
Skin Disease in Relation to the Use of Waterborne Paints by Housepainters

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Introduction

From 1 January 2000 on, the use of paints with a solvent content of less than 10% for indoor applications is compulsory in the Dutch regulations. The reason for this was to reduce exposure of professional painters to Volatile Organic Compounds (VOC), and thus to eliminate the occupational risk on Chronic Toxic Encephalopathy (CTE). CTE - also known as the "painters' disease" - has been recognised as an occupational disease in The Netherlands. It may be caused by a high and/or prolonged exposure to VOC or other neurotoxic substances.

The 1/1/2000 regulation was further tightened on 1/1/2002. Current maximum solvent contents for indoor paints that are used by professional painters are:

- 5% (60 g/l) for wall and ceiling paints;
- 8% (100 g/l) for all other paints, i.e. paints for wood, metal etc.

In practice, only waterborne paints are allowed now for indoor application. However, these paints have in most cases a more complex composition than the traditional alkyd resin solvent-borne paints, and may contain several components that are skin irritants or skin sensitizers. Besides, health surveillance among painters seemed to indicate an increase in

'self-reported' skin complaints over the years 1999-2000.

Therefore, the main question to be answered in this study was: is there a potential for an increase in skin allergy among house painters as a result of the increased use of modern waterborne paints?

A complicating factor is, that solvents are strong irritants for the skin. This means that skin irritation may be decreasing due to the use of waterborne paints and this might hide or blur a potential increasing sensitising effect from the use of waterborne paints. Moreover, a number of 'additional products' that painters use, such as putties and sealants, may contain skin irritants and sensitizers as well.

Methods

The composition of modern waterborne paints was investigated, as former investigations were more than 10 years old. For this purpose, suppliers of paints and their components were directly approached, and literature was studied. Thus, 'standard recipes' for a number of commonly used product types were defined, and a survey was made of paint additives used in waterborne paints. In addition, the composition of some additional products, commonly used by house painters, was investigated. These were putties, sealants, surface and

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hand cleaning agents, wood-repair products and solventborne paints – the latter are still used for outdoor work. The potential health effects of the paint components were investigated by a literature study and by means of recording the respective ‘R-phrases’ (‘risk-phrases’). For each type of paint the potential sensitizers and skin irritants were recorded.

Furthermore, the prevalence of skin disease among painters was studied in literature*, as well as exposure of house painters to paint components and relations between product use and skin disease.

Finally, a questionnaire study was performed. Firstly, the data from a continuously running ‘Painter’s Questionnaire’, which is filled in by 3600 painters each year and focuses on health complaints, were analysed for prevalence of skin complaints, use of waterborne paints, skin protection etc. Secondly, an additional questionnaire was sent to 200 painters who reported skin complaints in the first questionnaire and to 200 painters who reported *no* skin complaints. The second questionnaire contained more detailed questions on product use, tasks performed and skin disease during the pre-employment period. In this article, only part of the results will be presented.

Results

1. Product inventory

Paints

The inventory of the composition of modern housepaints has resulted in the definition of ‘standard recipes’ for seven commonly used paint types. Among these, five major types exist:

1. Standard waterborne (latex) wall and ceiling paint;
2. Waterborne polyurethane-acrylate dispersion trim paint (i.e. wood, metal);
3. Waterborne alkyd emulsion trim paint;
4. Solventborne high solids alkyd trim paint;
5. ‘Traditional’ solvent-rich alkyd trim paint.

As from the introduction of the new regulations in the Netherlands, polyurethane-acrylate dispersions for trim have gained popularity, at the expense of the ‘traditional’ acrylate dispersions. The first have a superior scratch resistance and aesthetic appearance. At the moment, also alkyd emulsions for trim are gaining popularity because of the high-gloss appearance that can be achieved. At the same time it has been observed that the composition of waterborne *wall*

paints has not changed much over the past decade.

In table 1, the main features of each of the five paint types are summarised. These include the VOC-content, the content of sensitising components and the content of ‘skin-irritating’ components (as indicated by the respective R-phrases).

One major outcome was, that alkyd resin paints of all types – traditional solvent rich, solventborne high solids and waterborne emulsions – contain much higher amounts of sensitising components than the other (waterborne) paint types.

This is due to the use of sensitising anti-skinning agents and cobalt-based driers in alkyds. The sensitising components in waterborne latex wall paint and PUR-acrylate dispersions consist of low amounts of preservatives and low amounts of residual monomers of the acrylate resin.

As far as the *irritating* components are concerned, it is clear that the solvents play a major role here. Although not all solvents carry the R-phrase for ‘skin irritation’ it is known that most solvents dehydrate the skin and do lead to skin irritation at frequent or prolonged exposure. Thus, solvent borne paints have the highest ‘irritative potency’, followed by the PUR-acrylate dispersions, which contain a relatively high content of glycolether solvents or ‘coalescing agents’.

