SURFACE CHEMISTRY IN CHEMICAL CLEANERS

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Few industries have a greater investment in precious equipment than the dairy operator. Since this equipment is constantly exposed to deteriorating agents such as film, scale, rust, and casein accumulations, a serious problem arises as to how to protect this investment. We have gone a long way towards solving the problem through Surface Chemistry.

Man spends about 25% of his time in trying to get rid of dirt, and the amount of time devoted to cleanliness in the dairy industry where such high standards are maintained is undoubtedly much higher. In view of the size of the problem it is surprising how little attention was paid to it until recently.

Cleaning methods lagged far behind the general advance of mass production processing. Not so long ago the only cleaners available to the dairy industry were raw chemicals. In the last twenty years more has been learned about soil removal than in the thousand years before, and scientists now give more and more time to the study of more effective means of soil removal.

This new knowledge, the result of research and experience, is now taking form in the science of Surface Chemistry. Based on certain fundamental principles, this knowledge is being formulated into cleaning materials. Since the concepts of this science are not yet generally available to the public, it may be of value to summarize them. It is important to remember that cleaning is not the result of any one of the factors we shall outline, but rather, a skillful organization and mobilization of these factors.

WETTING ACTION

Practically all contamination is surrounded by an oily, fatty, adhesive film which must be removed to destroy the bond holding the soil to the surface. All of us have observed the reaction when water is poured on an oily surface. The water collects in pools or droplets and will not spread out or get beneath the oil. In other words, water refuses to wet an oily surface, and water is supposed to be the wettest thing on earth. It doesn't deserve its reputation!

Wetting action brings the cleaning solution into close and intimate contact with the dirt, but it is usually not sufficient by itself to dislodge a mass of fat from the surface. If the surface tension is sufficiently reduced and the water made wetter than wet, this situation is reversed, and the fat will form tiny drops on the film of water which has penetrated beneath it.

It is easier to get rid of fat broken up into small drops than it is to remove a continuous layer.

Scientists have learned that certain chemicals can be added to water which not only enable it to spread out over an oily surface but to get down under the oil so that the oil is separated from the surface by a thin film of the cleaning solution. Wetting action by spreading the cleaning solution over an oily surface, and by actually getting under the oil, permits the cleaning solution to come to grips with dirt. Better wetting is made possibly by the control of surface and interfacial tensions. The importance of wetting action is highlighted by the fact that cleaning has been defined as "The release of contaminating matter from wet surfaces".

Before a surface can be cleaned it must first be wet. High wetting and penetrating action aids in removing undesirable organisms such as thermophilic and thermoduric bacteria. Revolutionary new quaternary ammonium compounds are providing new standards in the field of sanitization. Their high wetting action assures intimate contact with the surface being sanitized so that the powerful antibacterial and deodorant properties are fully utilized.

EMULSIFYING ACTION

EMULSIFYING Agents have the ability to scatter droplets of fat through water by enveloping them with a film of water. The film around each droplet separates the fat, and once scattered through water or other fluid the fat cannot be redeposited but is held in suspension for a variable period of time. The emulsifying action of a good cement floor cleaner penetrates cracks and pockets to loosen grime with a minimum of scrubbing and scouring.

WETTING action breaks a portion of the fat into small droplets; emulsifying action scatters these droplets. Wetting action then goes to work on another layer of the fatty film to break it up further. Wetting and emulsifying action work hand in hand, mutually supporting each other. The combined effect of the two actions is the loosening, breaking up, and dispersion of fatty films.

SAPONIFICATION

Certain alkalies have the ability to combine chemically with fatty acids to form soap and glycerine, and as we all know these are soluble in water. You can't see the soap that is formed in this manner, but it is there - and a remarkable thing happens. The dissolved soap, remember that it was originally a part of the soil, increases the emulsifying and wetting action of the cleaning solution. A portion of the soil is made to turn against itself and helps in its own removal. The dissolved soap has the effect of detaching and scattering solid particles, so that it helps in the removal of this type of soil as well. The importance of saponifying action in cleaning can be better appreciated when it is realized that fatty acids are among the components of butter, cream, and milk products. Petroleum oils cannot be saponified, and must be removed by wetting and emulsifying actions, but the animal fats can, by a properly formulated cleaning solution, be rendered soluble and made to play a part in the cleaning work itself. The ability of cleaning compounds to remove butterfat residues in bottle washers is largely the result of the succesful combination of the above factors.

COLLOIDAL ACTION

Contamination is a miscellany of solid particles of various types held in position by an oily or fatty film.

Emulsifying and saponifying actions help in the removal of fats, but all scientifically formulated detergents provide for the breaking up and dispersion of solid particles as well. Materials which have the ability to break up a solid mass into small particles and to scatter them through a liquid medium are known as colloidal agents. Colloidal action breaks up large particles into smaller ones. Individual particles of colloidal size are too small to be seen, but colloidal suspensions are visible.

