CHAPTER VI

SUMMARY AND CONCLUSIONS

Combinations of soaps with synthetic detergents as washing agents have received the attention of several researchers. The wetting power of the soap which is generally poorer than that of the synthetic detergent is greatly improved by the addition of a relatively small proportion of the latter.

A combination therefore can be expected to give better results, it would enhance the advantages of both and at the same time the properties which were subdued when used alone could be enhanced in combination owing to the expected cumulative effect.

Therefore a research was planned to study the optimum combinations of a soap and a synthetic detergent on differently soiled fabrics for better cleaning efficiency.

Objectives of the Study

The objectives of the study were :

1 To study the general characteristics of soaps and synthetic detergents individually and in combination for properties like surface tension, wettability, wetting time, emulsification and foaming power.

2 To study the cleaning efficiency (per cent soil removed)

of soaps and synthetic detergents individually and in combination.

3 To study the effect of the general properties of soaps and synthetic detergents on the per cent soil removed.

4 To determine the optimum combinations at varying ratios and concentrations for different fabrics.

5 To study the application of a soap and a synthetic detergent in combination (analysed as above) for the washing efficiency of soiled samples on a small washing machine.

Experimental Procedure

Two soaps, commercial bar soap* and sodium oleate, two anionic synthetic detergents, Teepol and sodium lauryl sulphate, and one nonionic synthetic detergent, Lissapol N, were studied in this work. Commercial bar soap and Teepol were purified, while the rest were pure as such.

These were studied individually in concentration from 1.0 g/l to 5.0 g/l. Four different combinations of a soap and a synthetic detergent were studied. The combinations were :

1 Purified 501 bar soap with purified Teepol

2 Sodium oleate with purified Teepol

3 Purified 501 bar soap with sodium lauryl sulphate

4 Purified 501 bar soap with Lissapol N.

*Commercial 501 bar soap

The above combinations were studied in three per cent ratios of 75:25, 50:50 and 25:75 in three concentrations, 1.25 g/l, 2.5 g/l and 5.0 g/l.

The properties determined for the cleansing agents were:

Surface tension	:	by drop method
Wettability	:	by centrifuge method
Wetting time	:	by drop method
Emulsifying power	:	by emulsification tendency of the mixture, oil and emulsifying agent to break
Foaming power	:	by measuring foam formation

The three fabrics used were cotton, polyester cotton blend (67/33) and polyester. The fabrics were soiled with solvent soil and emulsion soil. The cleaning efficiency of the soaps and detergents individually and in combinations was studied on the solvent soiled fabrics, while for optimum combinations the emulsion soiled samples were used.

The washing was done in the Launder-Ometer for 15 minutes at room temperature with forty steel balls (1/4" diameter) for agitation. Assessment for the removal of soil was obtained from the reflectance data of soiled samples, before and after by the use of the Photovolt Reflectance Meter.

To study the applications, the cleaning efficiency of the optimum combinations was also checked using a small washing machine, fabricated for the purpose with a stirrer from above.

Conclusions

The conclusions of the study have been given as follows:

1 General properties of soaps and synthetic detergents (individual and in combination)

2 Cleaning efficiency of soaps and synthetic detergents (individual and in combination)

3 Relationship between the general properties and cleaning efficiency

4 Optimum combinations of a soap and a synthetic detergent for different fabrics

5 Cleaning efficiency of the optimum combinations using a small washing machine, as an application of above.

1 General properties of detergents (individual and in combination)

The synthetic detergents, Teepol, Sodium lauryl sulphate and Lissapol N, did not show much change in the surface tension readings from 1.0 g/l to 5.0 g/l. The surface tension values of the two soaps used, purified 501 bar soap and sodium oleate, are comparable with the values for synthetic detergents

from 3.0 g/l to 5.0 g/l. At the lower concentration, 1.0 g/l and 2.0 g/l the surface tension of the soaps is much higher.

Soaps (purified bar soap and sodium oleate) showed good percentage wettability but this increased with increase in concentration. The anionic synthetic detergents (Teepol and sodium lauryl sulphate) gave intermediate results and the nonionic (Lissapol N) showed the lowest percentage wettability.

Rate of wetting was better (quick wetting) for the synthetic detergents than for the soaps. With increase in concentration the rate of wetting improved for the soaps, whereas synthetic detergents had good wetting rate even at a low concentration.

Emulsifying power was better for the soaps and sodium lauryl sulphate. The nonionic synthetic detergent showed very poor emulsifying power. For all the detergents the emulsifying power increased with increase in concentration. Foaming power of the anionic synthetic detergent was superior to the soaps and nonionic synthetic detergent.

When in combinations, surface tension, percentage wettability and wetting time showed readings towards the better ingredient (are having lower surface tension and wetting time and higher % wettability) especially at the lower concentration of 1.25 g/l and 2.5 g/l. Emulsifying power and foaming power however remain unchanged as an influence of other agent in combination.

2 Cleaning efficiency of soaps and synthetic detergents (individual and in combination)

The soaps, purified commercial 501 bar soap and sodium oleate, and the anionic synthetic detergent, sodium lauryl sulphate were seen to have better cleansing properties than purified Teepol and Lissapol N.

The maximum solvent soil was removed from 100% polyester fabric and the minimum from 100% cotton. The soaps were more effective in removing soil from 100% cotton fabrics than the synthetic detergents. After 2.5 g/l not much improvement in soil removed was noticed.

