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Skin hazards from nickel and chromium salts in association with cutting oil operations

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Under ordinary working conditions in which grinding fluids were used, the presence of nickel or chromates was not detectable by spot testing. Laboratory studies, however, indicate that nickel can be leached from the machined metals.

Key words: chromate dermatitis – contact dermatitis – cutting oil dermatitis – nickel dermatitis – skin hazards.

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In reviewing the skin problems associated with the use of grinding fluids (cutting oils), it has been assumed that allergic contact dermatitis occurs occasionally from nickel salts or chromates from the machined metal (Arndt 1969, Gellin 1969, Gellin 1970, Hodgson 1970, Key et al. 1966, Samitz 1974). The presence of these metallic salts or the potential of leaching nickel or chrome from this source, however, has not been adequately assessed.

The present report focuses on some aspects of this problem. We conducted a study in several plants in the Philadelphia area. Workers exposed to cutting oils were examined at their machines, and dispensary records were reviewed. Lathe turnings and oil-wipe rags contaminated by metallic swarf were collected and used in our laboratory experiments.

One plant employed over 5,600 workers, about 800 of whom had regular contact with grinding fluids. A smaller plant employed nine workers, eight of whom had regular contact with the grinding fluids. Water-miscible compounds (soluble oils, synthetic fluids and semi-synthetic fluids) were used in both plants. At the time of our examination none of the workers showed any clinical manifestation of allergic contact dermatitis. No instances of allergic contact dermatitis were recorded in dispensary records. Contact with metal chips did, however, cause minor traumatic lesions. These were, as a rule, treated by the worker himself and rarely required dispensary care.

We carried out two types of laboratory studies: (1) spot testing for nickel and chromates, and (2) leaching of the metals from lathe turnings and chips.

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Spot tests

Dimethylglyoxime (DMG) was used to test for the presence of nickel, and diphenyl carbazide (DPC) was used to detect chromates. Both tests were carried out according to the procedures described by Feigl (1967). Machinery, wipe rags, work benches and lathe scrap yielded negative results when tested directly on repeated visits. Ashed samples of new and used cutting oil and ashed samples of oil-wipe rags were similarly tested. Neither the presence of nickel nor chromium was demonstrated.

Leaching studies

Lathe turnings and metal chips were collected from the two industrial sources. One-gram quantities of these materials were weighed into 50 ml polycarbonate beakers in replicate, and treated with either 5 ml of physiological saline solution (pss), 5 ml of human sweat or 5 ml of a 50 % v/v cutting oil-water emulsion. The beakers were covered and allowed to stand for 1 week at room temperature (approximately 25°C). Blanks consisting only of the liquid phases, and controls consisting of the liquid phases spiked with known amounts of nickel and/or chromium, were similarly prepared.

Table 1. Leaching of nickel from lathe turnings and chips

Material	Nickel leached by pss, μg	Nickel leached by sweat, μg	Nickel leached by cutting oil, μg
303 s/s (2 samples)	9.70	6.20	
304 s/s (2 samples)	0.74	1.07	
286 s/s (6 samples)		1.62	
chrome-moly (6 samples)		2.15	
grey iron (12 samples)		less than 0.1	less than 0.1

Table 2. Leaching of chromium from lathe turnings and chips

Material	Chromium leached by sweat, μg	Chromium leached by cutting oil, μg
286 s/s (6 samples)	less than 0.05	
chrome-moly (6 samples)	less than 0.05	
grey iron (12 samples)	less than 0.05	less than 0.05

After the 1-week incubation, the liquid phases were analyzed for nickel and chromium. The procedure developed by Milner (1963) was employed for nickel analyses, and chromium analyses were carried out according to the method reported by Urone and Anders (1950). The leaching of nickel and chromium is summarized in Tables 1 and 2.

Summary and conclusion

Instances of allergic contact sensitivity in association with cutting oil preparations are uncommon and when reported are related to bactericides, rust inhibitors, nickel salts and chromates.

Because the problem of nickel and chromate contamination and associated skin contact is potentially serious, we studied the aspect as it pertains to workers using cutting oils. Surveys carried out in two plants revealed no instances of nickel or chromate dermatitis. Examination of machinery, work areas and oil-wipe rags gave negative results when tested with DMG and DPC on repeated visits. Results from our site visits indicate that direct contact with nickel or chromates from metal machined with cutting oils is not evident, thus negating this operation as a cause for metal contact hy-

persensitivity. On the other hand, in the laboratory significant amounts of nickel were leached from 303 stainless steel, and lesser amounts of nickel were leached from other alloys. Although no active cases of nickel dermatitis were observed, the nickel concentrations discovered from our laboratory studies exceeded the "sensitizing safety limit concentration" proposed by Malten & Spruit (1969). Correlation of the laboratory studies with actual exposure conditions to determine if contact dermatitis can result has not been done.

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