

Chromate dermatitis from a boiler lining

R. J. R. RYCROFT AND C. D. CALNAN

St. John's Hospital for Diseases of the Skin
London, England

Chromate dermatitis is described in a mechanical fitter working inside boiler combustion chambers. A source of hexavalent chromate is traced to the action of the heat and alkaline fuel ash on trivalent chrome ore in parts of the refractory lining. Removal of the patient from this contact has resulted in almost complete clearing of his dermatitis, without any relapse, during a 9-month follow-up period.

Key words: Allergic – chromate – contact dermatitis – occupational – refractory lining.

Received for publication February 2, 1977

A 49-year-old mechanical fitter developed a widespread dermatitis 9 months after first starting to work on the relining of boilers in a power station. The boilers burnt pulverised coal at about 1000°C and had a refractory lining to contain the heat produced. Each of four boilers was overhauled every year and damaged portions of its refractory lining replaced. This work kept a team of men busy for a large part of the year. The removal of the old lining released dust into the atmosphere within the boiler where the fitter would be working. This dust would lodge in any openings in his clothing such as around his collar and the tops of his socks. His dermatitis began over the shoulders and lower legs and spread to involve the trunk, limbs, palms and soles. At no time did it involve his face. The dermatitis became so severe that he required in-patient hospital treatment. It settled over the next 2 weeks in hospital with topical steroid therapy. He was subsequently patch tested with the

ICDRG standard series while still away from his job. He reacted to potassium dichromate 0.5 % pet. He had no previous history of eczema, asthma or hay fever and no family history of these conditions, apart from a daughter with hay fever.

A visit to the power station revealed that parts of the refractory lining of the boilers contained trivalent chromium and that the fuel ash from the boilers was generally alkaline (pH 9–10). It seemed possible that hexavalent chromate could be produced within the boiler combustion chambers by the action of heat and alkaline fuel ash on this refractory lining. This hypothesis was tested in the following manner.

Materials and Methods

Qualitative tests for hexavalent chromate were carried out with diphenylcarbazide on the following samples, extracted with water, dilute sulphuric acid and sodium hydroxide

solution. In most cases several samples of each type were tested.

Sample number

1. New chrome-containing lining
2. Chrome-containing lining removed from a boiler after 1 year's service
3. Pulverised fuel ash from a boiler
4. New chrome-containing lining heated with pulverised fuel ash at 900°C for 4 h.

Results

Hexavalent chromate *was* detected in the following:

Sample number 2 (in 1 out of 4 samples tested)

Sample number 4 (in the sample tested)

Hexavalent chromate *was not* detected in the following:

Sample number 1 (in *no* samples tested)

Sample number 3 (in *no* samples tested).

In summary, hexavalent chromate was detectable in chrome-containing lining only if it had previously been in service within a boiler or if new lining material was heated with alkaline pulverised fuel ash at 900°C for 4 h. Hexavalent chromate was not detectable in samples of new chrome-containing lining which had not been exposed to this experimental reproduction of conditions within a boiler in use.

Treatment and Progress

After 3 months away from work, during which time his skin improved considerably, the patient returned to work on the understanding that he would not be allocated to work which involved entry into the boiler combustion chambers. Six months after he returned to work under this restriction his

dermatitis had almost completely cleared and he had had no relapse.

Discussion

Fregert (1963) has previously described how trivalent chrome ore in the refractory lining of a steel furnace was oxidised to hexavalent chromate by the combined action of heat and alkalinity. He reported that the use of old, ground-up refractory bricks in foundry sand gave it the same order of chromate content as cement. The foundry workers working with this sand (pH 10.2–10.9) developed hand dermatitis and reacted to chromate on patch testing. In this case trivalent chrome ore in the refractory lining of the boiler combustion chambers has been shown to be oxidised to hexavalent chromate by the combined action of heat and alkaline fuel ash. Fregert (1962) has shown previously that coal ash is insufficiently alkaline on its own (pH 8.3–9.7) to promote this conversion, but in this case a sufficiently alkaline environment seems to have been created both experimentally and within the boiler in use. In the absence of simultaneous measurements of pH during testing with diphenylcarbazine, the explanation for this remains speculative. The refractory lining itself may also have contributed to the alkalinity experimentally and this contribution may have further increased the alkalinity at the interface between fuel ash and refractory lining within the boiler in use.

The stripping down of the refractory lining therefore released dust and grit that had been converted to a source of hexavalent chromate. The dermatitis it produced began on covered areas of the skin rather than on the hands or face. This was probably because dust that became lodged between clothing and the skin would have been subjected to sweating and chafing, thus increasing the absorption of chromate.

Removal of the patient from this contact has allowed the dermatitis to subside.

in the investigation of this case, which included all the analytical work reported.

Acknowledgments

Our sincere thanks to J. E. Howe, Esq. (Station Manager), D. C. Lednor, Esq. (Station Chemist) and Dr. J. F. Erskine (C.E.G.B. Regional Medical Adviser) for their exemplary co-operation and assistance

References

- Fregert, S. (1962) The chromium content of fuel ashes with reference to contact dermatitis. *Acta Dermato-venereologica* 42, 476-483.
Fregert, S. (1963) Contact dermatitis due to chromate in foundry sand. *Acta Dermato-venereologica* 43, 477-479.

Address:

Dr. R. J. G. Rycroft
Senior Registrar
Department of Industrial Dermatoses
St. John's Hospital for Diseases of the Skin
London WC2H 7BJ
England