

Irritant dermatitis during the relining of a blast furnace

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An outbreak of dermatitis is reported amongst steel erectors, platers and welders working on the relining of a blast furnace. Evidence is produced for regarding this as an occupational primary irritant contact dermatitis.

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Temperatures as high as 1800°C are reached inside a blast furnace. This heat is contained as well as it can be by a shell of steel plates lined by refractory (heat-resistant) bricks. In addition, around the hottest part of the furnace, water-cooling is usually applied to the outside of the steel shell. The refractory lining is gradually eroded and buckling then begins to appear in the steel plates. In the particular blast furnace involved in this outbreak of dermatitis, relining and replacement of damaged steel plating needed to be done every 7 years. Chrome-containing refractory bricks were used in parts of the lining.

The problem

During one such relining, 36 contractor's men were employed as steel erectors, platers and welders on the cutting-out and replacement of steel plating. It was the first time that most of these men had been involved in a blast furnace reline. Ten out of the 36 men complained of skin rashes after 1-3 weeks of work. Their rashes were mainly on the covered parts of the body, involving the thighs and legs more than the arms and

trunk, and were highly irritable, especially at night. The rash varied from a mild erythema to a papular eruption; in many of the men it was follicular.

The work

The contractor's men had started their work well before the wreckers had finished hacking out the last of the old refractory bricks. In order to remove the remaining iron and slag and brick fragments that fell to the bottom of the furnace, a large hole had first to be cut in the side of it. Working conditions were therefore very dusty at the time of onset of their rashes. This dust and grit could be seen lying on most horizontal surfaces when the site was visited. It was also noted that there was a white lime-like scale over many areas of the steel plating.

The work force

This contract was not unusual in being hundreds of miles from the contractor's headquarters and the men's homes. Such contractor's men appear to live a gipsy-like existence, being sent around the country to one job after another. On this contract

they worked 12-hour shifts, 7 days a week, for 4–5 weeks, before having a long week-end off. The contract lasted for 5 months. Their accommodation during the job was their own responsibility and they lived as cheaply as possible in transport cafés, public houses and bed and breakfast places. Washing and laundry facilities were therefore often very poor. Washing facilities on site were the contractor's responsibility and were hired locally in the form of purpose-designed caravans with changing and shower facilities; on inspection, they were both inadequate and faulty. The men were paid for their work at a basic hourly rate, considerably augmented by 'dirt money' and an accommodation allowance. Financial incentives to lead this kind of life need to be comparatively high. The weather throughout the first month of the contract was cold and dry with strong winds. The men dressed themselves in several layers to keep warm and most of them had boiler suits tied round at the ankles. They had three changes of clothes; their working clothes which they kept on the site, their 'in-between' clothes in which they travelled to and fro, and their best clothes which they kept in their 'digs'. Just as there was a reluctance to spend too much of their wages on their accommodation, there was an unwillingness to spend much on their working clothes. All the contractor's men seen on the site were wearing very dirty, worn, old clothing, consisting of multiple layers of T-shirts, sweaters, donkey-jackets, trousers and a boiler suit. Most of them said they used a launderette to wash their clothes and did this once every 2–4 weeks. Some of them probably got most of their laundering done during their 4–5-weekly, long weekend.

Materials and Methods

1. Patch testing with the ICDRG standard series was carried out on one of the worst affected of the 10 men with dermatitis.
2. Six dust and dirt samples were taken from the blast furnace area and five of these were of sufficient quantity for analysis. These five samples were taken as follows:

Sample number

 - 1 Scrapings from the outside of the blast furnace shell above the tap hole
 - 2 Dust deposited on the top cone of the blast furnace shell
 - 3 Dust deposited on the blast furnace hearth coolers
 - 4 Brick dust from the floor adjacent to number 3 stove on the east side
 - 5 Dried sludge from the blast furnace gas main to the pre-cooler.

