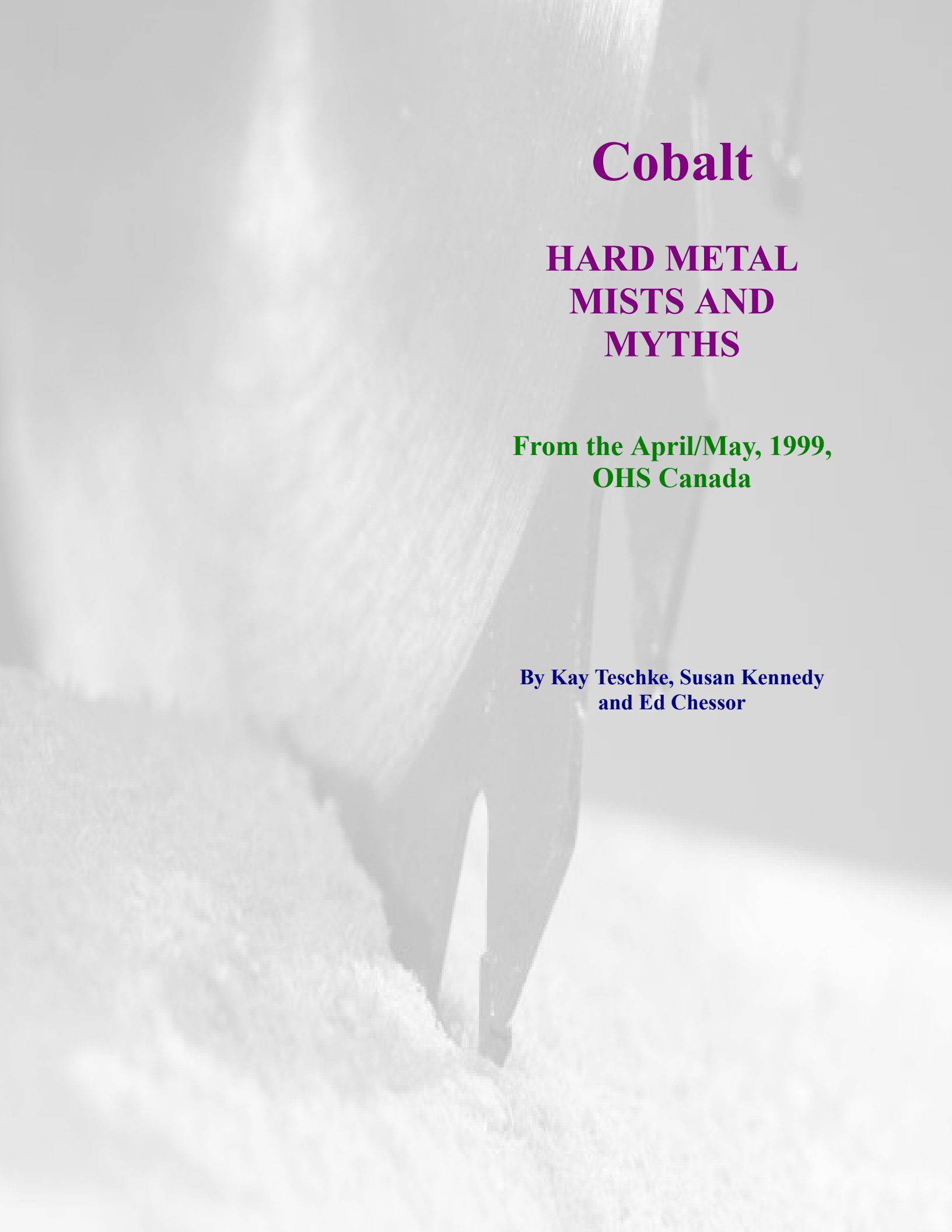

Cobalt

HARD METAL MISTS AND MYTHS

From the April/May, 1999,
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By Kay Teschke, Susan Kennedy
and Ed Chessor

In the early 1990s, we conducted a study in British Columbia sawmills after two events drew our attention to saw filers and their potential for cobalt exposures. We were contacted by saw filers in a B.C. sawmill using stellite saw tips, who were concerned about nasal and upper respiratory irritation. At about the same time, we learned about four saw grinders in a manufacturing plant in Washington State who had developed hard metal lung disease caused by exposure to cobalt from grinding tungsten carbide saw tips.

