Faculty of Occupational Medicine

Wilf Howe Memorial Prize 2012

Winning submission by Dr Michael Donoghue

Diphoterine for alkali chemical splashes to the skin at alumina refineries.

1. Clear description of innovation, initiative or intervention

Diphoterine is a commercially available amphoteric, hypertonic, chelating solution used to decontaminate and irrigate chemical splashes. It was developed in France and is manufactured by Prevor.

Alcoa of Australia operates three alumina refineries in Western Australia at Kwinana, Pinjarra and Wagerup. These three refineries employ about 3000 people and produce about 13% of the world's alumina. Much of the Bayer alumina refining process involves strong alkali solutions (primarily sodium hydroxide), which have the potential to cause chemical burns if the skin is splashed. There are, of course, many engineering and administrative controls to reduce the likelihood of splashes occurring, but there is residual risk and splashes do occur. It is therefore important to provide the best first aid available for chemical splashes. Traditionally this has involved deployment of emergency showers and emergency eyewash stations in close proximity to any areas of risk. However, in 2003 Alcoa's Environment Health & Safety Manager for the Western Australian Operations asked me whether I thought we should introduce Diphoterine at our refineries. Following a review of the literature and discussions with staff from alumina refineries in the United States and South America I decided this would be a good idea, as it seemed likely Diphoterine would provide better first aid treatment for alkali skin splashes.

I therefore contributed to the deployment of Diphoterine at Alcoa's three alumina refineries in Western Australia and then evaluated the benefit of the initiative (see below). The deployment was undertaken by a multidisciplinary team including myself, occupational hygienists, occupational physicians, occupational health nurses, health and safety managers, line managers and procurement staff.

In 2006 all employees and contractors working in the operational areas of all three refineries were trained in the use of Diphoterine and issued with a 100ml personal aerosol can, belt and carrying pouch. Employees and contractors were trained to respond to skin splashes by immediately removing contaminated clothing and applying Diphoterine from their personal can. They were instructed to discharge the entire contents of the can and to seek assistance from nearby colleagues if necessary to spray larger splashes with multiple cans. They were specifically advised that there was no need to shower before applying Diphoterine and that they should only shower if they did not have access to enough Diphoterine to cover the affected skin promptly. The instruction to call the plant emergency number for emergency medical response by onsite ambulance if they sustained or witnessed a large skin splash remained unchanged. The ambulances and medical centres were equipped with 5 litre canisters of Diphoterine and a large supply of 100ml cans.

2. Description of working population

All employees and contractors working in the operational areas of Alcoa's three alumina refineries in Western Australia (Kwinana, Pinjarra and Wagerup).

3. Reasons for choosing 1 and 2, including organisational context
Please refer to section 1.

Please note: I have no affiliation or financial involvement with Prevor, the manufacturer of Diphoterine. The initiative was funded by Alcoa of Australia.

4. How did you measure outcomes?
In order to evaluate the effectiveness of the initiative I undertook an audit of clinical cases seen at the three refinery medical centres and I interrogated injury data from Alcoa's Environment Health and Safety Incident Management System. The objective of the audit of clinical cases was to determine if the clinical severity of chemical burns were any different when Diphoterine was applied first following chemical splash, compared to when water was applied first. This comparison was made possible when the Diphoterine program was introduced because some employees chose to use Diphoterine first, whilst others chose to apply water first. This is the largest clinical case series of alkali splashes treated by Diphoterine reported to date. The objective of the injury rate analysis was to determine if there were any differences in the injury rates for chemical burns before and after the introduction of Diphoterine.

5. What were the health benefits?
180 cases of alkali splashes to the skin over a 17 month period were audited. There were no signs of a chemical burn in 52.9% of the group who applied Diphoterine first compared to 21.4% of the group who applied water first. Only 7.9% of the group who applied Diphoterine first had blisters or more severe signs compared to 23.8% of the group who applied water first. The differences were statistically significant ($P < 0.001$). There were no statistically significant differences between the two groups in either time elapsed from splash to clinical assessment ($P = 0.496$), or in body surface area splashed ($P = 0.233$). After implementation of Diphoterine the "OSHA first aid" injury rate for chemical burns fell 24.7% (95% CI 0.5 – 43.0%). Applying Diphoterine first was associated with significantly better outcomes following alkali skin splashes than applying water first.

I published the findings:
Donoghue AM. Diphoterine for alkali chemical splashes to the skin at alumina refineries. *Int J Dermatol* 2010;**49**:894-900.

6. Give an account of the difficulties / obstacles that arose and how they were addressed
Several difficulties were addressed by the multidisciplinary team:
1. Funding approval for the initiative was sought from senior management of the company. This involved explaining the evidence for Diphoterine's effectiveness, the frequency of chemical splashes at the refineries (despite engineering and administrative controls) and the cost of deployment.
2. Approval of Diphoterine was sought from the Therapeutics Goods Administration of the Australian Government in order to enable importation of Diphoterine into Australia for the first time. Specialised assistance was sought to undertake this process.
3. Management, union representatives, contractor representatives and employees were engaged in workshops explaining the benefits of deployment.
4. Training materials were developed and the program was "rolled out" using several means of communication – electronic and face to face. This required repetitive messaging as there was an entrenched culture of using showers for skin splashes and a reluctance to trust a new alternative.

7. Explain how this might be used elsewhere
Diphoterine could be usefully deployed at alumina refineries around the world. After discussing my experience with colleagues and publishing my findings, Diphoterine has been deployed at alumina refineries operated by other companies. It is also likely that Diphoterine could be usefully deployed wherever alkali skin splashes could reasonably be expected to occur. For example in chloralkali plants, various chemical industries, chemical pulp mills and industrial cleaning processes.