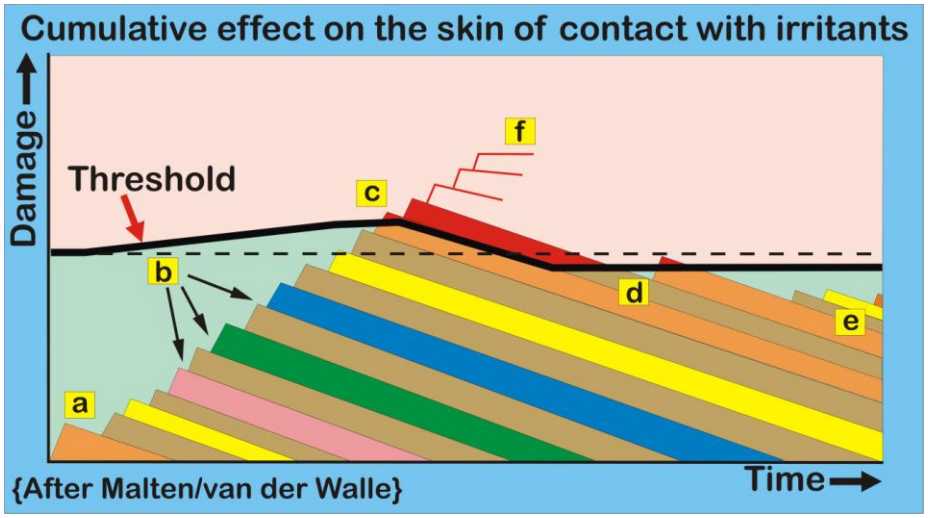
Why should we measure skin condition?

It is generally accepted that in order to detect damage to the lungs of a worker potentially exposed to harmful chemicals lung function testing is needed. For this the appropriate test equipment is required, ranging from a simple peak flow meter to more sophisticated spirometry instruments. Few would suggest that respiratory health surveillance could be effective without such equipment.

Similarly for damage to hearing caused by workplace noise exposure audiometric equipment is used.

Why, then, is it still widely assumed that it is unnecessary to use suitable instrumentation to detect sub-clinical skin damage? Whilst visual inspection of the skin is essential, it cannot detect the sub-clinical accumulation of damage due to repeated exposure to irritant chemicals, but only recognises that our skin management systems are not working when a clinically relevant skin problem becomes visible.

The diagram shows how such damage due to skin contact with irritant chemicals (**a**) can accumulate at the sub-clinical level (**b**) until a point is reached (the 'threshold') where the damage becomes visible (**c**). It is then only a short step to a full irritant contact dermatitis.[1]



If it were possible to detect and estimate the severity of this sub-clinical damage then action could be taken to reverse the process through a reduction of the exposure to irritant chemicals supported by optimum skin care.

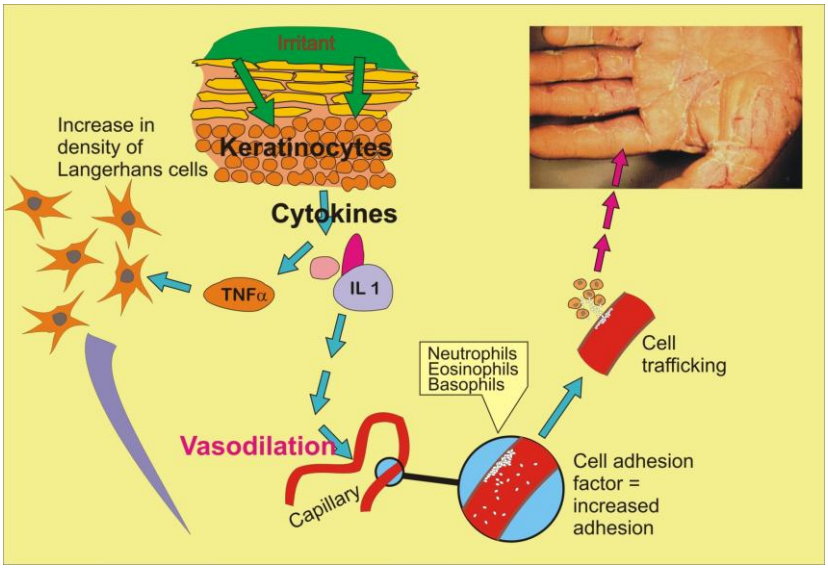
Fortunately, this is possible. It is known that as the damage accumulates the ability of the cells in the outer layers of the skin (corneocytes) to bind water is progressively reduced. **So measuring residual skin hydration can show where sub-clinical damage is occurring and provide an indication as to the severity of this damage, well before this can be identified by a visual examination of the skin.**

> "Indeed, subclinical irritant dermatitis can be detected by early changes (reduction) in stratum corneum hydration."[2]

There is another reason for wishing to measure sub-clinical skin damage.

