Contact angle measurement of lipstick

The wetting behaviour of molten lipstick mixtures was tested using the optical contact angle measuring and contour analysis system OCA 25 in combination with a Peltier temperature control unit TPC 160 and an electrical needle heating device NHD 400. The analysis of the contact angle between the molten lipstick mixture and various solid surfaces gives important insights for optimisations of the manufacturing process of lipsticks.

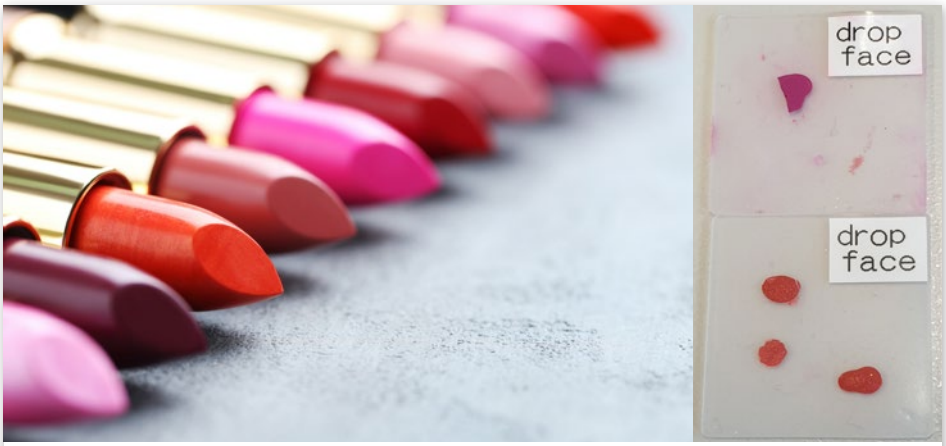

Fig. 1 left: Commercially available lipsticks in various colours
right: Lipstick applied to test substrates after analysis

Background

Current makeup trends dictate how the optimal lipstick ought to be. Whether glossy or matte, transparent or colour-intensive the ideal lipstick should always guarantee a smooth texture and high wearing comfort but also have a sufficient stability in order not to break during application.

The lipstick needs a high melting point so it does not soften and run even in warm climates. It must not crumble on the lips but has to spread evenly and form a smooth film.

All of these factors have to be considered during development and can be achieved by carefully designing the component mixture.

In addition to these application specific factors also the manufacturing process has to be taken into account. Typically the ready-made lipstick mass is fed by tubing systems into casting moulds that give the lipstick its final look.

These casting moulds are generally made of silicone or aluminium and provide the lipstick with its oblique tip and sometimes even a manufacturing logo. Hence, during production the hot molten lipstick has to have a good wetting behaviour inside the casting mould and after cooling down the lipstick has to be easily removable.

A wetting behaviour study of four different lipsticks on two different substrates using contact angle measurements of the molten lipstick mass will be presented throughout this application note.