Food deposits are among the forms of dirt removed by colloidal forces. The earliest cleaning materials known, coming long before soap and chemical cleaners, were colloidal agents like Fuller's earth. Improved compounds owe much of their cleaning efficiency to colloidal action.

SOLVENT ACTION

Solvents may be divided into two broad classifications. In one group the dissolved substance splits up into groups of ions which possess definite electric charges. Water is the most familar solvent of this type. Water alone has little ability to clean. However, in many chemical cleaners water acts as a solvent for the cleaning compound to liberate the energies which result in wetting, emulsification, saponification, and colloidal action. The chief limitation of the ionizing solvents is that they have no effect on oils, greases, gums and some resins.

The second broad classification of solvents, unlike water do not split the solids they dissolve into electrically charged groups of molecules. Derived basically from pertroleum, coal, and wood, these solvents are unable to dissolve many substances which are readily solube in water, but they do have the ability to dissolve not only oils and greases but many resins, rubber, plastics, bitumins, paraffins, and waxes. These solvents have a further advantage in that they can be formulated into cleaners which are chemically neutral, so that they offer a method for safe cleaning of reactive metals such as aluminum.

Solvent action in conjunction with balanced buffered acidity is necessary for long cleaning life and efficient safe removal of milkstone.

pH

pH is a yardstick for measuring the degree of alkalinity or acidity of water solutions. It is a measure of the energy but not the amount of alkali or acid in the solution. The most sensitive pH meters now available cannot discrminate between a causticity of 2% or 3%. Yet it is an established fact that the latter would produce much more effective cleaning and sanitizing in a bottle washer. Two solutions may register identical pH values on the most sensitive instruments known, yet one will corrode metal, one will not. One will remove butterfat swiftly, one would leave it unaffected. One will maintain its efficiency for days or weeks, one for only a few hours.

pH is important in the general picture of cleaning. It is valuable in providing comparative data on the action of a given cleaner, if all other conditions are equal. It takes its place as one among a number of factors which must be considered in formulating a scientific cleaning compound.

BUFFER ACTION

A carefully formulated alkaline or acid cleaner is buffered so that its cleaning energy will not be rapidly exhausted by the soil which it removes. As the energy of acidity or alkalinity is used up in cleaning, a fresh supply of energy is liberated to sustain the cleaning efficiency of the solution. A buffered

cleaner is formulated to possess a reserve of strength which enables it to absorb large quantities of dirt for long periods of time. Unbuffered cleaners are strongest at the moment the solution is first prepared. With the first particle of dirt removed such a solution is weaker, and it continues to grow weaker as cleaning proceeds. An unbuffered cleaner requires constant attention to maintain it at operating level. Loss of efficiency begins almost immediately and is reflected in erractic cleaning performance. The long life of the cleaning solution, the amount of maintenance it requires, and the uniformity of results it produces are factors largely dependent on buffering. Buffer action is highly important in dairy cleaning compounds for sustained cleaning action.

TOTAL ALKALINITY.

In the selection of a cleaning material, the criterion of value is not the amount of acid or alkali by weightor volume which is offered, but the extent to which the acid or alkali assists in the removal of soil. If a considerable part of the cleaning compound fails to yield active alkalinity or acidity, it represents so much inert material or filler which plays no part in cleaning and is a source of subsequent rinsing difficulties.

In the formula of a scientifically balanced cleaner a definite function is assigned to each compound. Colloidal action, saponification, buffer action, and total alkalinity are responsible for the efficiency of successful bottle washing compounds. The elements in the formula will not only fill their own functions but will support and reinforce each other, so the whole will be more active and more stable in cleaning activity than any of the component parts.

WATER CONDITIONING

Practically all natural water supplies contain dissolved bicarbonates and sulphates of calcium and magnesium. The presence of these minerals is responsible for water hardness. The fact that unbalanced detergents lose much of their efficiency in the presence of hard water has long been recognized, because they react with the dissolved salts to form insoluble precipitates. This reaction results in the partial loss of detergent efficiency. It may also precipitate a bacterial harboring film which resists subsequent water rinsing.

In a properly formulated and balanced cleaner hard water is conditioned to control the precipitation of minerals and prevent the formation of film and scale. Further, the water softening and cleaning functions of the compound are separate and distinct so that cleaning efficiency is not lost in the water softening process. Under these conditions more economical and more thorough cleaning is made possible. Rinsing is free and complete.

FUTURE OF SURFACE CHEMISTRY.

We have been able to present only the highlights of the principles of Surface Chemistry as applied to cleaning. The practical application of these principles has already resulted in spectacular advances in cleaning techniques, yet they represent only a beginning, an intimation of future possibilities. Research now under way points to the development of surface processing methods which will save enormous amounts of production time and costs. Surface Chemistry is a new and expanding field in which science operates in the service of industry.

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