



AIR TESTING IN THE FILING ROOMS

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I am Dr. Susan Kennedy. I work at the Department of Medicine and the Department of Health care and Epidemiology at the University of British Columbia. Our business includes research in occupational health issues. We are faculty members at UBC, but in addition to teaching, we are charged with the responsibility of conducting studies in workplaces with potential health problems.

The investigation that we are going to tell you about today started, because two things came together at the same time. One was a call from a filer, who was talking about what he felt were some health problems people were having in his mill. The other was that colleague in Seattle had recently treated two workers from a saw tip manufacturing place for a lung disease associated with exposure to cobalt. Those two people had a quite rare disease, associated with exposure to the metal Cobalt. Those two things put together made us think that there really was something we should be looking into in B.C. We made a proposal to the Workers' Compensation Board to give us funding to conduct a study in sawmills using Carbide and Stellite saw tips. We wanted to conduct our tests in mills using Carbides and mills using only Stellite. We found that most mills using Stellite also use Carbide. The final selection was eight mills with mix of Stellite, Carbide, wet grinding and dry grinding.

The study was designed to look at the metals in the air in filing rooms, at workstations handling Tungsten Carbide and Stellite. Cobalt is known to be associated with lung disease. We know this from the manufacture of the tips. It is not known, if it is present in a quantity to be a danger in mills using the tips, since the tips are not subjected to the high heat required in the making of tips. Carbides have a Cobalt content of 5 to 30%. Stellite has 40 % to 50 % Cobalt content. In addition Stellite has 30% Chromium, which is also known to be associated with lung problems. Stellite is an alloy. That means that all ingredients are molten together. The grindings tend to be a mix of all ingredients bound together. In tungsten carbide dust the cobalt is present as cobalt alone.

There are two health problems associated with cobalt. One is pneumoconiosis. It is a scarring of the lung tissue, and results in shortness of breath. It is sometimes very tricky to decide if shortness of breath is just a sign of age, or if it is brought on, or aggravated, through exposure to an agent in the workplace. The other is asthma. It is a restricting of the air passages. The symptom is wheezing. This again is hard to pin down as being work place related.

The first step is to find out how much and what kind " of metals people breathe in those filing rooms. People were fitted with personal sampling devices to measure their personal exposure. The samples so obtained were analyzed for metals, and I will stress here, we tested for metals only. We also took samples of the coolant used in wet grinding, because it was suggested, that it might not be the exposure to dry grinding dust, but the mist from coolant that is the health risk. If the coolant has the ability to leach out the metals and have them carried in the air in moisture droplets. This air sampling was done four times, every time we did the air testing we also checked the health of the people that carried the samplers.

The health testing involved being interviewed by our respiratory technician. We have a standard respiratory disease questionnaire, which is used through North America that helps us to evaluate the group of people tested. For example are there a higher percentage of people with asthma than in general population and so on. It tells us how much lung trouble we can expect because of other factors. We also had assistants following the people fitted with the samplers around, to record every 15 minutes what job was being done, how far the person was away from the machine. We also did breathing tests at the beginning of the shift, and after the shift to record any immediate reactions. Allergy skin tests were made to see whether people are allergic to common things like cats, pollen, dust and so on. We also tested people to see whether people had an allergy to cobalt or chromium. We have shown with cedar asthma, that it can be present in a person without showing an allergy reaction in a skin test. So, skin tests for allergy really do not help us very much, but it was done to eliminate possible arguments later. There were 118 saw filers involved in the study.

Some were tested once, some four times. It depended on what shift they were on when we showed up for the tests. The age averaged out to mid forties, a range from 30 into the sixties.

We took 282 air samples and 73 samples of coolant right out of the machines. We also took coolant concentrate samples as it came from the supplier. All samples were analyzed for the presence of 19 metals. For this presentation I choose the four which are of interest in this study: Cobalt, chromium, nickel and lead. Lead was included, because it is a major component in some sawguides and is used in filing rooms. Since this study is by no means finished, I will only say, that most air T samples were well below the permissible Workers' Compensation Board levels. In some samples the content: of cobalt came close to that permissible level. In those samples it turned out, that there was cobalt already present in the new coolant concentrate.

I would like to show you a comparison of our health findings in filing rooms with another group we tested. This group of industrial workers we studied recently is bus mechanics. The percentage reporting coughing is about the same. The percentage of persons reporting wheezing and coughing up phlegm is twice as high in saw filers. It tells us, that there is a difference between the two groups, which is not just chanced. It is a real difference. I want to emphasize again, that we are not ready to say what makes this difference. It might well be that the wheezing comes from breathing wood dust. Lung performance from the breathing tests show, that filers, as a group, have a 5% reduction compared to bus mechanics. It is a very slight difference, but it is significant enough to know it is not by chance.

