REDUCING DUST EXPOSURES AND PHYSICAL STRESSES IN DRYWALL FINISHING USING A SHROUDED VENTILATED ROTARY SANDER

Sahai, D., Vi, P.
Construction Safety Association of Ontario, Toronto, Ontario

Introduction

Almost every construction project involves installation of drywall for building interior walls. One aspect of drywall finishing is sanding of drywall compound. Currently, workers manually sand the compound using a handheld block or a long-handled pole (see figure 1 in appendix) with a piece of sandpaper on the end of a swivel plate. This work procedure places stress on the back, arms, and wrist, as pressure is applied to the paper to create the friction for sanding[(1)]. Additionally, sanding of drywall compound generates high levels of dust[(2)], including respirable silica[(3)]. Inhaling this dust causes eye, nose, throat, and respiratory tract irritation, coughing, phlegm production, and breathing difficulties[(2)]. Worse, the presence of respirable silica in drywall dust raises the risk of silicosis, pulmonary tuberculosis, chronic obstructive pulmonary disease, and lung cancer[(4)]. One method of controlling these occupational health hazards is the use of a shrouded ventilated rotary sander (SVRS). The purpose of this project was to document the potential ergonomic and hygiene benefits of using a SVRS as a method to prevent musculoskeletal injuries and dust-related illness. SVRS design consists of an abrasive pad that rotates against the work surface to generate dust. A shroud encloses the abrasive pad. The SVRS collects particulates by drawing air through the space between the outer circumference of the rotating abrasive pad and the inner surface of the shroud covering the abrasive pad; the dust then passes into a vacuum collection system equipped with a high-efficiency filter (see figure 2, 3, and 4 in appendix).

Method

This research study was conducted in a newly constructed home at the Interior Finishing Systems Training Center in Toronto, Ontario. Two very similar rooms, A and B, were selected for comparing dust concentrations generated by conventional pole sanding with those generated by an SVRS. For rooms A and B the total sanding area was 256 ft^2 and 286 ft^2 respectively. No mechanical ventilation was present in the house and the window in Room B was kept closed and sealed during the research study.

Eleven subjects—seven journeymen and four apprentices from the International Brotherhood of Painters and Allied Trades, District Council 46—participated in the study. While all participated in the dust measurement portion of the study, only ten participated in the ergonomic portion.

For each subject, two test runs were conducted: 1) for the respirable dust fraction using the pole sander in one room; 2) for the respirable dust fraction using the SVRS in the other room. The room to be sanded and the method of sanding were randomly selected. A TSI, model AM510, SidePak™ in conjunction with a Dorr-Oliver cyclone was used to measure respirable dust concentrations. The aerosol monitor is a small, direct reading, data logging aerosol monitor. At the same time that respirable dust was being measured, muscle activity was also being measured using electromyography (EMG). EMG signals were recorded by attaching surface electrodes to the skin surface above the following four muscles: (1) left and (2) right upper trapezius, and (3) left and (4) right flexor digitorum superficialis to estimate muscle loads on the shoulders and forearm.

Results

Ergonomic results found that despite the large differences in weight between the SVRS (8 lbs) and the pole sanding tool (2 lbs), working with the SVRS significantly ($p<0.05$) required less muscular activity in the static and median load level of the shoulder and forearm muscles. The

high muscular effort in the manual pole sanding condition was due to the forceful and repetitive movement of the upper extremity in order to create high friction force between the sanding paper and the wall. While using the SVRS, however, little muscular effort is required because the majority of the sanding force is generated by the SVRS. The muscular effort generated by the upper extremities was mainly used to support and guide the SVRS along the walls.

Hygiene results indicate that the SVRS was very effective in capturing most of the respirable airborne dust. Pole-sanding exposures ranged from 0.394 to 3.767 mg/m^3 with a mean value of 1.686 mg/m^3, whereas SVRS exposures ranged from below background levels to 0.458 mg/m^3 with a mean of 0.073 mg/m^3. The difference between the two sanding methods was found to be highly significant ($p<0.05$) and represents a 96% reduction in respirable dust exposure.
Silica was detected in the drywall compound used in this study at an average concentration of 5%, making drywall dust control a continuing concern for drywall finishers.

