Oscillatory analysis of petrolatum *Ph.Eur.* and Wollwachsalkoholsalbe *DAB 1999*-correlation between oscillatory data and maximum water absorption

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Introduction

Petrolatum is one of the main ingredients of Wollwachsalkoholsalbe *DAB 1999* (WWS) and thus contributes to its microstructure. Water absorption of WWS depends on the petrolatum type being used. According to DAB 1998 [1] a water absorption capacity of 200 % is required for WWS. The commentary of the DAB 1998 mentions that the lipophilic components have the major impact on water absoption. The present contribution deals with oscillatory analysis to find a new parameter that correlates with the water absorption of WWS.

Materials and methods

Materials

Four different petrolatum types: Merkur 1 to 4 were provided by MERKUR Vaseline GmbH & Co. KG (Hamburg, Germany). Two wool alcohols: Argowax batch no. WM 2085 and WM 2125 were provided by Westbrook Lanolin Company (Bradford, U.K.). The cetostearyl alcohol (Lanette O) was purchased from Henkel (Düsseldorf, Germany). All ingredients were of pharmacopeial grade.

Oscillatory analysis

A vibration measuring instrument (figure 1) was used for the analysis of petrolatum and WWS enabling non-destructive measurements. Test cylinders with a diameter of 35 mm and a height of 36 mm were casted and placed on the aluminium plate of the shaker (Brüel & Kjaer, type 4810), which performed a sinusoidal vibration. The acceleration of the test cylinder was measured by an acceleration indicator (Brüel & Kjaer, type 4375), mounted below the test cylinder.
The signal of the acceleration indicator was sent to a frequency meter (Philips, PM 6671) via a conditioning amplifier (Brüel & Kjaer, type 1023). The signal was also sent to a voltage amplifier (manufactured by TU Braunschweig) to attenuate the acceleration amplitude. The sine generator (Brüel & Kjaer, type 1023) was responsible for the logarithmic variation of the frequency in the range of 250 to 2500 Hz. An additional aluminium plate with an acceleration indicator (Brüel & Kjaer, type 4375) was positioned on top of the test cylinder for measuring the frequency depending on the acceleration. The signal was amplified by the conditioning amplifier (Brüel & Kjaer, type 2626) and was sent to the voltmeter (Philips, PM 2528). The computer stored the transmission factor together with the corresponding frequency. The transmission factor is the quotient of the acceleration of the transmitted vibration and the constant acceleration of the stimulated vibration. Figure 2 shows a typical data plot. From this graph the specific characteristics of the vibration measurement i.e. the dissipation was accessible.
The dissipation factor was calculated from the half width divided by the frequency of the maximum transmission factor. The half width is the difference of the frequencies, of which the value of the transmission factor is exactly half of the maximum transmission factor.

Maximum water absorption of WWS

For water absorption determination, water and lipophilic components of WWS were heated to 60°C separately. Twice as much heated water corresponding to the weight of the lipophilic components was added. After cooling to room temperature additional water was added to the emulsion in steps of 2 - 3 ml, in order to reach the maximum water absorption of WWS. The maximum water absorption was recognized when the cream did not stick to the pistill anmore.