‘Additional products’

The inventory of the composition of commonly used ‘additional products’ revealed that many of them may contain sensitising and/or irritating components. Besides, the content of these may be much higher than the content of sensitising and irritating components in paints. The additional questionnaire that was organised as well as interviews with painters revealed that not much has changed in the use of ‘additional products’ after the introduction of the new Dutch rules.

Table 2 provides a brief overview.

Epoxy-based wood repair products are widely used because of their fast curing, excellent adhesion and lack of shrink. However, epoxy resins as well as the reactive diluents and most amino hardeners are potent sensitizers, and the products contain high amounts of these components.

The putties mentioned in table 2 all have their own specific area of application: painters use waterbased putties mainly to fill small holes and cracks in walls, and solvent based alkyd putties to level larger wooden surfaces (e.g. doors). Polyester

Table 1 Main features of five commonly-used paint types (standard recipes)

Paint type	VOC (%)	Sensitizing components (%)	Skin-irritating components (incl. solvents) (%)
Standard latex wall paint	1.5	~ 0.06 (max.)	~ 1.6
PUR-acrylate dispersion trim paint	8.7	~ 0.03 (max.)	~ 9.0
Alkyd emulsion trim paint	0.8	1.2	~ 1.9
High Solids Alkyd	15	0.7	~ 13 – 20
Solvent rich Alkyd	29	0.5	~ 31

* full list of references is available from the author

Table 2 Sensitising and 'skin-irritating' components in 'additional products', used by housepainters

Product	Sensitising components	Skin-irritating components
Wood-repair products	+++ (epoxy resins, reactive diluents, amino-compound hardeners)	+++ (epoxy resins, reactive diluents, amino-compound hardeners)
Putties – waterbased acrylic	+ (monomers, preservatives)	+ (monomers, preservatives)
Putties – solvent based alkyd	+ (dryers)	+++ (solvents)
Putties – 2-pack polyester	+++ (hardener: dibenzoylperoxide)	+++ (styrene)
Sealants – waterbased acrylic	+ (monomers, preservatives)	+ (monomers, preservatives)
Sealants – silicone	-	-
Sealants – 'oxim curing silicone'	++ (butanonoxim)	-
Sealants – solvent based acrylic	-	+++ (solvents)
Sealants – polysulfide	-	++ (solvents, bariumoxide)
Sealants – polyurethane; 1-pack	++ (‘free’ isocyanate)	+++ (‘free’ isocyanate, solvents, CaO)
Surface and hand cleaning agents; waterbased	+ (preservatives)	++ (surfactant, abrasives, lye)
Surface and hand cleaning agents; solvent based	-	+++ (solvents, abrasives)
Drier for alkyd paints	+++ (Cobalt-salts)	+++ (Cobalt-salts)
‘Drying Retarder’ for waterbased paints (coalescing agents)	-	+++ (glycoether solvents)

putties are used on steel and as wood repair products for smaller cracks. The latter in particular are relatively hazardous to the skin.

With respect to sealants, one has to distinguish between window sealants and other, more ‘general purpose’ sealants. Apart from this, special ‘wet room’ sealants exist, which contain a fungicide. As far as window sealants are concerned, the ‘oxim curing’ silicone sealant in particular contains a relatively high amount of sensitising components, and so does the one-pack polyurethane sealant. An alternative for these two sealants is the so-called Hybrid sealant (a modified silicone), which does not contain sensitising components. Besides, this sealant is more suitable for application together with water-based paints. However, many painters are not yet satisfied with the technical properties of this alternative.

Finally, professional painters may add various additives themselves to what paint manufacturers sell as ‘ready-to-use’ paint. In particular, sensitising driers are added to alkyd type paints, and ‘drying retarders’ (i.e., glycoether solvents) to waterborne paints.

2. Prevalence of skin disease among Dutch house painters

The most accurate data that were available on the prevalence of skin disease among house painters in The Netherlands

appeared to be generated by the already-mentioned ‘Painter’s Questionnaire’. The questionnaire generates data on ‘self-reported’ hand eczema as well as data on the prevalence of five objective ‘indicators’ of hand eczema. The latter have been described in Table 5.

