A SIMPLE METHOD FOR EVALUATING THE CLEANING POWER OF COMMERCIAL DETERGENTS

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ABSTRACT: *Commercial detergents, in spite of their various names and marks, are used to remove foreign matter (dirt) from substrate. Following removal of dirt from the surface, it is necessary to prevent redeposition, so the detergent must have suspending power.*

In this experimental work, a simple method has been developed to evaluate the cleaning power of commercial detergents. The method, showing the change of surface tension of detergent solution versus concentration, makes possible the dynamic study of the cleaning power of different commercial detergents without concerning their formulation. It has been found that the method differentiates between various detergents. The examined detergents were: Arial, Barf, Bianco, Darya, Paak, Persil, Sepid, Shoma, Vash and Yes.

KEY WORDS: *Commercial detergents, Cleaning power, Dynamically, Evaluation.*

INTRODUCTION

Commercial detergents, in spite of their various names and marks, are used to remove foreign matter (dirt) from substrate. The dirt that accumulate on substrate contains a variety of materials including different greases, solid particles of dust, soot, etc.

The detergent is made up basically of two parts. The hydrocarbon tail or the olephilic group is the portion of the detergent that acts as the solubilizer to enable the detergent to be fully compatible and soluble in the oil bases. The other part of the detergent is the polar head group, usually containing a metal cation. The three most commonly used metals are calcium, magnesium and sodium. The polar head is soluble in water.

The condition for spontaneous replacement of dirt from the substrate is Eq. (1) [1] :

$$\gamma_{os} \geq \gamma_{ol} + \gamma_{sl} \quad (1)$$

where γ_{os} is interfacial tension between dirt and substrate γ_{ol} is interfacial tension between dirt and solution, γ_{sl} is interfacial tension between substrate and solution.

After detachment of dirt from the surface, it is necessary to prevent redeposition, therefore, the detergent must have suspending power, i.e., the dirt should remain dispersed in the fluid phase as a dis-experi-persion or emulsion.

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In spite of many research on detergency, most of them are dealing with pure surfactants. In this experimental work, the cleaning power of some of the popular commercial detergents are investigated without concerning their formulations. Therefore, this research is designed to find a direct method for evaluating the cleaning power of commercial detergents.

Theoretical Background

Detergency is a complex process which depends on many factors, such as the nature of the dirt, the surface, detergent formulation, temperature, pH, electrolytes concentration, hardness and the mixing energy. Despite this complexity, good detergency should satisfy two important conditions [2]:

1) Ability in lowering the surface and interfacial tensions between different phases, 2) Capability in micellization.

Cleaning power is the ability of a detergent to loosen and remove dirt, keep it suspended in water and prevent it from redeposition on the surface.

It is observed that cleaning is composed of a) Loosening the dirt, b) Solublizing the dirt, c) Removing the dirt.

Loosening the dirt requires the Eq. (1) to be satisfied, but its solublization is achieved when the micelle forms. Micelle formation or micellization [3] is a fundamental property of each detergent because a number of important interfacial phenomena, such as solublization, depend on the existance of micelles in solution, Therefore, micellization promotes the primary purpose of cleaning, i.e., solublizing and suspending the dirt. The dirt can be removed from the substrate by foam flotation. Consumers are interested in step (c). To them, a good detergent must generate a large volume of initial foam which persists in the presence of dirt throughout the washing process. Scientifically, a large volume of foam is not always desirable [4].

EXPERIMENTAL

Materials

The detergents used in this study were Barf, Darya, Sepid, Shoma and Vash (locally-made)., Arial, Bianco, Persil and Yes (foreign-made). These were all commercial samples and were used without further treatment.

Measurement of surface tension

Surface tension of the detergent solutions were measured at ambient temperature (20°C) by Drop Weight Method [1]. To improve the accuracy of the measurement, 30 drops were collected and their weight averaged. The surface tension of the detergent solution was calculated using the follwing Eq.(2).

$$\gamma = \frac{\phi \ mg}{2\pi r} \qquad (2)$$

Where mg= weight of a drop, r= radius of the capillary tube, ϕ = constant, was found to be 1.64 by calibration.