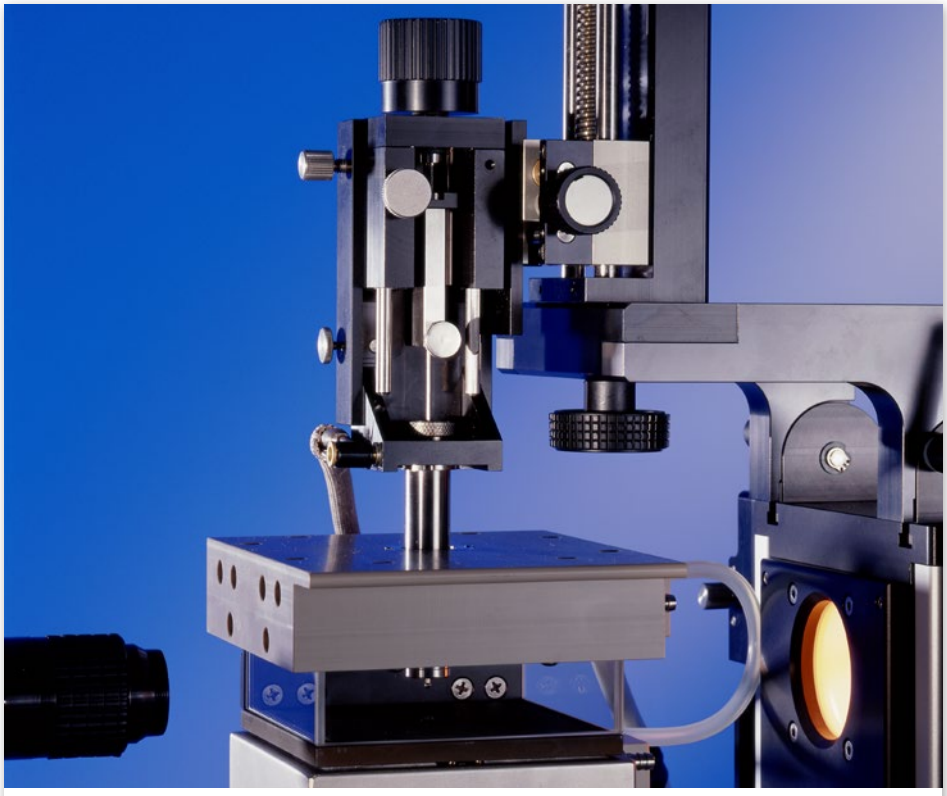

Fig. 2: electrical needle heating device and Peltier temperature control unit

Experiment

In order to analyse the wetting behaviour of the four lipstick samples, the optical contact angle measuring and contour analysis system OCA 25 is being used in combination with a Peltier temperature control unit TPC 160 and an electrical needle heating device NHD 400 (see Fig. 2).

The samples consist of two colour lipsticks (A and B) and two sunblock lipsticks (C and D). The wetting behaviour is individually tested against a solid silicone and an aluminium sample plate.

A small piece of the tested lipstick mass is put into the cannula of the electrical needle heating device NHD 400 and heated to 95 °C. One of the solid sample plates is placed into the Peltier temperature control unit TPC 160 and heated to 95 °C as well.

Once the samples are heated up the molten lipstick is dosed out of the orifice of the cannula using a plunger.

The contact angle of the resulting drop on the solid sample (see Fig. 1 right) is then analysed with the optical contact angle measuring and contour analysis system OCA 25 using the SCA 20 software module.

Results

The colour lipsticks A and B showed good wetting on the silicone substrate (see Fig. 3 and Fig. 4) with mean contact angles of 66.3° and 61.7° (cf. Table 1) respectively.

The sunblock lipsticks C and D showed very good wetting on the aluminium substrate (see Fig. 5 and Fig. 6) with mean contact angles of 28.8° and 17.4° (cf. Table 1) respectively.

Summary

Using the optical contact angle measuring and contour analysis system OCA 25 in combination with a Peltier temperature control unit TPC 160 and an electrical needle heating device NHD 400, the wetting behaviour of molten lipstick samples on silicone and aluminium substrates was investigated.

The colour lipsticks showed good wetting behaviour on the silicone substrate with contact angles ranging from 62° to 66°. The sunblock lipsticks showed very good wetting on the aluminium substrate with contact angles ranging from 17° to 29°.

The opportunity to analyse the wetting behaviour of molten solids on various solid substrates enables the producers of lipsticks to improve their manufacturing procedures and formulations.

Fig. 3: Contact angle measurement of colour lipstick A on silicone substrate

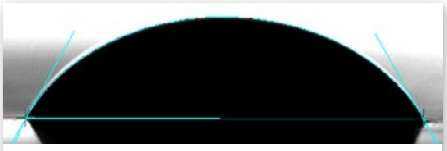

Fig. 4: Contact angle measurement of colour lipstick B on silicone substrate

Fig. 5: Contact angle measurement of sunblock lipstick C on aluminium substrate

Fig. 6: Contact angle measurement of sunblock lipstick D on aluminium substrate

Table 1: Measured mean contact angles of molten lipstick mass on silicone and aluminium substrates

Lipstick	Mean contact angle [°]	
	Silicone substrate	Aluminium substrate
Colour lipstick A	66.3	-
Colour lipstick B	61.7	-
Sunblock lipstick C	-	28.8
Sunblock lipstick D	-	17.4

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