While the frequency of ‘self-reported’ hand eczema rose from 12,8% in 1999 to 13,8% in 2000 (which is before and after introduction of the new rules, respectively), the frequencies of the five objective indicators of hand eczema have decreased in the year 2000, see Figure 1. Although these data seem to be conflicting, one explanation may be the following. The increase in ‘self-reported’ hand eczema might reflect an increased awareness among painters of health issues associated with paints, as a result of the new rules. At the same time, the decrease in the prevalence of the five ‘objective’

Percentage of Dutch housepainters having one or more of the five ‘objective indicators’ of hand eczema (n = 15.478)

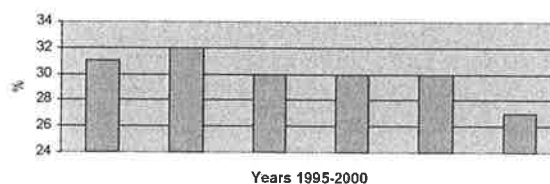


Figure 1

indicators may reflect the actual situation more accurately.

3. Causal relationships

By means of literature study, the two questionnaires, interviews and the inventory of the compositions of the products that painters use, it has been tried to indicate potential causal relationships between exposures and skin disease. The development of skin disease is generally 'multi-causal' and in the painters' case the following main factors have been investigated:

- Exposure to sensitising substances;
- Exposure to irritating substances;
- Mechanical stress, e.g. as a result of handling sand paper;
- Personal factors ('skin atopy', dry skin type);
- Use of personal protection (glove type, 'glove hygiene').

Unfortunately it is not possible to deal with these factors thoroughly in this paper. However, a few remarks may be made, trying to select the most eye-catching details.

In most cases, the exposure of housepainters to *sensitising* substances is not very severe. In most paints as well as most putties and sealants, the content of sensitising substances is low. Moreover, skin contact is not very intense, except for sealants, which are handled with bare fingers. Sensitising substances however *may* play a major role when epoxy products (e.g. wood repair), 'oxim curing' sealants or two-pack polyester putties are used. In those cases where painters add cobalt-based driers to the paint themselves, this may constitute a significant exposure to sensitising substances as well. In other cases, such as the well-known isothiazolinone preservatives in waterbased paints (e.g. Kathon), private exposure through cosmetics (e.g. shampoos) may interfere with occupational exposure. Literature data on sensitisation frequencies – e.g. patch test results – among painters are scarce, and often lack tests with various paint constituents. An adaptation of the 'standard test series' seems appropriate.

As far as *irritative* factors are concerned, wood and paint dust generated at sanding, the use of solvent-borne sealants and the use of special hand cleansers or solvents for hand cleaning seem to be the major factors. It's interesting to see that hand cleaning with solvents seems to be closely related to the use of solventborne paints (data from the additional questionnaire). Thus, a reduction in the use of solventborne paints might reduce skin irritation as a result of hand cleaning substantially.

The influence of *mechanical* stress due to the use of sandpaper is hard to estimate, but obvious.

Personal factors such as an increased sensitivity of the skin, called 'skin atopy', may according to literature significantly increase the risk for hand eczema, especially irritative eczema. The additional questionnaire in this study, though small in size, gave some indications of this effect (tables 3 and 4). A 'dry skin type' is thought to increase the risk as well.

Finally, the use of *gloves* may protect against skin disease, but

Table 3 Skin-atopy among painters with and without skin complaints (%)

[additional questionnaire]

A history of:	Painters with skin complaints (n = 92)	Painters without skin complaints (n = 77)
'Flexural eczema'	10,9	2,6
Hand eczema	11,9	2,6

Table 4 Skin-complaints among painters with and without skin-atopy (%)

[additional questionnaire]

	Painters with a history of 'flexural eczema' (n = 12)	Painters with a history of hand eczema (n = 13)
with skin complaints	83%	85%
without skin complaints	17%	15%

may be a risk factor in itself as well, due to sensitising components (latex) or 'occlusion' of chemicals or moisture.

Conclusions

The Dutch rules of 1/1/2000, which resulted in an increase in the use of waterborne paints for indoor applications, do not seem to have resulted in an increase in allergic skin disease among professional painters. In contrast, a decrease in exposure to both sensitising and irritative agents seems to have occurred (less alkyds with sensitising driers and anti-skinning agents, less solvents), and the frequency of objective skin complaints seems to be decreasing. However, if alkyd emulsions become more popular in the near future, the exposure to sensitising substances in paints may rise again. On the other hand, a number of 'additional products' seem to be more important as far as sensitising and irritating substances are concerned.

Table 5 Descriptions of the five 'objective indicators' of hand eczema used in the 'Painters' Questionnaire'

The formulation of the questions on skin disease, in addition to the 'self-reported' skin disease, in the Painters' Questionnaire is as follows:

"Did you have one or more of the following complaints during the past 12 months:

- Red, swollen hands and fingers
- Red hands or fingers with lesions
- Vesicles on hands or in between the fingers
- Rough or scaling hands with lesions
- Itching hands or fingers with lesions. "