CHAPTER 5

ON THE AMOUNT OF FAT THAT A GIVEN AMOUNT OF POTASSIUM HYDROXIDE CAN SAPONIFY

First experiment

1048. In my research into how bases that can form salts act on fat, one of the aspects that still need to be addressed is to find out how much fat can be saponified by a given amount of alkali.

1049. 20 g of lard, which would have yielded 19.115 g free fatty acids on complete saponification, were boiled in water containing 3.315 g pure potassium hydroxide for at least fifty hours. Accordingly, the ratio of the potential amount of saponified fat to the amount of alkali was 100 to 18[1]. A gelatinous, semi-transparent mass resulted that was perfectly homogenous and dissolved completely in boiling alcohol. This solution did not turn litmus red. It gelled on cooling. The soapy mass also dissolved completely in boiling water and the solution was only slightly opalescent. After having been concentrated, it set as a gel on cooling and on dilution with water, it deposited a large amount of pearly material.

1050. It follows from this experiment that it is possible to saponify a given amount of fat by using no more than the amount of alkali needed to neutralize the stearic, palmitic and oleic acids that the fat could yield. A slight excess of alkali is needed to obtain a soap that is as hard as possible, since non-alkaline water acts on the soap as a solvent whereas water containing a certain amount of alkali does not dissolve it. Sea salt acts like potassium hydroxide but I do not think that its effect on water is strong enough to remove as much water from the soap as potassium hydroxide and carbonate do.

Second experiment

1051. I boiled 20 g fat for more than sixty hours in water containing 1.657 g of pure potassium hydroxide. Accordingly, the ratio of the potential amount of saponified fat to the actual amount of caustic potash was 100 : 9. The water that had evaporated was not replenished until the material was almost dry. This resulted in a homogenous mass with the following properties: it was almost completely soluble in boiling alcohol; the solution had no effect on litmus; it became very cloudy on cooling. When it was boiled in 5 dL of water, a liquid oil formed on the surface of the liquor. The mixture was filtered and the filtrate concentrated. It contained 1. glycerin; 2. a true alkaline soap that deposited a pearly material consisting of potassium bistearate and bipalmitate.

Examination of the material on the filter

1052. This material was white. When boiled in 3 dL of water, it produced a thick emulsion and a white, partially liquid fatty material that collected on the surface of the liquid.

A. White fatty material

1053. It did not stain paper as readily as ordinary fat. After having treated it with alcohol, I was convinced that it consisted of unchanged fat, a small amount of potassium bistearate, bipalmitate and peroleate. There was also a trace of a greenish coloring principle.

B. Thick emulsion

1054. It was poured onto a filter. The filtrate was slightly milky and contained a little alkaline soap. The material that remained on the filter was white and opaque. When heated in a dish, it lost water and melted to form a yellow, transparent, oily liquid. This liquid was treated several times with boiling alcohol. After five or six washes, a residue was left that was hardly soluble in alcohol and that had the main properties of non-saponified fat. From the first washing liquor I obtained a powdery deposit of a fatty nature on cooling. It had a higher melting point than the fat, crystallized in needles, was not very soluble in alcohol, and did not turn litmus red. I do not know what the nature or origin of this substance is since analysis of the pure fat and the saponified fat has never presented anything like it. The filtrates of the first and subsequent washing liquors were combined and concentrated; on cooling they yielded a substantial amount of potassium bistearate and bipalmitate. There remained in solution: 1. a fat with a melting point of about 25°C that seemed to have been saponified since it colored litmus strongly and was highly soluble in alcohol; it left only a very small amount of potash on incineration; 2. a small amount of alkaline soap that was soluble in water; 3. traces of unchanged fat; 4. traces of potassium bistearate and bipalmitate.

1055. It is clear that in the previous experiment, the potassium hydroxide had only saponified the amount of fat that it could convert into neutral soap since it is highly likely that the soapy matter[2] observed in the material that was insoluble in water was separated from the soaps by the action of water on the neutral soaps. The second experiment allowed me to observe that with soapy matter or alkaline soaps, non-saponified fat can form, if not a true chemical compound, at least an intimate mixture that forms an emulsion with water and that does not stain cloth. This is the kind of emulsion that results from scouring[3] wool, where the fatty matter separated from the fibers is not saponified.

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[1] How the author arrives at the value of 18 is not quite clear but a ratio involving fat and potassium hydroxide was also used to define the saponification value: the number of milligrams of potassium hydroxide required to saponify 1 g of fat, *i.e.* to neutralize the free fatty acids and the fatty acids combined as acylglycerols. The literature value for the saponification value of lard is 193-200.

[2] The text calls them 'sursavons' or soaps containing more fatty matter than neutral soaps. The bistearate, the bipalmitate and the peroleate are examples of what the author calls 'sursavons'.

[3] The author talks about 'degreasing' of 'étoffes', where the latter can mean a fabric or cloth. Accordingly, translating it into 'wool scouring' has an element of guesswork.