

CONTACT POINT

Occupational allergic contact dermatitis caused by hexahydrophthalic acid diglycidyl ester and anhydride epoxy hardeners

Denis Sasseville  | Yassein Shamout | Linda Moreau

Division of Dermatology, McGill University Health Centre, Montreal, Canada

Correspondence

Denis Sasseville MD, Montreal General Hospital, Room L8.210, 1650 Cedar Avenue, Montreal, QC, Canada.

Email: denis.sasseville@mcgill.ca

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CASE REPORT

A 55-year-old general labourer worked for 2 months in a company producing electrical wiring devices, capacitors, and insulators. He was operating a metal press that injected a mixture of epoxy resin and hardener onto the manufactured parts. There was occasional skin contact with the mix when he flushed out or cleaned the feeding hose and the injection system of the machine. Six weeks after beginning this work, he developed mild dermatitis on the forearms. Two weeks later, he was asked to clean and scrub a barrel containing residues of hardened resin, which he solubilized with acetone. Within <24 h, acute facial dermatitis developed, and he was withdrawn from work. The lesions cleared over a period of 2 weeks with applications of desoximetasone 0.25% cream. However, upon returning to his regular work, the patient suffered a relapse after the first day and had to quit his job.

We reviewed relevant material safety data sheets and obtained, from the employer, samples of 2 epoxy resins (Epalloy® 5200 and Lindoxy 190) and 2 hardeners (LS-252 and Lindride 52). They were diluted 1% pet. according to the recommendations of de Groot.¹ Patch testing was performed with the North American Contact Dermatitis Group (NACDG) baseline series (AllergEAZE™; SmartPractice, Calgary, Canada) applied on Finn Chambers® (SmartPractice), and with a glues and plastics series (Chemotechnique Diagnostics, Vellinge, Sweden) on IQ-Ultra chambers® (Chemotechnique). The patient was also tested with the above-mentioned 4 products from his workplace, which failed to induce a positive reaction in 4 controls. One additional control subject, who was already known to be allergic to epoxy resins, including cycloaliphatic epoxy, had a ++ reaction to Epalloy® 5200. Readings of patch tests were performed on day (D) 2

and D4 according to NACDG standards. The results of patch testing are shown in Table 1.

DISCUSSION

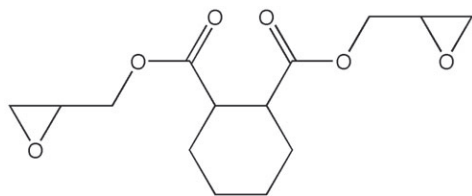
Epalloy® 5200 CVC (Thermoset Specialties, Moorestown, NJ, USA) and Lindoxy 190 (Lindau Chemicals, Columbia, SC, USA) are both cycloaliphatic epoxy resins designed for specific applications. Epalloy® 5200 contains 95% to 100% hexahydrophthalic acid diglycidyl ester, CAS no. 5493-5445-8, also known as diglycidyl 1,2-cyclohexanedicarboxylate (Figure 1). Interestingly, the patient reacted to the cycloaliphatic epoxy resin from our glues series, CAS no. 5493-5445-8,² which is therefore the same compound as Epalloy® 5200. Lindoxy 190 is made of >97% 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, CAS no. 2386-2387-0 (Figure 1). According to the manufacturers, Epalloy® 5200 and Lindoxy 190 are low-viscosity resins designed for use with anhydride catalysts for applications that require good electrical resistance, weatherability, and high glass transition temperatures. Allergic sensitization to cycloaliphatic epoxies or similar compounds has rarely been reported,²⁻⁶ and their chemical structure is different enough from that of diglycidyl ether of bisphenol A epoxy resin, which is present in most baseline series, for cross-reactions to not be systematic.

Our patient was also sensitized to phenyl glycidyl ether (PGE). In their study, Aalto-Korte et al. reported that 6 of their 9 patients who were allergic to cycloaliphatic epoxy resin were simultaneously sensitized to PGE.² In an earlier study, of 5 patients who were allergic to cycloaliphatic epoxy resin, 4 were also sensitized to PGE, and the

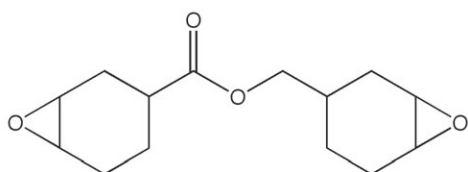
TABLE 1 Results of patch testing

Compound	Concentration / %	Day 2	Day 4
From baseline series:			
DGEBA epoxy resin	1	?	?
From glues and adhesives series:			
Epoxy resin, cycloaliphatic	0.5	–	++
Phenyl glycidyl ether	0.25	+	++
Products from work:			
Epalloy® 5200	1	++	+++
Lindoxy 190	1	+	++
LS-252	1	+	++
Lindride 52	1	–	–

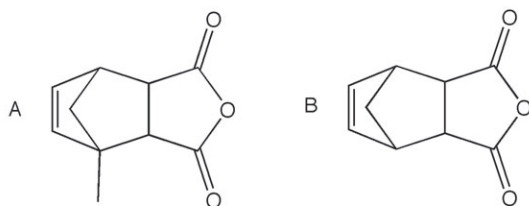
DGEBA, diglycidyl ether of bisphenol A. All compounds in pet.



Hexahydrophthalic acid diglycidyl ester, CAS no. 5493-45-8



3,4-Epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, CAS no. 2386-87-0



A. Methyl-5-norbornene-2,3-dicarboxylic anhydride, CAS no. 25134-21-8

B. 5-Norbornene-2,3-dicarboxylic anhydride, CAS no. 826-62-0

FIGURE 1 Chemical structure of cycloaliphatic epoxy resins and carboxylic anhydrides

investigators suggested that PGE and cycloaliphatic epoxy resin cross-react.⁶

Lindride 52 (Lindau Chemicals, Columbia, SC, USA) contains >95% methylhexahydrophthalic anhydride, CAS no. 19438-60-9, whereas its counterpart LS-252 (Lindau Chemicals) is a mixture composed of ~60% methyl-5-norbornene-2,3-dicarboxylic anhydride (CAS no. 25134-21-8), 10% to 30% 5-norbornene-2,3-dicarboxylic anhydride (CAS no. 826-62-0), and 1% to 5% 1-(2-hydroxypropyl)imidazole

(CAS no. 37788-55-9). Our patient did not react to Lindride 52, but showed a positive patch test reaction to LS-252. Given that the norbornene anhydrides (Figure 1) represent at least 70% of the composition of the compound, we presume that they are responsible for our patient's sensitization. It is also possible, however, that the culprit is the imidazole moiety, as we did not separately test this ingredient. Anhydride curing agents are known to induce immediate hypersensitivity reactions such as occupational asthma,⁷ and contact urticaria,⁸ but have rarely caused delayed hypersensitivity and allergic contact dermatitis.⁹ This report highlights the importance of testing workplace materials in appropriate vehicles and dilutions for a thorough investigation of occupational contact dermatitis.

Conflict of interest

Denis Sasseville receives royalties from UpToDate (Wolters Kluwer Health). The other authors have no conflict of interest to declare.

ORCID

Denis Sasseville  <http://orcid.org/0000-0001-9104-2342>

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