Emulsion soil was more easily removed than solvent soil by the cleaning agents (both individual and in combinations). Percentage soil removed depended not only on the substrate (fibre/fabric) and the cleaning agent but also on the type of soil. Emulsion soil was more easily removed from cotton fabric than solvent soil. The percentage emulsion soil removed was higher for polyester and lower for cotton. This was similar to solvent soil results fibrewise.

In the combinations, of a soap and a synthetic detergent, the cleaning efficiency for all fabrics improved at the lower concentration of 1.25 g/l and 2.5 g/l, the cleaning efficiency was influenced by the component having better result when used as individual. Even a small amount of the same showed cleaning efficiency as high as when it was used alone.

3 Relationship between the general properties and cleaning efficiency

The properties of soaps and synthetic detergents like surface tension, wetting time, and foaming did not show any specific or direct relation with their cleaning efficiency. Percentage wettability and emulsification showed a relationship with cleaning efficiency, higher the percentage wettability and emulsifying ability better the cleaning ability. However it was indicated that an agent with overall good general properties proved to be an effective cleaning agent, sodium lauryl sulphate to be noted as an example from this comparison.

Even though in combination, the general properties like emulsification and foaming power was not improved but this did not affect the cleansing ability. All combinations showed an improvement in their cleaning efficiency. When used in combination, the general properties are improved and so the cleansing properties also improved. It is seen in Combination IV, of purified commercial soap and Lissapol N, that Lissapol when used alone on cotton gave poor results, but when used in combination, even at low concentration, it gave good results. This could be attributed to the low wetting time of Lissapol N and high emulsifying power of purified commercial soap. For Combination III, of purified 501 bar soap and sodium lauryl sulphate, also it was seen that it gave very good cleansing properties. When purified commercial soap and sodium lauryl

sulphate are used individually, their detergent properties are good. Both of them have good emulsifying power, percentage wettability is better for purified commercial soap, whereas in foaming power and rate of wetting, sodium lauryl sulphate is superior. When the two are used in combination the cleansing property is improved tremendously, even at the lower concentrations.

Therefore it was seen that when used in combination the cleansing efficiency improves due to the combined effect of the general properties of the individual detergents. It thus concludes that even though each property individually may not have a direct relationship with detergency but when all the properties are combined in mixtures detergency is affected and cleaning efficiency is improved.

4 Optimum combinations of a soap and a synthetic detergent for different fabrics

The optimum combination for different fabrics varied. The concentration and ratio also varied with the different fabrics. For cotton fabrics the anionic soaps gave better results whereas for 100% polyester the nonionic synthetic detergent Lissapol N and anionic synthetic detergent sodium lauryl sulphate were effective. For all fabrics sodium oleate gave best results at 5.0 g/l concentration.

At a lower concentration, the more efficient component, is effective in combination. But at the higher concentration the influence decreases. The optimum combination for cotton was the purified 501 bar soap and nonionic detergent Lissapol N Combination IV where the major component was of 501 bar soap. Combination II of 75:25 per cent ratio where the major component was the anionic soap (sodium oleate) and Combination III in 50:50 per cent ratio that is equal portions of the anionic soap (purified 501 bar soap) and anionic detergent (sodium lauryl sulphate) were efficient in the concentration 2.5 g/l.

In general the per cent ratio having a greater part of soap was more effective for cotton fabric. On the blend fabric at 2.5 g/l concentration the combinations had a tendency to be more affected by the better component but again as was the case with cotton fabric at the higher concentration of 5.0 g/l, this tendency was specifically seen with Combination II of sodium oleate and Teepol both on 100% cotton and 67/33 polyester/cotton blend fabric.

Here the optimum combination was Combination III, of purified 501 bar soap and sodium lauryl sulphate at ratio 50:50 or 25:75. Equal proportions of soap and synthetic detergent gave the better results for the blend fabric.

For polyester fabric all the combinations gave good results. Even when a small part of the better agent was used the results were comparable to the individual agents for their efficiency. Lissapol N when used alone on polyester gave the poorest results as compared to other agents. But when combined with purified 501 bar soap, it gave results comparable to the efficiency of purified 501 bar soap used alone. When used in combination, the best results were seen for combination II, of sodium oleate and purified Teepol, for the per cent ratio 75:25 (sodium oleate : purified Teepol) at 2.5 g/l and 5.0 g/l. At 1.25 g/l all the three ratios of the combinations gave better results than either agent when used individually.

Under the conditions used in this work it was seen that an unbuilt soap removed greater amount of soil than a built soap at the same concentration.

5 Cleaning efficiency of the optimum combinations using a small washing machine, as an application of above

The washing efficiency of the fabricated model was also assessed by comparing it to the Launder-Ometer. Combination III (501 bar soap : sodium lauryl sulphate 25:75) and Combination IV (501 bar soap : Lissapol N 75:25) gave good results and were comparable with the Launder-Ometer results. With the agitation given by the stirrer of the small washing machine. The combinations seemed to be more effective.

Mixtures of soaps and synthetic detergents have many of the desirable properties of each component and therefore are more versatile than either component taken separately. It is also better to use a higher concentration of a pure product or active ingredient than using a high concentration which is substituted with builders.