

Letter to the Editor

The dermatological significance of correct chemical structures for (meth)acrylates

Dear Sir

In the August issue of *Contact Dermatitis* was published the article 'Allergic contact reactions from poly(oxy-1,2-ethanediyl) α,α' -[(1-methyl-ethylidene)di-4,1-phenylene]bis[ω -[(2-methyl-1-oxo-2-propenyl)oxy] (BIS-EMA)', which I co-authored with Professor L. Kanerva (1). The message that I tried to convey is that looking at chemicals by their idealized structure leaves an important, in some cases even the essential, element out, the rôle of impurities; sometimes, more important even, the fact that certain chemicals have a molecular weight distribution rather than consisting 100% of only one, well-defined chemical.

This applies in extremis to the chemistry of acrylates and methacrylates, and I tried to make that point in the above-mentioned article. I used 3 ways to convey this message:

- by the use of a chemical name that more adequately describes the substance BIS-EMA;
- in the discussion;
- by the chemical structures given in Fig. 1.

For technical reasons, the chemical structure given for BIS-EMA in Fig. 1 was slightly, but significantly, modified compared to the original version, which is given below:

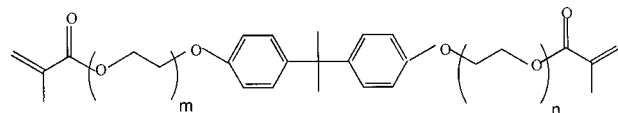


Fig. 1.

The consequences of this change, caused by a flaw in cyberspace communication, are not without consequences.

BIS-EMA is made by direct esterification or transesterification, using ethoxylated bisphenol A. This intermediate is made in a reaction between bisphenol A, ethylene oxide and water. In this reaction, the phenolic hydroxy groups are difficult to react with ethylene oxide. Once a phenolic hydroxy

group is ethoxylated (reacted with 1 molecule of ethylene oxide), the resulting aliphatic hydroxy group is far more reactive than the phenolic hydroxy group and hence will preferentially react with ethylene oxide.

The consequences are as follows:

- The intermediate will contain some ethylene glycol and diethylene glycol, unavoidable by-products of the direct reaction of ethylene oxide and water.
- The intermediate will have an uneven molecular weight distribution: it will contain more than statistical quantities of phenolic hydroxy groups (which have not reacted at all with ethylene oxide, i.e., either m or $n=0$ in the figure).
- The intermediate will predominantly comprise asymmetrical molecules (i.e., with $m>n$ in the figure).

Once this product is methacrylated (be it by direct esterification or by transesterification), there are 2 dermatologically significant consequences of the above.

- The final product will contain small but dermatologically significant amounts of 2-HEMA, EGDMA and DEGDMA.
- The final product will contain significant amounts of the monomethacrylate with a free phenolic group, as phenolic hydroxy groups are very difficult to esterify, and hence the primary hydroxy groups (from the reaction products of phenolic hydroxy groups and ethylene oxide and the reaction products of already ethoxylated phenolic hydroxy groups) will be much more completely methacrylated.

The presence of HEMA, EGDMA and DEGDMA, as well as its corresponding monoester, has been detected beyond any doubt by the NMR analysis performed on the Protomp garant[®] paste.

This example shows that (in this case involuntarily) representing chemicals by an 'idealized' structure sometimes leads to dermatologically significant substances remaining unnoticed. This has

been shown before for irritant contact dermatitis in the patent literature (2).

Yours sincerely
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References

1. Kanerva L, Zwanenburg R. Allergic contact reactions to poly (oxy-1,2-ethanediyl) α,α' -[(1-methylethylidene)di-4,1-phenylene]bis[ω -[(2-methyl-1-oxo-2-propenyl)oxy](BIS-EMA). *Contact Dermatitis* 2000; 43: 115–117.
2. Bergvall G. Acrylate monomer having a reduced primary irritation index and a method of making same *USA patent* 5, 543, 557 (1996: 5).