TECHNO FILE

studio dust

by Mark Goldberg, PhD and Colleen Dwyer-Meloche

Most potters know that silica can cause serious, long-term health effects, and other materials used in ceramics, such as metals, are also hazardous. We measured dust in our studio and found that high concentrations of dust can be generated from common activities. These observations suggest guidelines that could reduce dust in the air and will thus limit personal exposures.

Defining the Terms

Flux: Used mainly in glazes to lower the high melting point of the glass former silica.

Micron: A unit of length equal to one millionth of a meter.

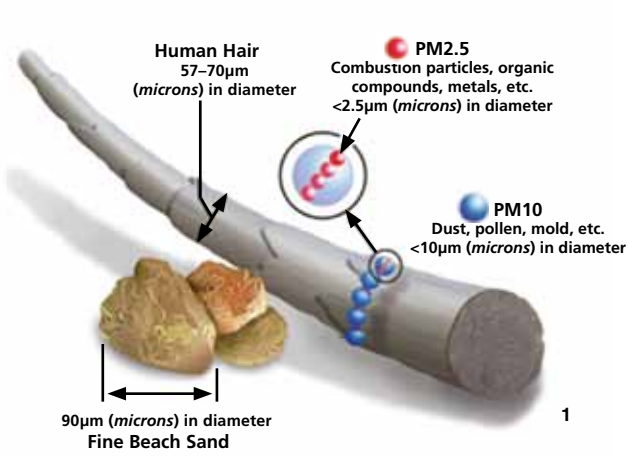
Silica: Silicon dioxide, SiO_2, is the primary glass former in clay and glazes. Vitrification, fluidity, transparency, opacity, melting point, and other properties of silica glass are controlled by adding flux and/or refractory elements and materials. Silica's melting point is 3110°F (1710°C).

Silicosis: Lung fibrosis caused by the inhalation of dust containing silica.

Particulates: Particulate matter, or PM, is a complex mixture of extremely small particles and liquid droplets. The size of particles is directly linked to their potential for causing health problems. The U.S. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects.

Cause and Effect

Most potters are aware that the studio can be a hazardous place, especially from exposures to dust. Much has been written about silica causing silicosis, a disease that results in inflammation and scarring of the lungs, reducing the transfer of oxygen to the blood stream. Extended exposure to silica can also cause lung cancer. Other dusts can also be dangerous, including exposures to plaster dust that can cause irritation of the eyes, skin, and respiratory system. Exposures to dusts when mixing and applying glazes can also be hazardous, due to silica as well as metals used as fluxes and colorants. General recommendations to keep the studio clean with regular sweeping, mopping, and cleaning surfaces plus the use of OSHA-approved dust masks in dusty operations should be followed.



1 Size of fine particulates (PM2.5) in relation to human hair and sand. Particles under 10 microns (PM10) can enter the lung but there are usually good mechanisms to clear these larger particles. The fine particulates are potentially the most dangerous as they can penetrate deep into the lung where they may be sequestered, enter the bloodstream, and move to other organs. *Image courtesy of the U.S. EPA.*

The most important dusts, regardless of composition, are fine particulates that are less than 2½ millionth (called PM2.5) of a meter (micron) in diameter (1). These extremely small particles can penetrate into the deepest portions of the lung, the alveoli, where oxygen is exchanged into the blood stream. These particles can sequester in the lungs or can travel to the blood stream and to other parts of the body. My (Mark Goldberg) own research in outdoor air pollution has shown that these particles, and other pollutants, can have profoundly negative effects on health. As many diseases take years to develop, potters need to limit exposures over their entire careers.

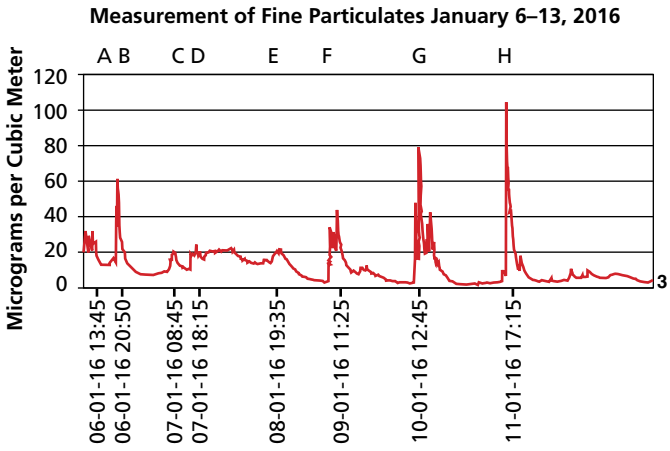
2 A view of our shared ceramics studio.

Measurement Matters

We decided to measure how much dust is in the air in our pottery studio and try to determine which activities increase levels of dust. The studio is small (1000 square feet with a 12 foot ceiling) with 4–5 potters working in the space part-time (2). We have an electric kiln, a slab roller, two electric wheels, and tables and shelves. Our work includes functional and sculptural pieces, and we use plaster and glazes. We try to keep our studio as clean as possible, where usually there is no apparent dust on the floor.