After completion of the study, we learned of a saw filer from a small northern B.C. sawmill who recently died of hard metal lung disease at age 50, and a tungsten carbide tool grinder from Michigan who recently developed severe lung impairment from this disease at age 24. Other fatalities have been reported in the recent scientific literature, including a 22-year-old Finnish male hard-metal tool grinder, a 37-year Old Italian female tool grinder, and a 52 year old Belgian male diamond polisher. These unfortunate cases demonstrate that there is a real risk among workers exposed to cobalt in grinding operations. Our study results point in the same direction.

A review of the medical literature on cobalt indicated that there are two lung diseases that are related to airborne exposure to this metal. The main occupational group, which has been studied, is manufacturers of tungsten carbide tools. Some of these cobalt-exposed workers (perhaps about five per cent) develop sensitivity to cobalt that results in asthma. A smaller percentage (about one per cent) may develop hard metal lung disease, a disease in which the alveolar tissue of the lungs becomes inflamed and possibly scarred.

The disease can be treated by medications and by removal from the exposure, but treatment is sometimes not successful and the disease can be fatal. And, because of the rarity of these occupational diseases and the non-specific nature of the symptoms, few physicians would be likely to recognize the relationship between a patient's symptoms and possible workplace exposures to cobalt.

We decided to carry out a study in lumber mills with several purposes:

*** to measure the levels of exposure to airborne metals in saw filing tradesmen;**

*** to determine what specific jobs or tasks had the highest exposures;**

*** to measure the lung function and respiratory symptoms of saw filers; and**

*** to see if lung function or symptoms were associated with exposures or work tasks.**

The study was conducted in eight sawmills on the west coast of B.C. Seven of the mills used tungsten carbide saw tips, and six used stellite tips, and five mills used both types. Cobalt was present in the tungsten carbide tips at concentrations of 2.4 to 30 per cent

and in the stellite tips at concentrations of 50 to 63 per cent. In tungsten carbide, cobalt is the binder for the tungsten carbide. In stellite, cobalt is part of the metal alloy.

Each mill was visited four times, at least one month apart. On these visits, each filing room employee wore a filter cassette and personal sampling pump to capture airborne metals. The work locations and tasks were charted every 10 minutes throughout the day. Each worker also had breathing tests in the morning and afternoon, and answered a detailed questionnaire about his current health, past health and job history. A total of 278 air samples and 73 coolant samples were analyzed for 22 different metals. Respiratory health testing was conducted on 118 saw filing room workers. In addition, the effectiveness of 196 ventilation systems was tested.

Exposure results

Levels of airborne metals in the saw filing rooms were low. Most of the air samples did not have detectable level of many of the 22 metals measured, even though detection limits were usually less than 1/100th of the applicable exposure standards.

There were 62 air samples with measurable cobalt levels. The average cobalt concentration in these was 9 micrograms per cubic metre (ug/m3) and the maximum was 106 ug/m3. The Workers' Compensation Board of B.C. permissible concentration at the time of the study was 100 ug/m3. (It has since been lowered to 20 ug/m3, the same as the current American Conference of Governmental Industrial Hygienists threshold limit value, set in 1991.)

Even though the concentration of cobalt in stellite is higher than in tungsten carbide, we found that exposure to cobalt was most likely to be associated with tungsten carbide grinding. In addition, although wet grinding is often considered to be a means of controlling exposures, we found that both wet and dry grinding of tungsten carbide contributed about equally to cobalt exposures. Stellite welding also contributed to elevated cobalt exposures, though the levels were lower than for carbide grinding.

There were several possible explanations for our findings. Because wet grinding is often considered a control measure, wet grinding machines were usually not ventilated, whereas dry grinding machines were. Coolant from tungsten carbide wet grinders often had very high cobalt levels, while coolant from stellite wet grinders had much lower cobalt concentrations. Cobalt may leach into recirculated coolants from the fine grinding particles, but since cobalt is part of the alloy in stellite, it may be less available for leaching than in tungsten carbide.

Respiratory health results

The good news is that we did not find any workers in these eight mills with obvious, current hard metal lung disease or cobalt asthma. Also, we did not find an increase in the one symptom that is most often caused by hard metal disease -- becoming short of breath when doing light work such as walking up a slight hill.

However, we did find that the saw filers, compared to other industrial workers, were about twice as likely to report bringing up phlegm, and about three times as likely to report coughing, phlegm, and wheezing that was worse at work. Also, saw filers doing stellite welding had about five times more nasal symptoms than expected.