One gramme of each sample was dissolved in 100 ml of distilled water and the pH measured. Two samples (3 and 4) were analyzed further for their basic constituents.

Results

 1. Patch tests with ICDRG standard series in the one man tested were all negative at 2 and 4 days.
 2. The pH of each of the five samples was as follows:

<i>Sample number</i>	<i>pH</i>
1	9.85
2	9.95
3	11.95
4	10.75
5	9.05

The basic constituents of samples 3 and 4 were as follows:

Sample 3

Anions: sulphate, chlorides, silicates, hydroxides and oxides.

Soluble cations: potassium, sodium and calcium.

Insoluble cations: predominantly iron.

The sensitivity of the method did not allow the detection of trace elements. One gramme of the sample was mixed with 200 ml of distilled water and filtered. The solution produced was titrated against standard acid solution and the total alkalinity expressed as NaOH in the sample was found to be 1.6 %.

Sample 4

Anions: sulphate, chloride, carbonate and oxides.

Soluble cations: sodium and calcium.

Insoluble cations: predominantly iron.

Discussion

The diagnosis of irritant dermatitis is supported here by the following considerations. Clinically, the follicular appearance of many of the men's rashes was suggestive of an irritant being involved. The distribution of the dermatitis on areas of the body covered by clothes and liable to chafing, such as the thighs, indicated that this was an irritant capable of penetrating the clothing. The description of working conditions by the men and our own examination of the blast furnace area pointed toward dust and grit as the most pervasive potential irritant in the working environment. Because a source of irritant material of high alkalinity exists amongst the raw materials of a blast furnace in limestone, it was suspected that this dust and grit might be strongly alkaline. The analyses confirmed this, particularly in the case of sample 3, where hydroxides of calcium, sodium or potassium contributed towards a pH of 11.95. Alkaline hydroxides are generally held to be more damaging to the skin than the corresponding carbonates (Schwartz et al. 1957). A further essential

in the diagnosis of an irritant dermatitis is the exclusion of an allergic aetiology. The presence of chrome bricks in the refractory lining made chromate sensitivity a possibility (Fregert 1963) but patch tests in the one patient tested showed entirely negative results.

Many occupations are described in the literature where dermatitis may occur from lime (Schwartz et al. 1957), but we have not found a specific mention of men working on blast furnace relinings. An irritant dermatitis due to alkali ash has previously been described by Rustemeyer & Mitchell (1972). In their patients the exposed skin was affected and the pH of an aqueous extract of a pair of overalls worn at work was 9.1. In the present outbreak the dermatitis had a predilection for areas of the body covered by clothes and constantly being moved. This may be explained by the highly alkaline dust (pH 9.05–11.95) gradually permeating the clothing and being transferred to the skin through sweating, chafing and poor personal hygiene. When, for example, calcium oxide comes into contact with the skin it absorbs moisture from it to form calcium hydroxide (slaked lime) which is strongly alkaline and a powerful keratin solvent (Schwartz et al. 1957). Working clothing that is not laundered often enough may not only fail to protect the skin, but may actually provide a microclimate that is positively damaging to it.

This type of follicular dermatitis of the lower limbs is probably a common occurrence in men working in a wide variety of dirty jobs. It is extremely difficult to devise suitable protective clothing for work that involves both hard physical labour and exposure to irritant dusts. A clothing design that repelled or filtered out dust effectively would so reduce the flow of air through the clothing that perspiration would rapidly accumulate in it and make it intolerable to wear (Crockford et al. 1972). In the absence of ideal protective clothing, it is im-

portant that whatever clothing is worn should be frequently and effectively laundered if it is not to become irritant to the skin in its own right. The skin should be adequately washed as soon as possible after each shift to prevent a gradual build-up of skin contamination from one shift to the next. The best method of prevention, however, would be to suppress the dust at source by means, for example, of water-sprays. The technology has already been developed to do this for respiratory hazards, such as silica and asbestos, and perhaps it also has a part to play in the control of dusts which irritate the skin.

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