So far, all our test results are very confusing. We have to do a lot more correlating the findings from the tests before we can make recommendations. For now, I can give you only a few suggestions. Proper ventilation is just as important in wet grinding as it is in dry grinding. The coolant as it comes, as a concentrate is highly alkaline. In use, through bacterial action it gradually becomes acidic. This will leach metals out of the grinding dust in the coolant reservoir. So, clean the tanks frequently and keep the coolant fresh.

I would like to finish by saying, that the results so far do not point to any imminent danger. If you decide to invite us back next year, we will be able to actually tell you the whole

Dr. Susan Kennedy, 1993 -RESULTS AND CONCLUSIONS

1. The study was conducted in eight coastal sawmills. Most of these mills contacted us to volunteer participation. All eight mills used saw steel as saw tips, seven used tungsten carbide tips, and six mills used Stellite tips. Each mill was visited on four days, or pairs of days, at least one month apart in the summer and fall of 1991.
2. Industrial hygiene assessments included 278 personal total-metal-in-air samples (1 to 4 samples taken on each of 112 saw filing room employees), 1 analyzed for 22 different metals; 73 samples of 1" coolant from wet grinding machines, analyzed for 23 metals; and testing of 196 local exhaust ventilation systems.
3. Levels of total airborne metals in the saw filing rooms were generally low. Most of the 278 air samples did not have detectable levels of many of the 22 metals measured (the detection limits were less than 1/100th of the lowest exposure standard' for almost all the metals). Of the 22 metals analyzed, six metals were considered of greatest interest because, in samples with detectable levels, the average concentrations were more than 1/20th of the lowest exposure standard (ACGIH Threshold Limit Value or WCB Permissible Concentration).

These metals were

Cobalt, 59 samples greater than the detection limit, average = 0.0098 mg/m³
chromium, 92 samples greater than the detection limit, average = 0.0042 mg/m³
iron, 277 samples greater than the detection' limit, average = 0.051 mg/m³
lead, 39 samples greater than the detection limit, average = 0.014 mg/m³
cadmium, 10 samples greater than the detection limit, average = 0.0069 mg/m³
silver, 9 samples greater than the detection limit, average = 0.0042 mg/m³

Three of these metals had at least one air sample with a concentration above the TL V or PC:

cobalt: 3 samples greater than the TL V of 0.05 mg/m³, and 1 of these greater than the WCB PC of 0.1 mg/m³

chromium: 2 samples greater than the WCB PC of 0.05 mg/m³ for chromium VI

silver: 1 sample greater than the WCB PC of 0.01 mg/m³

Even for these metals, however, exposures of individual saw filers averaged over all the sampling days were all below the exposure standards.

1. Increases in cobalt air concentrations were related to the following operations (in order from greatest to least exposure):
2. grinding tungsten carbide tips at a wet grinder
3. Grinding tungsten carbide tips at a dry grinder
4. heating Stellite

The contribution of heating Stellite to cobalt air levels was no longer apparent when three outliner were removed from the analysis therefore the impact of this activity is not certain. Tungsten carbide wet grinding machines had very high average levels of cobalt in their coolants, and these machines were often not ventilated. Stellite wet grinding machines had much lower of cobalt in their coolants, despite the fact Stellite contains more cobalt than tungsten carbide (50 - 63% versus 2 - 30%).

Heating Stellite rather than heating tungsten carbide may increase cobalt levels because Stellite tips are usually welded to the saw body whereas tungsten carbide tips are soldered, a much lower temperature heating process.

About 33% of samples had detectable exposures to chromium. Increases in chromium exposure were related to the following jobs or operations (in order from greatest to least exposure):

- working as a knife grinder
- heating Stellite
- heating saw steel

Chipper knives have a chromium content of about 9%, considerably less than the 23 - 33% found in Stellite, and as expected, there were lower concentrations of chromium in knife grinding coolants than in Stellite grinding coolants. However, knife grinding produced higher chromium exposures. An explanation for this may be that knife grinders spend more time in the vicinity of their grinding machines than employees tending Stellite-grinding machines do. In addition, most of the knife grinding machines was not ventilated. Heating Stellite is likely produced greater chromium. Exposures than heating saw steel because of the higher concentrations of chromium in Stellite than saw steel (< 1%).

Exposures to the other four metals of interest may be partially explained as follows.

Iron is present in both saw and knife steels as well as many other materials used in the filing rooms. Every saw filing room employee was exposed, but levels were generally low compared to exposure standards.

only 12% of air samples had detectable lead levels. Most of the exposed individuals worked with lead-based Babbitt. Babbitt areas had a high proportion of ventilation systems rated "poor".