Details of the experiments have been reported elsewhere [5]

RESULTS AND DISCUSSION

Fig. 1 shows surface tension profile for different hand-washing detergents. For these detergents, a large volume of foam throughout the washing process is favourite, even though foaming is not the primary purpose in cleaning. Fig. 1 illustrates that the reduction of surface tension is sharp at low concentration of detergents. Low surface tension promotes foaming. At high concentration of detergents, the general trend is a lower slope for the surface tension profile. The break in the curve occurs at the critical micelle concentration (CMC), the concentration at which the monomeric form of the sur-

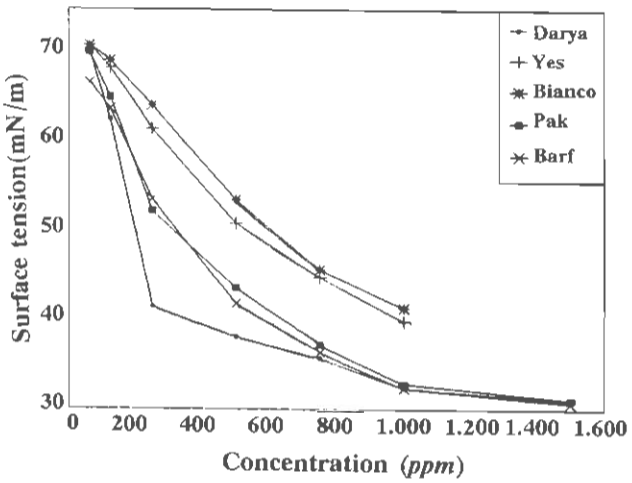

Fig. 1: Surface tension profile for hand-washing detergents.

factant exists in dilute solution aggregates to form a cluster known as a micelle. Micelleization promotes loosing, solublizing and suspending the dirt.

In conclusion, a hand washing detergent with sharp surface tension reduction and low CMC is the best. Fig. 1 demonstrates that the Darya has the best performance as a hand-washing detergent because its suface-tension reduction is high when the concentration is low and has the lowest CMC. Yes and Bianco have the poorest performance.

Fig. 2 shows surface tension profile for different washing-machine detergents. For these detergents, a low volume of foam throughout the washing process is favorable, because high volume of foam press the walls of machine as a semi-solid [4].

Fig. 2 indicates that Sepid has low performance because it produces high volume of foam and it also has high CMC. Shoma's performance could be better if its foaming agent is decreased. Persil is a good washing machine detergent even though its CMC is high.

Thus, a premium washing machine detergent having a minimum lather and a low CMC is yet to be desired. Other aspect of detergents can be evaluated but in this work only cleaning power was considered.

Gharavi et al.[6] evaluated some commercial detergents from medical point of views. They have found that Darya has the best cleaning performance among investigated detergents, however, they used a standard method which is tedious and time consuming, completely different from the simple method outlined in this work. In the standard method, the final result of cleaning power measure is important but in the method proposed here the cleaning power is studied dynamically.

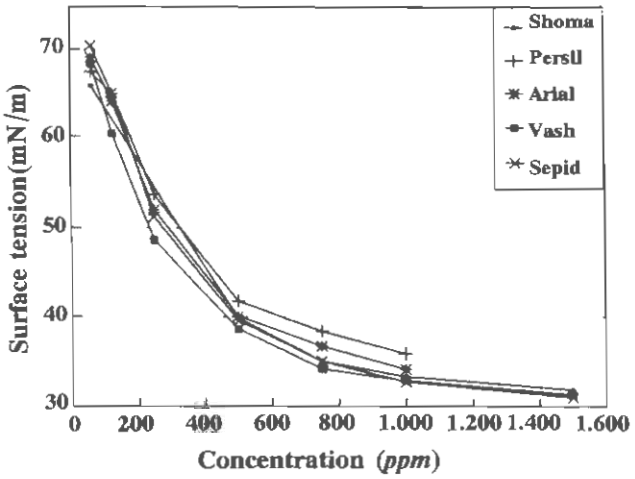

Fig. 2: Surface tension profile for washing-machine detergents.

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