

Surface Modification in the Bathroom – Skin and Hair

Cosmetics are substances used to improve or enhance the appearance of the human body. They are used by men and women alike and their demand is so great it has generated one of the largest industries on the planet. Whether it is pigments giving colour to eye shadow powders or emulsions making our skin smooth and wrinkle free, all of these effects occur only on the surface of the skin or hair which means most cosmetics are surface acting.



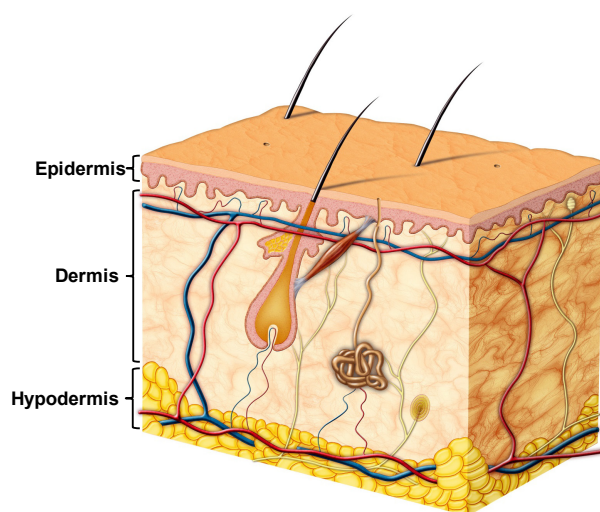
Surface modification in the bathroom

Look for anything that affects the skin or hair, such as hair conditioner and skin moisturiser, these are all surface modifiers. There are many other products that have the same effect while also doing something else – deodorants that moisturise your under-arms and shampoo that treats your hair for example.

Skin – how it works

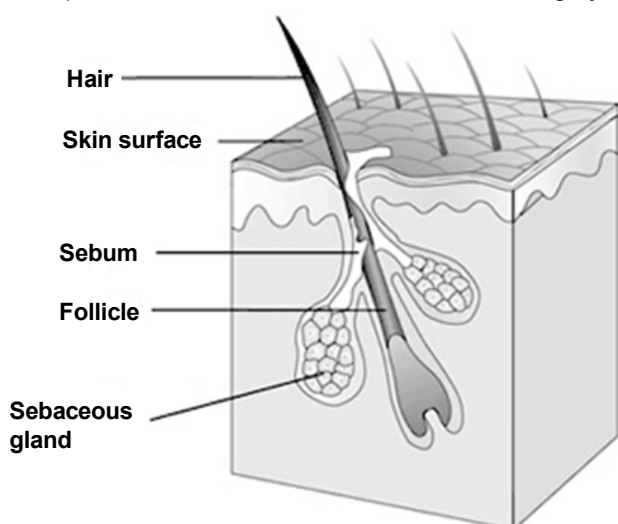
Skin is your largest organ and can be the most abused in day to day life. Consider how often it endures being rubbed with abrasive materials, being cleaned with surfactants that strip away protective oils and is exposed to the sun and harmful ultra violet radiation. Despite all of this, it continues to protect our delicate internal organs from the outside world.

The skin is made up of three layers: the epidermis, dermis and hypodermis. It is only the epidermis that is affected by moisturising creams.



Without moisturising, skin becomes dry and flaky. This is because water is lost through our skin by evaporation. The skin has its own moisturising system already built in called sebum. Sebum is oil that is

excreted onto your skin to keep moisture in. It is generated in sebaceous glands next to the hairs and gets trapped causing spots.



Washing with surfactants in the form of shower gel and shampoo removes the oil from the skin's surface, meaning we have to replace it with moisturising creams to maintain our skin's health. Dry atmospheres such as air conditioned or centrally heated homes make the problem worse as water evaporation is increased.

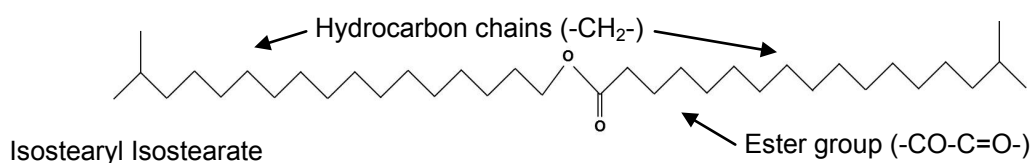
Moisturising your skin

Moisturisers work on the skin in a range of ways:

- Humectancy - absorption of water from the environment into the skin
- External surface occlusion - creates a barrier on the surface that reduces water loss from the skin
- Internal occlusion - creates a barrier inside the epidermis that reduces water loss
- Structured physical barrier - a chemically ordered physical barrier to water loss on the surface

DuraQuench IQ is a moisturising product produced by Croda available to the cosmetics industry to add to their moisturiser products to improve them. It uses internal surface occlusion and also creates a structured physical barrier to moisturise the skin.