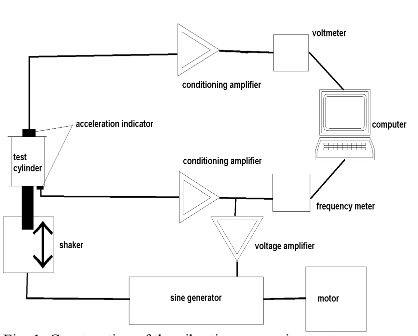

Fig. 1: Construction of the vibration measuring system

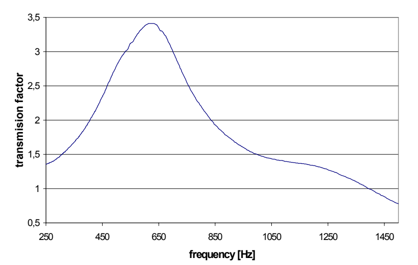

Fig. 2: Transmission factor vs. frequency

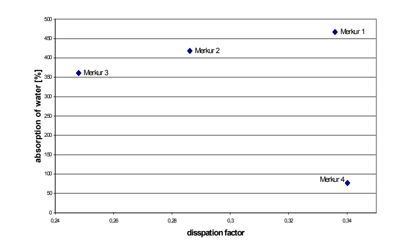

Fig. 3: Water absorption of WWS (lanolin alcohol WM 2085) vs. dissipation factor

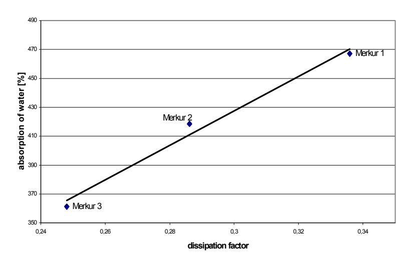

Fig. 4: Water absorption of WWS (lanolin alcohol WM 2085) vs. dissipation factor (correlation coefficient: 0,9924)

Results and discussion

The results from the maximum water absorption are listed in table 1.

	petrolatum with WM 2085 and Lanette O (1.value, 2.value)	petrolatum with WM 2125 and Lanette O (1.value, 2.value)
Merkur 1	467,1 % (465,7 %, 468,5 %)	403,3 % (407,7 %, 398,9 %)
Merkur 2	418,5 % (425,5 %, 411,4 %)	366,8 % (371,5 %, 362,1 %)
Merkur 2	361,3 5 (356,7 %, 365,9 %)	381,4 % (385,6 %, 377,1 %)
Merkur 4	76,7 % (80,4 %, 72,9 %)	80,8 % (87,5 %, 74,1 %)

Tab. 1: Maximum water absorption of WWS

As a characteristic parameter of the vibration measurement the dissipation factor was taken. The dissipation factor is the quotient of the dissipation module and the storage module. The dissipation module is an appropiate parameter for the viscous part of the sample and responsible for attenuation of the wave. The storage module is a parameter of the elastic part of the sample. According to the wave model of Bartholomäus [2] the elastic part of the sample is responsible for the transmission of the wave produced by the shaker. Table 2 summarizes the results from the vibration measurements.

	petrolatum (dissipation factor)	petrolatum with WM 2085 and Lanette O (dissipation factor)	petrolatum with WM 2125 and Lanette O (dissipation factor)
Merkur 1	0,3766	0,3266	0.3114
standard deviation	0,015	0,021	0,017
Merkur 2	0,3115	0,2861	0,2678
standard deviation	0,013	0,023	0,088
Merkur 3	0,3714	0,2480	0,2815
standard deviation	0,017	0,028	0,020
Merkur 4	0,3282	0,3401	0,3401
standard deviation	0,019	0,011	0,088

Tab. 2: Mean values of the dissipation factor (n=18)

The dissipation factor of Merkur 4 increases with the incorporation of wool alcohols and cetostearyl alcohol, whereas it decreases in the case of Merkur 1, 2 and 3. The results from water absorption experiments also show the exceptional behaviour of Merkur 4, as far as this petrolatum type results in the lowest value of water absorption. Figure 3 combines the results from the vibration measurements with those from the water absorption.
Figure 4 represents the same graph as Figure 4 with the exception of Merkur 4.
Independent of the type of the wool alcohol there is a linear relationship between the water absorption and the dissipation factor. Furthermore, the kind of water incorporation (hot or cold resp.) does not change the result. However, it seems to be a prerequisite that the dissipation factor of petrolatum decreases with the incorporation of wool alcohols and cetostearyl alcohols.

References

[1] Deutsches Arzneibuch 1998, Kommentar

[2] Bartholomäus, J.-H.,Beitrag zur Korrelation zwischen mechanischen Eigenschaften von Gelen und ihrer Struktur, Dissertation, TU Braunschweig (1988)

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