Conclusions and recommendations
This study compares respirable dust concentrations generated during conventional pole sanding with those generated by an SVRS. Based on the hygiene and ergonomic measures, it is concluded that the SVRS is an effective method for drywall sanding and it is recommended that the SVRS be used to control drywall dust. The SVRS has many advantages over pole sanding, including the following:

1. For sanders and nearby workers the SVRS significantly reduces exposure to drywall dust. Thus workers are much less likely to suffer adverse health effects.
2. It greatly reduces the need for respiratory protection.
3. Because it controls drywall dust so well, it can significantly reduce cleanup time.
4. It is easy to use and not likely to cause musculoskeletal problems.
5. It is ideal for situations where creating dust is a problem, for example, renovations where the building is occupied, new construction when other trades are in the area, hospital work where patients must be protected, and work around dust-sensitive electronic equipment such as computers.

Disadvantages of the SVRS include the following:
1. The vacuum is not portable enough to be used, for instance, on a scaffold.
2. The vacuum hose can create a tripping hazard.
3. Being round, the sanding head of the SVRS cannot get completely into corners.
4. Vacuum and sander require significant power that is not always available, especially on new construction sites.

References

1. **Pan C., S. Chiou, H. Hsiao, et al:** Assessment of perceived traumatic injury hazards during drywall taping and sanding. *International Journal of Industrial Ergonomics* 25: 621-631. (2000).
2. **National Institute for Occupational Safety and Health (NIOSH):** Control of drywall sanding dust exposures. *Appl. Occup. Environ. Hyg*. 15: 820–821 (2000).
3. **National Institute for Occupational Safety and Health (NIOSH):** *Health Effects of Occupational Exposure to Respirable Crystalline Silica. Department of Health and Human Services. Centers for Disease Control and Prevention.* [DHHS (NIOSH) Publication No. 2002-129] Cincinnati, Ohio, 2002
4. **Susie, P. and S. Schneider:** Chemical exposures on a new construction site. *Appl. Occup. Environ. Hyg.* 10:100-103 (1995)

Appendix

FIGURE 1. Sanding drywall using a pole sander

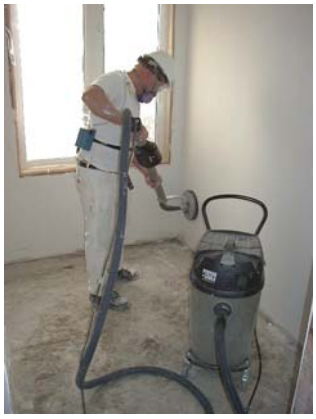

FIGURE 2. Shrouded ventilated rotary sander (SVRS) attached to vacuum

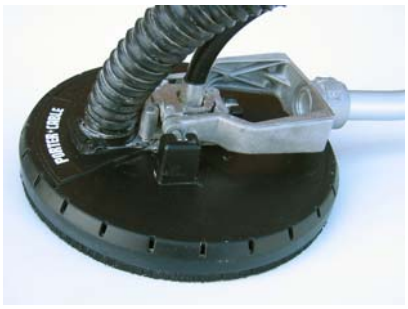

FIGURE 3. Articulating sanding head of the SVRS with extractor shroud

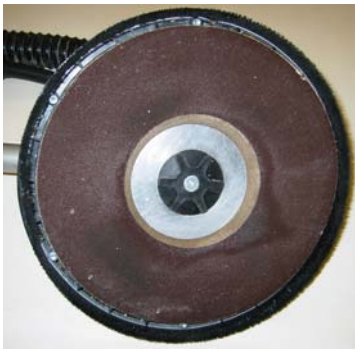

FIGURE 4. Sanding pad and brush-type skirt attachment of the articulating sanding head