Internal occlusion is achieved using the ester isostearyl isostearate. This long chain can interact with other hydrocarbon chains in the skin, like the fats found in the epidermis.

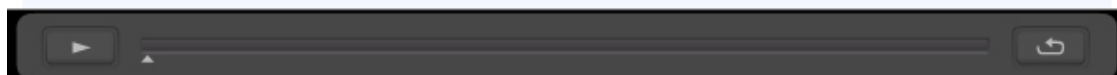


The very top layer of skin is an area of the epidermis called the *stratum corneum*. It is made up of protein-rich dead cells and layers of fats, called lipids, which form a natural barrier to moisture entering or leaving the skin.

Animation: How Duraquench IQ moisturises skin

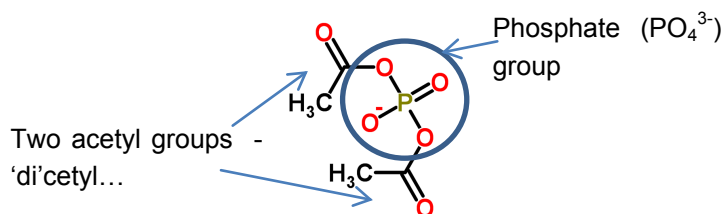


Human beings are covered in skin. It protects our delicate internal organs from the outside world but sometimes it needs protection itself – moisturisers protect your skin from drying out and help keep it healthy.



The lipids form a liquid crystal arrangement with a repeating pattern through the layer and water moves between the lipids to escape the skin. Isostearyl isostearate changes the spaces between the lipids so that it is harder for water to travel through the layer, thus reducing the amount of water that can escape from the skin.

DuraQuench IQ also contains dicetyl phosphate which acts to produce a water resistant barrier on the skin's surface. All moisturisers have this effect to a greater or lesser extent but DuraQuench IQ produces a particularly thick layer which prevents too much water being lost.



The overall effect of DuraQuench IQ is to prevent water loss and plump up the skin. This both protects skin from drying out and improves the appearance of wrinkles, just what the customer ordered!

What you leave behind

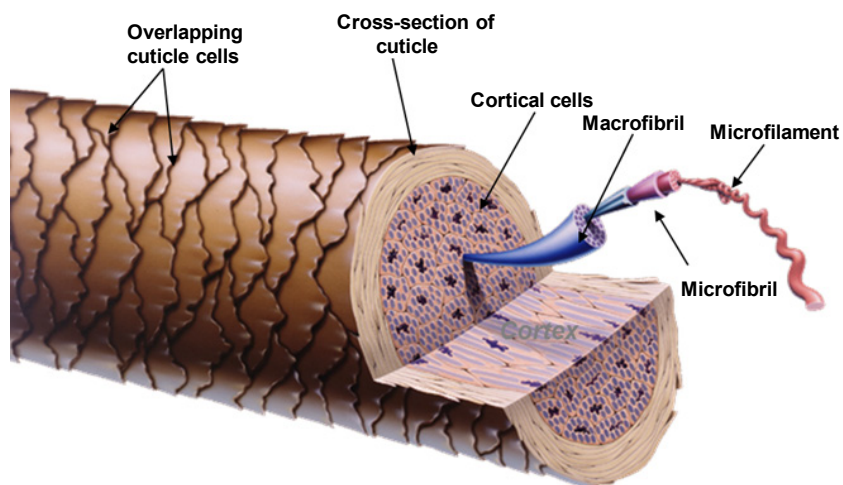
The epidermis is made of keratinocytes, cells containing keratin that start as new cells at the bottom of the epidermis and gradually move up through the layers as more cells are made beneath them. When they reach the *stratum corneum* they eventually break off and are shed. This entire process takes about a month.

In an hour, you will lose between 30-40,000 skin cells. You lost 10 just reading that last sentence. In a year, around 3.6 kilograms will have fallen off you. You know that dust in your house that gets hoovered up once a week? That is mostly dead bits of you. Not all of it gets hoovered though – some gets eaten by dust mites, tiny insects that live in our buildings munching on our dead skin! If you have asthma or allergies, it might be due to dust mite excretion!