The diagram on page 2 illustrates what happens when an irritant chemical penetrates the outer layer of the skin (*stratum corneum*) and reaches the living keratinocytes. These are stimulated to release cytokines. At the same time there is an increase in the density of Langerhans cells in the (probably still sub-clinically) damaged area of the skin. Langerhans cells form part of the process that results in an allergic contact dermatitis. Thus an increase in the density of these cells can result in a heightened possibility of that person developing a sensitisation and subsequent allergic contact dermatitis.[3,4]

Furthermore, for the Langerhans cell to initiate such a reaction it needs a signal that causes it to migrate down lymph channels to a regional lymph node. It is in the lymph node that it reacts with T-lymphocytes to cause the release of inflammatory mediators. The signal is provided by a substance known as Tumour Necrosis Factor α (TNFα). This is one of the cytokines released by keratinocytes due to contact with an irritant.



An additional concern is that sub-clinically damaged skin can significantly affect the time taken and rate of penetration of potentially toxic chemicals through the skin.[5] Since, with many toxic chemicals, skin uptake is more significant that inhalation[6], and since, also, many chemicals can be metabolised within the skin resulting in some cases in increased toxicity of the metabolite, any effect on the skin's barrier properties, even when this is sub-clinical, should be of concern.[6]

What this means is that sub-clinically damaged skin increases both the possibility of sensitisation and the development of an allergic contact dermatitis at a much lower level of exposure than would be necessary with healthy, undamaged skin. Furthermore, increased rates of skin penetration due to sub-clinically damaged skin is also of concern. So identifying this sub-clinical damage and taking action to restore the skin to a healthy condition is important, not only in the prevention of irritant contact dermatitis but also in reducing the potential for the development of skin allergies and systemic damage.

> "In conclusion, the hapten-induced skin contact irritation conditions the development and severity of allergic contact dermatitis." *Skin Contact Irritation Conditions the Development and Severity of Allergic Contact Dermatitis, Bonneville M, Chavagnac C, Vocanson M, et al., Journal of Investigative Dermatology, (2007) Volume 127*

Fortunately, there are now simple, relatively low cost methods for measuring skin hydration. These are non-invasive, intrinsically safe, use no chemicals and are quick and simple to use. The picture illustrates one such instrument, the **Skin Hydration Monitor EDS10**. This measures skin hydration on a scale of 1-12, with low values (i.e. <5) indicating damaged skin.

So just as the occupational health nurse will consider it standard procedure to carry out lung function testing to identify where inhalation exposure is resulting in damage to health, so they should regard skin condition measurement as an essential element of a normal skin health surveillance program in order to identify situations where action is needed to minimise the potential for the worker to develop either irritant contact dermatitis, allergic contact dermatitis or both.

How can skin hydration measurement help?

By measuring underlying skin condition through skin hydration measurement it is possible to:

(a) detect accumulated damage due to contact with irritants at a sub-clinical stage and take remedial action to help the skin recover, or at least prevent further deterioration.

(b) monitor whether the intervention is achieving the desired results.

(c) identify those areas within a workplace where skin exposure is inadequately managed

(d) produce quantitative data on worker skin condition to ensure that there is no general deterioration in general skin condition

(e) provide management with reliable data such that they can take informed decisions regarding further action.

What can skin hydration measurement not tell us?

Skin hydration measurement will not indicate exactly when a person with low hydration measurement would develop a clinical irritant contact dermatitis.

Skin hydration measurement cannot differentiate between occupationally and non-occupationally caused damage.

Skin hydration measurement cannot detect sensitisation or impending allergy. Visual assessment still has an essential part in any comprehensive skin health surveillance system.

Skin hydration measurement cannot detect other conditions that can result in skin damage, such as psychosomatic effects, endogenous skin diseases, etc.

Skin hydration measurement cannot identify the different irritants in the workplace and the contribution that each is making individually to the overall accumulated damage.

However, since irritant contact dermatitis is the most common form of occupational skin disease and since skin hydration measurement can be invaluable in detecting and managing sub-clinical irritant damage it must be regarded as an invaluable and essential tool in helping to avoid occupational skin disease.

References

1. Malten K E, Thoughts on contact dermatitis, Contact Dermatitis, 1981, 7, 238-247
2. From: The Potential Use of Non-Invasive Methods in the Safety Assessment of Cosmetic Products – Report and Recommendations – ECVAM Workshop 36. (European Centre for the Validation of Alternative Methods)
3. Proksch E, Brasch J, Integrity of the permeability barrier rebulates epidermal Langerhans cell density, British Journal of Dermatology, 1966, 134, 630-638
4. Proksch E, Brasch J, Influence of epidermal permeability barrier disruption and Langerhans cell density on allergic contact dermatitis, Acta Dermatovenereologica, 1997, 77, 102-104
5. World Health Organisation Environmental Health Criteria 235, Dermal Absorption – para. 3.4.4.
6. Weiss T, Schuster H, et al.; Dermal uptake and excretion of 4,4'-Methylenedianiline during rotor blade production in helicopter industry – an intervention study; Ann.Occup.Hyg, 2011, 55, 8, 886-892

EnviroDerm Services
Unit 10, Building 11, The Mews, Mitcheldean, GL17 0SN
Tel: +44 1386 832 311/831 777, Fax: +44 1386 898 122, info@enviroderm.co.uk ~ www.enviroderm.co.uk