Only 3.6% of samples had detectable cadmium concentrations. Most of the exposed individuals soldered carbide tips with silver solder.

- Only 3.2% of samples had detectable silver levels. Most of the exposed employees performed either silver soldering or circular saw grinding during the sampling period.

RECOMMENDATIONS: INDUSTRIAL HYGIENE ASSESSMENT FOLLOW-UP BY MILL PERSONNEL

- 1. At wet tungsten carbide grinding machines and knife grinding machines which are currently not ventilated, enclosing or ventilating the machines should be considered. For tungsten carbide wet grinding machines, an alternate or additional control measure might be frequent changing of the coolant to minimize cobalt concentrations in the coolant. The change schedule required is currently unknown (see Recommendation 8. below, and Epilogue section 7.1 in the main body of the report).**
- 2. Ventilation at tungsten carbide grinding machines, Stellite heating operations, and babbitt areas that was rated "poor" should be considered for upgrading. Moving the exhaust hoods closer to the point of contaminant generation, more completely enclosing the operation (e.g., putting sidewalls down from canopy hoods), and ensuring, that all contaminant generating operations are enclosed (e.g., hoods over babbitt pouring area as well as babbitt pot) would usually be effective and inexpensive means of improvement for the problems observed in the study mills. The success of these modifications can be tested with smoke tubes to visualize the draw of the hoods.**
- 3. Consideration should be given to annual monitoring of personal exposures to cobalt in air for employees doing the following jobs: grinding tungsten carbide tips at a wet grinder. grinding tungsten carbide tips at a dry grinder heating Stellite**
- 4. Consideration should be given to annual monitoring of personal exposures to chromium in air for employees working as knife grinders doing Stellite heating (i.e., in most cases, welding)**
- 5. Consideration should be given to two metal sub- situations: changing to lead-free Babbitt. Changing to cadmium-free silver solder if your mill chooses to make these substitutions, it is important to make sure that the potential harmful effects of metals in the new compounds are examined. Any components of concern in the new compounds should be monitored from time to time to make sure a new hazard is not introduced. .**
- 6. If your mill chooses to continue using lead babbitt, consideration should be given to implementing a blood-lead monitoring program for employees using the babbitt (e.g., jobs which involve making babbitt guides, or weighting knives with babbitt). Air sampling is usually not considered an adequate way to check lead exposures. Family physicians can arrange to have blood lead levels checked. Blood lead samples can also be arranged I through the Occupational Health Department of the Workers' Compensation Board.**
- 7. Consideration should be given to annual monitoring of personal exposures to cadmium (if cadmium-containing silver solder is still used) and silver in air for employees using silver solder.**

FUTURE STUDIES IN THESE MILLS OR OTHER SAW FILING ROOMS

- 1. This study was unable to determine how quickly high levels of cobalt accumulate in tungsten carbide grinding machine coolants, therefore no schedule for fluid replacement can be proposed. We therefore recommend that a study be done to determine the optimum time for replacing the coolant at tungsten carbide wet grinding machines to prevent the build up of cobalt in the fluid. Such a study would involve an initial complete replacement of the fluid in the series of wet grinding machines, then sampling over time to determine the rate of increase in cobalt concentrations. The study could also investigate whether removing solids from used coolant would be an effective means to maintain low cobalt concentrations, and determine what level of cobalt in coolant is required to minimize cobalt concentrations in air around wet grinding machines. (Note that some coolant manufacturers have been trying to produce a fluid that will not leach cobalt from tungsten carbide. Evidence from studies to date at the University of Washington has not shown a benefit.)**
- 2. The method by which cobalt and chromium were measured in this study did not indicate whether the metals were present in their simple forms or in ionized form. Since the form of the metal may influence disease processes, it would be useful to know which forms are present in the work room air. A follow-up study of saw filing room jobs with the highest potential for cobalt or chromium exposure, using different methods of exposure sampling and analysis, would identify what forms of metal exposures these individuals have.**

