2 Hair-care products

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2.1 Introduction

Before discussing product formulation, some general remarks about product development are appropriate.

1. Make sure that the brief is clear. There is little point in developing a wonderful product if it is not the one that was requested. The brief should include, as a minimum:
   (i) Required performance parameters in as much detail as possible
   (ii) Benchmark products, unless the development is in a completely new area
   (iii) Guidelines on cost
   (iv) Proposed claims, and how these might be justified
   (v) The required timing

2. Do not produce a Rolls Royce when a Mini would suffice or vice versa. On the one hand, the accounts department will be extremely unhappy. On the other, the product being launched will fail to deliver its promised performance.

3. Do not use new raw materials if ones from existing stocks will do the job just as well; avoiding unnecessary proliferation of the raw material stocklist will benefit purchasing, stock control, space and cashflow.

4. Specifications often appear virtually identical, while in practice similar products from different suppliers do not perform identically. This can be very important for detergents and emulsifiers. Alternative sources of supply can be investigated as a separate issue.

5. Ensure reproducibility on scale-up to full production, making use of suitable plant and equipment. Dialogue with experienced process plant operators can be invaluable.

6. Keep formulations as simple as possible; there should be a sound reason for the inclusion of each ingredient.

7. Try to develop products which can be made as cheaply as possible, i.e. with minimum energy requirements (heating, stirring) and minimum time in the tank. Large-scale processing equipment is very expensive;
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careful formulation can help to optimise the use of tank space and tank time.

2.2 Hair: structure and chemistry

Hair consists of three main layers:

(i) the central core or medulla, which is not always present and whose function is not entirely clear;
(ii) the cortex, which contributes the bulk of the hair shaft and consists of elongated keratinised cells, the whole structure having a fibrous nature. Each fibre is in turn made up of bundles of small fibres until, at molecular level, polypeptide chains are found to be twisted together to form a helix, an arrangement often favoured by nature;
(iii) the cuticle, in the form of thin overlapping scales that cover the cortex like tiles on a roof. The overlap is such that the hair is smoothest from root to tip. Techniques such as back-combing, where the comb or brush is used 'against the grain' of the cuticle can cause considerable mechanical damage. Cuticular cells also consist mostly of keratinised proteins but, in this case, in the form of thin plates; the main difference between cortex and cuticle is more a question of geometry than chemistry [1, 2].

There are, of course, other constituents of hair, e.g. water, lipids and minerals, and some work on how these are affected by the application of toiletries has been carried out [3, 4]. However, the main concern in this chapter is the interaction between hair-care products and the main protein structure of the cuticle, and of the cortex where this is exposed because of damage, chemical treatment, or weathering [5]. A great deal of finer structure has been revealed by electron microscopy and this has some bearing on these interactions [6]. The conditions under which products are applied (e.g. the use of heat) may also affect the integrity of the hair's structure [7, 8].

The cosmetic chemist is always aiming to achieve a result which looks good, and time should be given to examining the mechanical and optical properties of the hair, and how these affect our perception of 'a good-looking result' [9–11].

Hair does not grow continuously, but passes between the anagen (or growing) phase and the telagen (or resting) phase via the relatively brief transitional catagen phase. The relative time spent in each phase can vary considerably depending on the site on the body, age, sex, general health, etc. Each individual hair has its own sequence, which is unaffected by that of its neighbours. Some accurate measurements have been made of hair growth rates and the factor affecting them [12].

The size and shape of a hair is determined by the follicle from which it