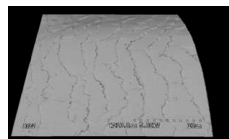
Hair – how it works

Hair is a “filamentous biomaterial” (stringy natural stuff) that sprouts in a greater or lesser extent from almost all the skin on the human body. It is made from keratin, a protein which is built from chemicals called amino acids, bonded end to end to form a string. This is an example of a biological polymer. The keratin chains curl around to form helical shapes, known as an alpha-helix.

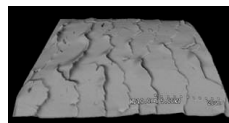


Each individual hair fibre is made of smaller fibres called macrofibrils which are in turn made of even smaller fibres called microfibrils. The outer layer of the hair is called the cuticle and forms a scale-like surface. It is the cuticle layer that hair conditioning agents affect.

The scaly cuticle surface becomes rough in badly conditioned hair. Rough cuticles increase friction between hair strands so hair appears frizzy and becomes difficult to comb. Conditioners work on this surface layer to smooth the cuticle and improve the “hair dynamics”. Hair dynamics include how easy the hair is to comb, how shiny it is, how soft it is and how it moves.



Hair in good condition – smooth cuticle layers

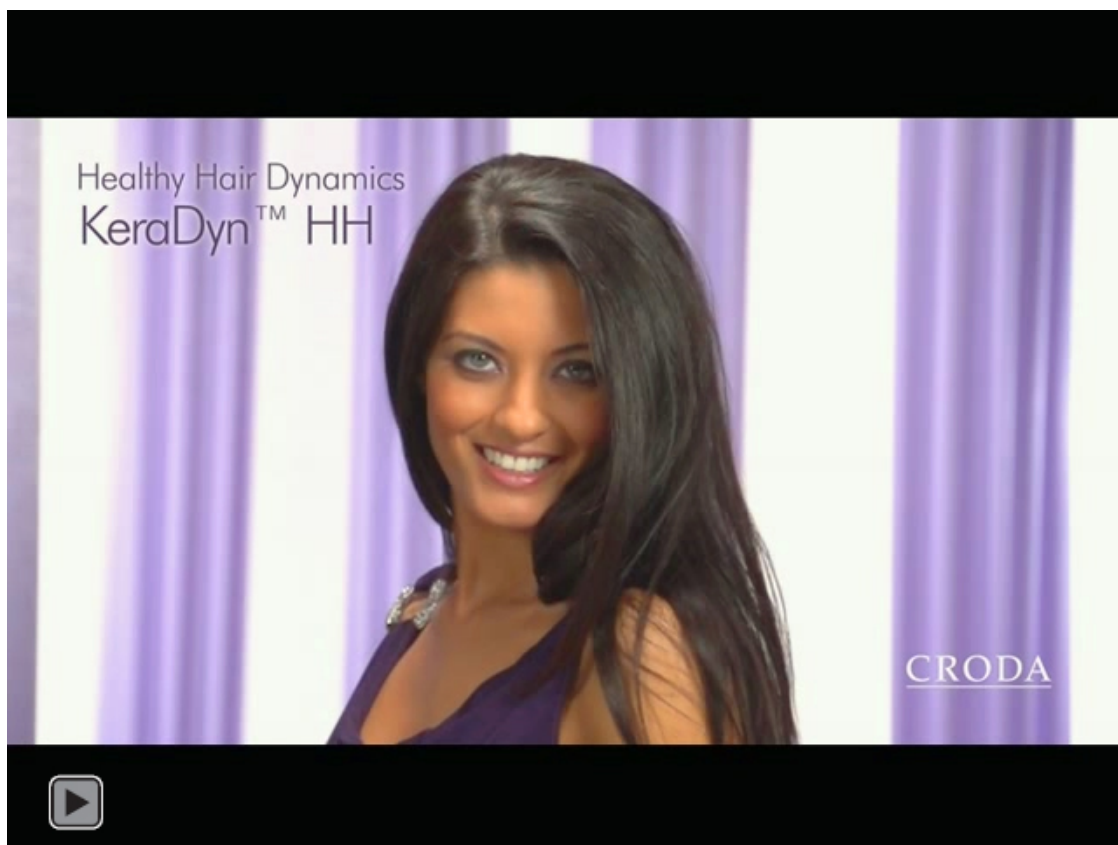
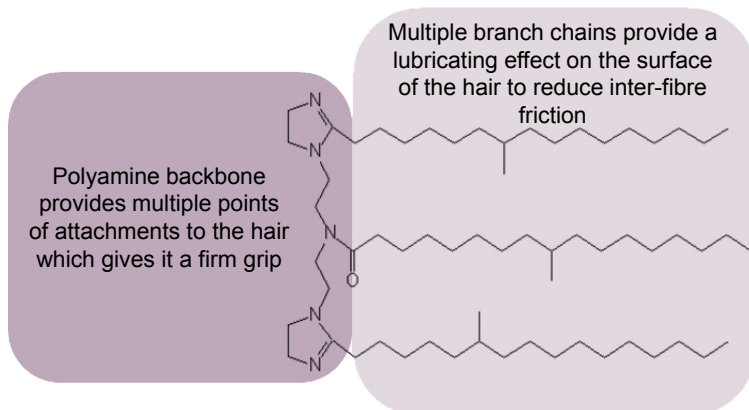