SUMMARY: RESPIRATORY HEALTH ASSESSMENT, RESULTS

- 1. Respiratory health evaluation was carried out among 118 saw filing tradesmen (saw filers) from sawmills, using standardized techniques. The participation rate was 90%. The study was - designed to measure respiratory health outcomes, I.: not other possible health effects of exposures in these workplaces.**
- 2. Compared to an external population (bus mechanics), studied using the same methods and equipment, saw filers in this study reported approximately twice the prevalence of phlegm production and wheezing ($p, 0.01$), and 3 times the prevalence of work-related symptoms of cough, phlegm, ($p < 0.001$) and wheezing ($p < 0.05$). They also had significantly lower average levels for the lung function variables MMF ($p = 0.06$), and FEV1/FVC ($p < 0.05$), compared to the external population.**
- 3. Stellite welding in the current job was associated with a 5-fold increase in nasal symptoms and a 3- fold increase in work-related cough (both $p < 0.05$) compared to saw filers not performing this task, adjustment for this task did not fully explain the other increased symptoms seen compared to bus mechanics. This task was also associated with a small but statistically significant decrease in air- flow rate (FEV1/FVC%, $p < 0.05$).**

4. Tungsten carbide grinding (particularly when coolant was used at least 50% of the time), was associated with significant reductions in average lung volumes (FEV1 and FVC) and with FEV1 reduced to the clinically abnormal range (all $p < 0.05$). Duration of work in jobs in which tungsten carbide grinding (wet or dry) was performed was ~ also marginally significant as an additional predictor of reduced FVC ($p = 0.08$). No specific increases in respiratory symptoms were found in association with this task.
5. Once these job tasks were taken into account (as well as other predictors such as smoking and age), no additional differences were seen in health out-comes among the eight mills studied.
6. There were no significant relationships found between the change in lung function over one work shift and any of the daily metal exposure measurements. There was no evidence seen to suggest the presence of current cases of specific cobalt or chromium asthma.

CONCLUSIONS

1. The results of the respiratory health assessment provide evidence that the saw filers studied are at risk for work-related increases in acute respiratory and nasal symptoms as well as for measurable reductions in lung function. The results support the hypothesis that chromium exposure from Stellite welding may be leading the airway irritation, although they do not rule out the possibility that other welding fume exposures may be playing a role in the airway irritation found. The results also provide strong support for the hypothesis that cobalt exposure from tungsten carbide grinding may be leading to significant reductions in lung volume, including levels in the clinically abnormal range. As lung volume reductions are the expected finding in hard metal lung disease, this result must be interpreted as indicating significant potential risk for this outcome in the saw filing work force.
2. It is somewhat reassuring that we did not find any obvious current cases of either hard metal lung disease or specific asthma. However, it would have been extremely unlikely to find such cases on a study of this size among currently employed tradesmen. This cross-sectional study does not allow us to determine conclusively whether or not the significant lung volume reductions found are indicative of the early stages of hard metal lung disease; however, given the poor prognosis for hard metal lung disease in some cases, the findings suggest the need for further follow-up of these and other saw filers in order to answer this question.
3. Exposure-response evaluation suggested that exposure to airborne cobalt at the proposed B.C. Permissible Concentration (0.020 mg/m³) may be sufficient to lead to lung volume reductions in the clinically abnormal range, however, as this conclusion depends on an assumption that the exposure levels measured during the study reflect past exposure levels in these mills, this conclusion should be interpreted with some caution.

RECOMMENDATIONS: RESPIRATORY HEALTH ASSESSMENT IMMEDIATE FOLLOW-UP OF THE CURRENT STUDY GROUP

- 1. We recommend that all participants in this study be evaluated with more detailed clinical tests, with the following order of priority: Chest x-ray testing on all participants This should be performed on all participants in order to have sufficient comparative information on those who may have lung function abnormalities and those who do not. This test will assist in the evaluation of possible hard metal lung diseases. Complete lung function testing (diffusing capacity and subdivisions of lung volume) and a CT scan for any participant with evidence of lung function abnormality x-ray suggestive of hard metal disease. These tests are necessary to rule out (or confirm) a diagnosis of hard metal pneumoconiosis.**

FUTURE STUDY OF THIS GROUP AND OTHERS WITH SIMILAR EXPOSURES

We recommend that a follow-up study of respiratory health and exposure factors among saw filers be conducted in approximately one to two year's time. This is necessary in order to provide confirmatory (or contrary) evidence for the results of this study. The follow-up study should include respiratory symptom assessment, lung function testing, chest x-ray, and blood testing, and should include the following components:

- 1. locating and testing retired saw filers (and saw filers who have left the trade, as feasible) to determine whether cases of hard metal pneumoconiosis are present**
- 2. repeated respiratory health testing of all saw filers who participated in this study to evaluate**
- 3. change in health status**
- 4. enrollment of saw filers from additional B.C. sawmills and other locations where filing occurs (selected at random) and**
- 5. blood testing for evaluation of specific cobalt associated lymphocyte transformation on all participants to allow for the evaluation of whether or not the early respiratory effects of**
- 6. cobalt exposure can be tested by a blood test in the same manner as currently performed for**
- 7. beryllium exposure.**



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