DOW CORNING

The Payne cup method – a screening tool to measure the occlusivity of topical formulations *in vitro*

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PURPOSE

Transepidermal Water Loss (TEWL) is a measurement of skin barrier function *in vivo*. It can also be used to evaluate the occlusivity of a formulation. The TEWL method provides direct *in vivo* results in the end user, requires, however, panels of at least six people and often more to detect differences between products.

The Payne cup method provides an alternative for screening the occlusivity of formulations *in vitro*. This method, based on ASTM standard E96/E 96M – 05 [1] evaluating the water vapor permeability of polymer films, was adapted to personal care and topical applications within Dow Corning [2].

The objective of this work was to show the correlation between both methodologies.

MATERIAL & METHODS

Payne cup method

The method uses a standardized stainless-steel testing chamber (Figure 1), into which a collagen film is placed as semi-permeable membrane.

The cup is filled with water, and the material to be tested is coated to 0.5 mil (12.7 µm) on the surface of the membrane.

The testing chamber is closed and placed in a temperature-controlled oven at 31 ± 1°C / 12-18% RH. The water loss in the cups is then measured gravimetrically every two hours over a period of 8 hours. Comparison against control cups allows the water loss to be calculated across a material or formulation.

Figure 1: Closed Payne cup

TEWL measurements

4 young women with healthy skin condition; volar forearm

2 mg/cm² product (Table 1) was applied in randomised order, covered with medical gauze

TEWL was measured before and after application, 3 hours later with product as well as after wiping the product off the skin, against untreated control

TEWL equipment:

- Tewameter MPA5 (Courage + Khasaka, Germany), average of 3 measurements
- Aquaflux probe (Biox, UK), 1 single measurement

Test products

Blend of white petrolatum jelly, Eur Ph, and Dow Corning® ST-Elastomer 10 with varying degrees of occlusivity (Table 1)

Table 1: Petrolatum / Dow Corning® ST-Elastomer 10 blends

Petrolatum	ST-Elastomer 10	Occlusivity
100%	0%	Fully occlusive
70%	30%	Fully occlusive
50%	50%	Semi-occlusive
30%	70%	Semi-occlusive
0%	100%	Non-occlusive

RESULTS & DISCUSSION

Payne cup

The different blends show varying degrees of occlusivity. Petrolatum is a fully occlusive, Dow Corning® ST-Elastomer 10 is a non-occlusive material.

Water loss between the different blends is significantly different (p<0.05).

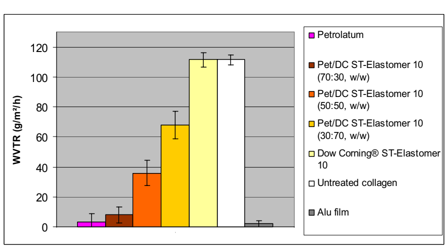


Figure 2: Water loss as measured by the Payne cup method

RESULTS & DISCUSSION (cont.)

TEWL

TEWL drops step-wise with increasing occlusivity after product application and 3 hours after leaving product on the skin. Petrolatum produced the most significant drop, while the pure ST-Elastomer 10 produces only a small drop (due to the presence of a material film on the skin) relative to baseline.

The amplitude of TEWL decrease for petrolatum differs between instruments: ~4 units with the Tewameter (Figure 3), ~9 units with the Aquaflux (Figure 4).

The same effect is still seen after 3 hours. Due to wear-off, TEWL values increase slightly.

After removing the product, TEWL values return to baseline level for all products.

Due to small panel size, statistical significance between products was more difficult to show.

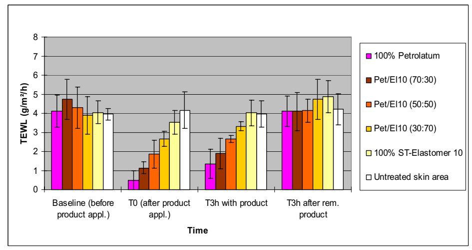


Figure 3: TEWL as measured by the Tewameter.

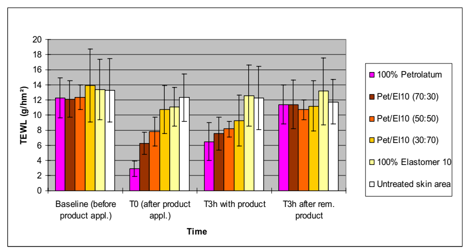
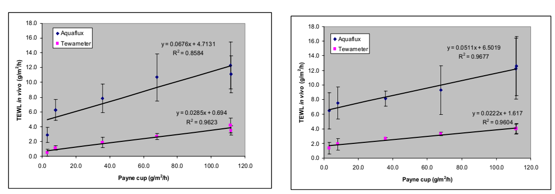


Figure 4: TEWL as measured by the Aquaflux instrument.

Correlation Payne cup – TEWL

Excellent correlations between both methods are obtained after product application and after 3 hours.

The correlation for the Tewameter shows a lower slope (lower amplitude, see above).



Figures 5 and 6: Correlation between Payne cup and TEWL methods after product application (left) and after 3 hours (right)

CONCLUSIONS

Water vapor transmission as measured by the Payne cup method and TEWL values *in vivo* are directly correlated.

The Payne cup method offers easy occlusivity testing *in vitro*. It is therefore of advantage to first screen a series of formulations and materials with this method, before confirming properties on the skin with more resource intense *in vivo* panels.

The Payne cup method is therefore a useful screening tool, helping to speed up development of topical formulations.

REFERENCES

1. ASTM standard E 96/E 96M – 05: Standard Test Methods for Water Vapor Transmission of Materials, ASTM International, 2005
2. Van Reeth I, Wilson A.. Understanding factors which influence permeability of silicones and their derivatives. Cosmetics & Toiletries (1994), 109(7), 87-92.