nH₂O](#), it's an odorless, dry fine or bulky powder. In addition to being used for climbing and other sports, magnesium carbonate is widely used as an antacid, an anti-caking agent in food and in personal care products. [Pub Chem](#) notes that magnesium carbonate is listed as a safer chemical by the EPA. It is known as a green circle chemical and has, "...been verified to be of low concern based on experimental and modeled data." Pub Chem also notes that it has been reported to cause

eye and skin irritation, with exposure routes typically on the skin or eyes and through inhalation, with recommendations to wash or rinse the skin or eyes with fresh water, or to breathe fresh air. As an inhalation it is noted that a “nuisance-causing concentration of airborne particles can be reached quickly when dispersed.” Which gym owners and staff know, as the air in gyms can appear hazy at peak times. Which leads to many questions about how chalk dust affects indoor air quality.

Indoor Air Quality

With HVAC systems running into the tens of thousands and chalk eaters cost nearly \$2000 to clean 5000 square feet of gym space, understanding the basic of chalk particles and air quality is necessary to making good decisions on how to mitigate chalk in your gym. Airborne particles of chalk are known as particulate matter (PM). Understanding how air borne chalk particles affect air quality means understanding some basics of indoor air quality (IAQ). The EPA defines indoor air quality as, “the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants.”

The primary causes of poor indoor air quality are:

- Indoor pollution sources that release gases or particles, such as VOC’s.
- Outdoor chemical contaminants: Vehicle or building exhaust, plumbing vents
- Biological contaminants: Bacteria, molds, pollen, insects, bird droppings and viruses.
- Physical contaminants: Particulate matter (PM) is a complex mixture of solid and/or liquid particles suspended in the air (which can include soil, dust, metals, organic chemicals, sulfates and nitrates).
- Inadequate ventilation: Indoor pollutant levels can be increased by not bringing in enough outdoor air and by not carrying indoor air pollutants out of the building.
- High temperature and humidity levels: High temperature and humidity are related to increased concentrations of some pollutants.

Size Matters

Visible dust on the floor, or surfaces of the gym is unsightly and messy, but unless it’s disturbed it’s not creating problems for air quality. Gym members can and will complain about chalk covered surfaces and greasy holds that have a build-up of chalk, sweat and skin oil. When you see chalk dust on the floor or on a surface it’s very fine, like talc, what you are seeing is a bunch of sub-micron particles lumped together to make a larger particle. It’s the smaller particles of chalk, the ones you don’t see or recognize that affect air quality.

The EPA is concerned about particles 10 micron or smaller because these particles are inhalable. These particles once inhaled can affect the heart and lungs and cause serious health effects. But it’s important to note that the EPA concerns are based on outdoor PM levels, which are well studied and documented. Outdoor PM effects on human health are well-established and are

used to set health-based standards for outdoor air. However, less is known about the specific impacts of indoor PM on health. PM is found in all indoor environments.

Due to poor ventilation and other contributing factors, indoor PM levels have the potential to exceed outdoor PM levels, indoor levels can be gauged by MERV rating. MERV means Minimum Efficiency Reporting Value this rating was developed by the American Society of Heating, Refrigeration and Air Conditioner Engineers - ASHRAE. MERV values run on a scale from 1 to 16 and gauge the effectiveness of the HVAC system in a building or indoor space. For instance, if your HVAC system has a high MERV rating, it is more efficient, meaning that the filter will trap more airborne particles. But filters alone don't make for effective air cleaners: you have to figure in air flow through the HVAC system and how clean the air filters are. A dirty or clogged air filter or using a filter that is too restrictive may result in low air flow and could cause the system to malfunction.

90% of chalk dust is estimated to be 5 microns or less, it's very very small. A "micron" is a unit of measurement and is an abbreviation of the term "micrometer". One micron is a millionth of a meter (1/1,000,000 meters) or about .00004 inches. Steve Smith with Camfil USA, a company that develops and produces air filters and clean air solutions, has extensively studied, how chalk particles fall. On average Smith says, in a controlled environment it takes 5.7 seconds for a 6 micron and bigger chalk particle to fall 10 feet. But, Smith says, chalk particles 5 microns and smaller are so small that gravity doesn't have an immediate effect on them and it can take up to 33 days for them to fall down out of the air, but in areas that have air flow, the particles are constantly being moved and lifted. Chalk particles of 1 micron or less become permanent dust as gravity has no effect on particles of that nano size.

The physics of air flow creates a challenge when it comes to getting chalk dust out of the air. It's difficult to generate a sucking air flow that is strong enough to pull the particles out of the air, so particles are removed by blowing particles through the air from one air cleaner to the next to collect all the sub atomic particles.

There are three basic strategies to improve indoor air quality:

- **Source Control:** Usually the most effective way to improve indoor air quality is to eliminate individual sources of PM or pollution or to reduce their emissions.
- **Ventilation Improvements:** Ventilation also helps remove or dilute indoor airborne pollutants coming from indoor sources. This reduces the level of contaminants and improves indoor air quality (IAQ).
- **Air Cleaners:** An effective air cleaner is an efficient collector of PM and has high air-circulation rate.

When athletes and climbers are engaged in physical activity, they have an [increase in respiratory minute ventilation](#) which has a proportional effect on increasing the quantity of PM that is inhaled. Additionally, an increase in airflow velocity can deliver PM deeper into the respiratory tract. It is known that PM of 5 microns and smaller can [enter the lungs and bloodstream](#) where

they can build up and cause health problems.