Hair in bad condition – rough cuticle layers

Conditioning your hair

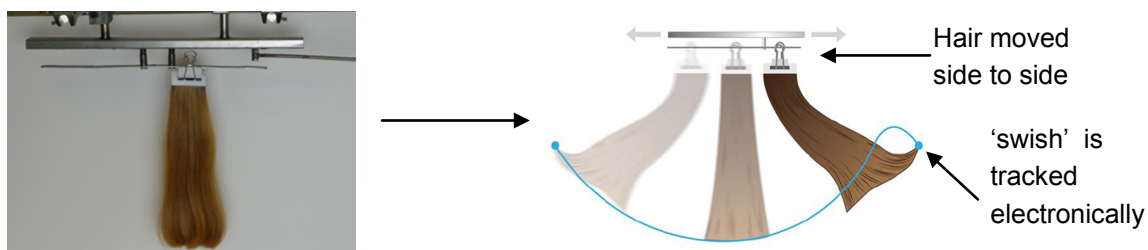
Hair conditioning is a large part of a lot of people’s daily hair care routine. Conditioners are generally used on longer hair as it is older and the hair fibres are more worn. These products only affect the cuticle of the hair, hence they are surface modifiers.

Croda make a product called KeraDyn HH which is a special conditioning agent for hair. KeraDyn HH is a molecule which has a polyamine chain at one end. This end can stick to the hair fibre, anchoring the molecule in place. The tail ends of the molecule are long branched hydrocarbon chains called isostearyl carbon chains, which act as a lubricant between the hairs, reducing friction and therefore improving condition.



How do they test hair dynamics?

Movement is one of the most important of the hair dynamics. This is how the hair behaves when it is swooshed and is a major selling point for commercial conditioners. The test for hair movement involves anchoring a tress of hair to a machine that moves it side to side. Digital movie cameras and special computer software track the way the hair moves and can measure how much swish has been added by the product being tested.



Hair Forensics

Your hair lasts as long as you keep it without cutting it. When the hair strand is forming, it will contain traces from your diet and metabolism at the time that section of hair was formed.

This means you have a record of what you ingested that goes back as long as your hair. Hair strand tests are used to test for long term substance misuse that could be missed using urine or blood tests. Forensic chemists often carry out these tests.

1 cm of hair will give information about around one month in time – what could a hair strand test tell about you?

- Amphetamine
- Methamphetamine
- Benzodiazepines
- Buprenorphine
- Cannabis (THC)
- Cocaine
- Diazepam (Valium™)
- Flunitrazepam (Rohypnol™)
- Heroin
- Ketamine
- Lorazepam
- Mephedrone
- Methadone
- Morphine

Conclusions

The cosmetics industry is one of the largest in the world and is built around making consumers feel better about their appearance and health. Moisturisers and hair conditioner improvers are big business and are used regularly by a huge number of people. Moisturisers act on the skin to help it retain the water it would otherwise lose as a result of modern lifestyles. They act on several areas of the skin both as a barrier and by changing the properties of the skin itself to improve water retention. Hair conditioners act to smooth out the cuticle of the hair so that hairs moving past each other slide freely and don't get tangled. They do this by modifying the surface of the hair to make it more slippery.

Test your knowledge

Take the short quiz below to test your understanding of surface modification - hair and skin.

Quiz: Surface Modification - Skin and Hair

1. What are the three layers of skin called?

- Hyperdermis, dermis and epidermis
- Hypodermis, dermis and endodermis
- Hypodermis, dermis and epidermis
- Hypodermis, delmis, epidermis

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