We used an inexpensive, but sufficiently accurate, portable instrument to measure PM2.5. It is made by the Dylos company (model DC1700; www.dylosproducts.com). As with all particle monitors, it cannot distinguish between the types of particles in the air. We set up the monitor to make measurements every minute over a seven-day period during January 2016. At the same time, we tried to record activities that may generate dust. The studio was not very active when we did the sampling, with usually only one person working at a time.

Air quality in a studio depends on concentrations of outdoor air that can infiltrate indoors. Outdoor pollution can vary considerably from day to day, and how much enters the studio depends on the rate at which a building replaces its air and whether windows are open. Indoor air depends on these factors as well as the activities in the studio.



3 Concentrations of fine particulates (PM2.5) (mass per volume) in our studio over a seven-day period, measured every minute. The vertical axis shows concentrations measured by the DC1700, in micrograms per cubic meter. The horizontal axis shows date and time of day. We tried to record activities that we thought would generate dust and these are labeled in the graph. **A** mopping; **B** making plaster molds; **C** cleaning with a wet sponge; **D** removal of plaster molds; **E** making sculpture and cleaning with a sponge; **F** mopping; **G** sanding of plaster molds; **H** sculpting. Background levels during the night were very low.

In the results of our sampling campaign (3), the graph shows that after midnight dust concentrations were quite low and reflects "background" levels (infiltration of outdoor pollution, settling of indoor dusts). There are peaks that correspond with the recorded activities (labeled A to H) and some of these activities generated very large concentrations of dust. Some smaller unlabeled peaks around 4PM are also seen, and these were due mostly to sweeping or mopping the floor.

There are some additional, important observations:

1) Even when concentrations were high, one could not see the dust in the air (so do not be fooled).

2) Dust is easily re-suspended, even when one is wet mopping (A, F) or using wet sponges (E).

3) Sanding of ceramic pieces or plaster (B, G); and sculpting leather-hard clay (H) can generate lots of dust.

These recordings cannot be generalized to other studios, as they will have their own profile depending on location (outdoor concentrations), the building, the size of the studio, activities in the studio, etc.

Due Diligence

There will always be dust in a properly kept studio, even if there are peaks during certain activities, exposure to dusts may not lead to any important short-term or long-term health effects if one takes appropriate precautions. We know from countless studies of occupational health that you can minimize health effects by first reducing how much dust is produced and then ensuring that you are well protected from the dusts that remain. For example, our data indicate that one should clean the floors at the end of the day and, because dust is re-suspended, even during wet mopping, a proper OSHA-approved mask should be worn (e.g., P100, which blocks 99.97% of particles (www.osha.gov/video/respiratory_protection/resptypes_transcript.html)). Surgical masks are of no value, as they do not stop fine particulates. By the morning, any re-suspended dust should have settled.

We recommend that dusty operations be left for the end of the day. One should have well-ventilated areas for mixing dry ingredients (plaster, glaze material) and, certainly, for spraying glazes one should use a proper spray booth (www.dep.state.pa.us/dep/deputate/pollprev/bpmanual/CLocalOther.htm), and always wear an appropriate mask when spraying glaze. If you do not have these dedicated areas in your studio, then you need to think how to limit the amount of dust generated and perhaps only do these operations at the end of the day, with mopping afterwards.

In the following box, we list our recommendations for some common activities.

Activity	How To Reduce Exposures
Vacuuming	Vacuuming the studio can be extremely hazardous, as the exhaust will contain huge numbers of fine particles. If you must vacuum, wear an approved mask and leave the studio for at least 1–2 days.
Mopping and cleaning horizontal surfaces	We suggest mopping at the end of the day and always wearing an approved mask while mopping. This should be done every day or every second day; once a week is not sufficient.
Sanding dry pieces	This should be avoided, as a wet sponge can be used instead. If you must, do it at the end of the day, wear a mask, and mop and sponge table surfaces afterward.
Mixing clay, plaster, glazes	Mix in a well-ventilated area, at the end of the day, wear a mask, and mop afterward.
Spraying glazes	Do in a well-ventilated area, either outdoors or use a spray booth with sufficient suction that suspended glaze is vented. Always wear a mask as glaze can back spray when it hits a piece. Do not assume that the ventilation in the hood will protect you from all of the droplets.
Reductive Sculpting Techniques	Avoiding dust when carving or shaving away clay is more difficult, especially when the pieces are getting close to dry. Wear a mask when you are scraping or sanding pieces, and mop afterward.
Loading kilns	Often one wants to make one last check on surfaces of the pieces when loading a kiln, especially a bisque firing, and scraping or sanding may be used. Wear a mask if you are doing this and mop afterward.
Cleaning Kilns	Kiln manufacturers often recommend vacuuming. This should only be done when wearing a mask and at the end of the day.
Clothes	Do not wear your work clothes home as you will only track dust into your home.

The authors *Mark Goldberg is an environmental epidemiologist and a professor at McGill University, Montreal, Canada. He is also a part-time potter; learn more at www.markgoldbergpottery.com.*

Colleen Dwyer-Meloche is a Montreal, Canada, artist who works predominantly with porcelain. Her art practice ranges from eclectic ceramics for the home to sculptural constructions incorporating clay, wood, metal and at times, found objects, see more at www.colleendwyermeloche.com.

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