What is known about people who are exposed to poor IAQ is that they can experience health effects at the time of exposure or even years after breathing it. Symptoms can include: eye, nose, throat and lung irritation, coughing, skin irritation, headache, fatigue, dizziness and nausea.

Are There Effects of Breathing Chalk Particles?

There is no known research on the effects of humans breathing in chalk dust. Dr. Cheryl Pirozzi, a Pulmonary Physician with the University Of Utah Hospitals And Clinics and a climber herself, does research on the effects of outdoor pollution. The effects of breathing in climbing chalk is a topic that she has spent quite a lot of time thinking about. Dr. Pirozzi notes that to her knowledge there is no published data on the specific health effects of humans breathing in magnesium carbonate and that it isn't known what the PM 10 or PM 2.5 concentrations in indoor climbing gyms are, "these are two big research questions that we need information on," says Dr. Pirozzi.

Higher occupancy rates and the type of activity developing in the gym effects indoor air quality as athletes and climbers increase CO₂, while high occupancy also influences PM concentrations. Dr. Pirozzi says that, "concentrations of PM 2.5 and PM 10 are going to vary quite a bit due to building characteristics, the filter, MERV rating, climbing traffic and time of day." Generally speaking, Dr. Pirozzi can talk about the health effects of particulate pollution, but she thinks it is unknown how much particulate pollution climbers are exposed to in gyms.

A [2008 study](#) and a [2012 study](#) on chalk dust concentrations and reduction strategies both measured very high levels of particulate matter during busy hours. Dr. Pirozzi says, "This shows that climbing gyms may have very elevated levels of particulate matter, but there are likely many factors that would influence those levels. It would be interesting to evaluate with the newer filter systems."

OSHA has standards of permissible exposure limits for magnesium carbonate that consider both the concentrations of magnesium carbonate in the air and length of exposure, however without specific data from gyms, there is no way to determine the air quality and how much, if any, magnesium carbonate indoor climbers are exposed to. The question Dr. Pirozzi wants to know the answer to is; are there different health effects from exposure to magnesium carbonate compared with other PM? The answer to this question, she acknowledges lies in study and research.

Source Control

The simplest approach is to implement reduction strategies, to reduce the amount of chalk dust in the gym and you'll reduce the amount of dust in the air and on surfaces. Considering the ritual most climbers have regarding around the way they chalk up before a climb, or can obsessively chalk up while on a route, it's not realistic to ban chalk. But there are strategies between all or

nothing that can be implemented.

Specify the Type of Chalk and the Delivery Method Members Use

Many gyms ask members to not use loose chalk, asking members to use chalk balls or liquid chalk instead. A [2012 study](#) on the air borne concentrations of multiple types of chalk using chalk balls, pressed chalk and powdered chalk. The study determined that with the exception of liquid chalk; chalk balls, pressed and powdered chalk leads to airborne chalk particles, the concentration of which is determined by traffic in the gym. While chalk in a chalk ball does not lead to a significant reduction in airborne particles compared to regular block chalk, it is worth noting that the chalk ball does prevent spills. But the study is clear in stating that chalk balls did not lead to a reduction of airborne particles. In comparison ethanol based (liquid chalk) led to the same low mass concentrations of airborne chalk particle as banning chalk entirely.

Educate New and Existing Members on How to Chalk Up

In general climbers use too much chalk, says Kevin Brown of FrictionLabs. A climber for over 20 years, Brown says it all too common for climbers to use too much chalk and cake it on their hands and fingers. Too much chalk he explains actually acts like a dry lubricant, and he notes that generic chalk contributes to the problem, as climbers tend to use more of it and it gets spilled. FrictionLabs recommends that climbers use less chalk and employ a layering strategy: apply a base layer of liquid chalk then reapply small amounts of loose chalk as needed, the liquid chalk base will reduce the total amount of chalk the climber uses in a session. Brown states, “just like there is a belay test and safety talks about the skills that climbers need, climbers need to know about chalk. Chalk creates a huge mess in the gym and no one really talks about how you should use chalk.” When you put chalk on your hands initially, Brown says, instead of reaching down into your chalk bag repeatedly for more chalk, you can move it from one hand to the other, distributing it from your palms to your fingertips. Layering with liquid chalk works by filling in all the nooks and crannies, and creates a good base layer climbers will need less additional chalk as they climb. Climbers don’t need a completely chalky hand to have a good grip, Brown notes that there’s a real opportunity for climbers to use chalk smarter.

Putting It All Together

Installing HVAC systems, chalk eaters, or implementing cleaning protocols impacts your bottom line either in major capital expenses or ongoing increased labor, this is considered a reactive approach, cleaning up after the fact. It’s nearly unimaginable that gyms could or would ever ban all types of powdered chalk, but implementing education about how to apply and use chalk is definitely a step in the right direction.

About The Author



Amanda Ashley is a writer, climber, and a climbing mom. From her early days spent training on the musty community woody in The School at the New River Gorge to training in modern mega climbing gyms all over the West, she's seen the rise of climbing gyms and the evolution of routesetting up close and personal for the past 20 years. Amanda writes about climbers, routesetting, changes in climbing movement and performance, and the climbing industry. Amanda's work has appeared in Climbing Magazine, Climbing Business Journal, and the Utah Adventure Journal.

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