In addition, saw filers doing tungsten carbide wet grinding performed more poorly on breathing tests than other saw filers and than other industrial workers. Breathing tests showed significantly reduced lung volumes, which is consistent with hard metal lung disease. Tungsten carbide wet grinders were also about five times more likely to have breathing test results in the "abnormal" range than other saw filers. There was some additional evidence that the number of years a filer had done this kind of work was an important risk factor an abnormal breathing test.

Recommendations

We suggest that automated grinding machines be fitted with complete enclosures that are vented to the outside air. The enclosures need to be opened only during machine set-up operations. We estimate that about 200 of approximately 600 saw filing machines in B.C. have now been enclosed in this way. Evidence from a recent Finnish study indicated that enclosures were an effective way to control exposures from grinding hard metals.

In addition, for tungsten carbide wet grinding, we suggest that frequent changing of the coolant may minimize cobalt exposures; however, without further study; we cannot recommend a specific change schedule.

From the health testing point of view, we recommend that any hard metal tool grinder who has chest symptoms, especially breathlessness, should see his or her family doctor and ask for lung testing, including breathing tests and a chest X-ray to look for possible hard metal lung disease. If the symptoms are more those of asthma (coughing, wheezing, especially at the end of the day or at night) the possibility of work-related asthma should be considered.

Our colleagues in Washington State have recently proposed that all workers maintaining tungsten carbide tools be monitored regularly for the development of hard metal lung disease. We agree that this may be useful, however, neither research group knows for sure exactly what tests would be useful on a routine basis. This is something we hope to study in the next few years. In the meantime, every effort should be made to protect workers from mists and fumes containing cobalt.

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Cobalt-Exposed Occupations and Industries, and Associated Diseases

It is important to note that cobalt and its compounds are found in many other industries, as a component of metal alloys, as a binder, as a colorant and as a trace element. The effects of cobalt are not limited to hard metal lung disease and asthma. Sensitization also results in allergic dermatitis, respiratory effects may include lung cancer, and a link to a fatal disease of heart muscle, called cardiomyopathy, appears to be well established. The accompanying table indicates a range of occupations and industries with cobalt exposure, and the associated health effects reported in the medical literature.

Occupations and industries reported to have cobalt exposures (source of cobalt)

Diseases in these occupation or industries reported to be associated with cobalt exposure

Hard metal industry including manufacturers, tool grinders, saw filers Hard metal lung disease Asthma Allergic contact dermatitis, eczema, Cardiomyopathy, Lung cancer Deficits in attention and short-term memory

Diamond polishers and saw producer's (binder in diamond polishing disks and saws) hard metal lung disease, asthma

Welding (metal coating, steel alloys) Hard metal lung disease

Dental technicians (dental alloys) Hard metal lung disease, Allergic contact dermatitis

Glassware factory Asthma

Porcelain factory (blue glazes) Lung cancer Impaired lung function Impaired thyroid hormone metabolism

Mineral assay laboratories Cardiomyopathy

Cobalt refining Difficulty breathing, wheezing, Eczema

Construction workers (cement, fly ash) allergic contact dermatitis

Rockwool insulation manufacturing (trace metal) allergic contact dermatitis

Offset printers allergic contact dermatitis

Bank clerks (coins) Allergic contact dermatitis

Goldsmithing Allergic contact dermatitis

***based on a search of Medline, 1966 to January 1999, using cobalt and occupations or ex-**

posures as text keywords limited to human.

Some related articles that readers may find useful

Chessor E. Ventilation for cobalt and other air contaminants in saw filing rooms. Synergist 1998; July 15:26-29

Kennedy SM, Chan-Yeung M, Marion S, Lea J, Teschke K. Maintenance of stellite and tungsten carbide saw tips: respiratory health and exposure-response evaluations. occupational and Environmental Medicine. 1995; 52:185-191

Linnainmaa M, Susitaival P, Makela P, Sjoblom T. Respiratory symptoms and dermatoses among grinders and brazers of hard metal and stellite blades. Occupational Medicine 1997; 47:33-39

Linnainmaa MT. Control of exposure to cobalt during grinding of hard metal blades. Applied Occupational and Environmental Hygiene 1995; 10:692-698

Moulin JJ, Wild P, Romazini S, Lasfargues G, Peltier A, Bozec C, Deguerry P, Pellet F, Perdrix A. Lung cancer risk in hard metal workers. American Journal of Epidemiology 1998; 148:241-248

Teschke K, Marion SA, van Zuylen MJA, Kennedy SM. Maintenance of stellite and tungsten carbide saw tips: Determinants of exposure to cobalt and chromium. American Industrial Hygiene Association Journal. 1995; 56:661-669

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