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ISSN: 2278-6848 | Volume: 07 Issue: 08 | October – December 2016
Paper is available at www.jrps.in | Email : info@jrps.in

Study of types of Types Of Cleaning Detergents, Their advantages and disadvantages

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Introduction : *Surfactants (short for surface-active agents) are molecules that contain a hydrophilic, or "water-loving" end, and a hydrophobic, or "water-fearing" end. The electrical charge on the water-loving end of the molecule distinguishes between the different types of surfactants. Surfactants are usually organic compounds that are amphiphilic, meaning they contain both hydrophobic groups (their tails) and hydrophilic groups (their heads). Therefore, a surfactant contains both a water-insoluble (or oil-soluble) component and a water-soluble component. Surfactants will diffuse in water and adsorb at interfaces between air and water or at the interface between oil and water, in the case where water is mixed with oil. The water-insoluble hydrophobic group may extend out of the bulk water phase, into the air or into the oil phase, while the water-soluble head group remains in the water phase.*

A detergent is a surfactant or a mixture of surfactants with "cleaning properties in dilute solutions. These substances are usually alkylbenzenesulfonates, a family of compounds that are similar to soap but are more soluble in hard water, because the polar sulfonate (of detergents) is less likely than the polar carboxyl (of soap) to bind to calcium and other ions found in hard water. In most household contexts, the term detergent by itself refers specifically to laundry detergent or dish detergent, as opposed to hand soap or other types of cleaning agents. Detergents are commonly available as powders or concentrated solutions. Surfactants come in four different types: Anionic, nonionic, cationic and amphoteric.

1. Anionic Detergents :

Structure and Chemical Composition

Anionic detergents consist of a long hydrocarbon tail and a negatively charged head group. However they differ from soaps in that the head is a different ion to carboxylate. Common anionic detergents include alkyl phosphates, where heads are benzensulfonate or phosphate ions respectively.

A possible (typical) chemical composition is: $CH_3(CH_2)_n(C_6H_6)O(SO_2)O^-Na^+$

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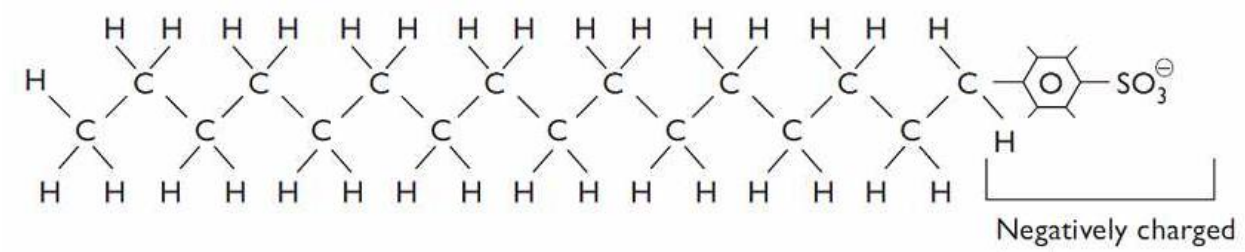

Uses:

1. Commonly known as a "neutral" detergent.
2. The most widely used soapless detergent.
3. Available in both liquid or powder.
4. Manufactured from strong alkalis and weak acids.
5. Effectiveness is even greater when combined with a non-ionic detergent.
6. These detergents produce foam when used in excess quantities and, therefore, should only be used in the recommended amounts.

Advantages:

1. Safe for use on all floors and should not affect any pigment present in the floor covering.
2. Can safely be used on waxed or unwaxed floors or floors treated with a water emulsion floor wax or solvent-based wax.
3. Can be used in conjunction with mopping equipment or a polishing/scrubbing machine.
4. More effective than non-ionic detergents in the wetting of metal surfaces.
5. Very effective in removing inorganic dirt and soil.
6. Greater dirt carrying capacity than non-ionic detergents.
7. Fairly inexpensive.

Disadvantages:

1. Not very effective in hard water.
2. More difficult to rinse than non-ionic detergents.
3. Produces considerable foam.

2. Non Ionic Detergents :

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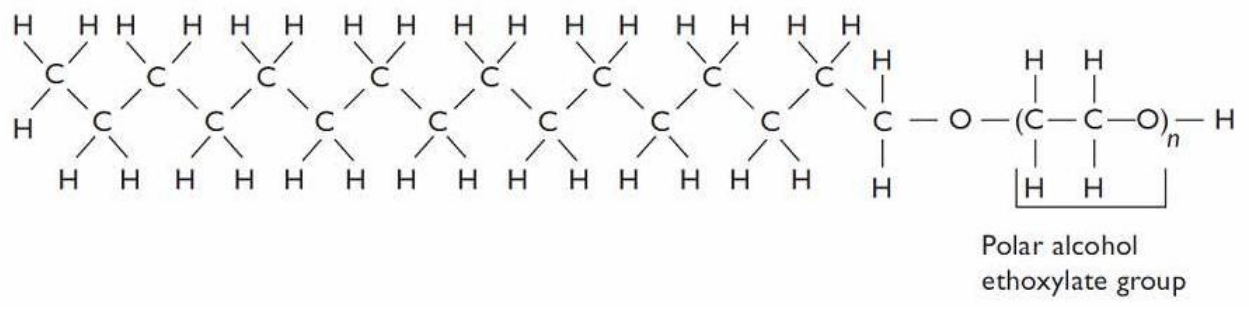
Structure and Chemical Composition

These are characterised by the presence of hydrophilic groups rather than charged heads. They consist of a long hydrocarbon tail, and a polar alcohol ethoxylate (polyoxyetheylene ethers) group. They are molecules, not ions.

$CH_3(CH_2)_nO(CH_2CH_2O)_n(CH_2)_2OH$ The 2nd n varies from 5 to 50.



Uses:

1. These detergents do not ionize or carry a charge when dissolved in water.
2. They are manufactured from alkalis and acids of equal strengths and are, therefore, neither alkaline or acid. They have a pH value of 7.
3. Compatible with many ingredients and can, therefore, be included in a wide variety of formulations.
4. Acts as a foam booster when combined with other detergents such as anionic detergents.

Advantages:

1. Safe for use on all surfaces.
2. Produce less foam than anionic detergents.
3. Because of their low foam characteristics, they may be effectively used in conjunction with scrubbing machines or other cleaning equipment.
4. Easier to rinse.
5. More effective for use in hard water than anionic detergents.
6. Very effective for removing oils and grease.

Disadvantages:

1. Less effective than anionic detergents in the wetting of metal surfaces.
2. Generally more expensive than anionic detergents.
3. Mostly available in liquid form.

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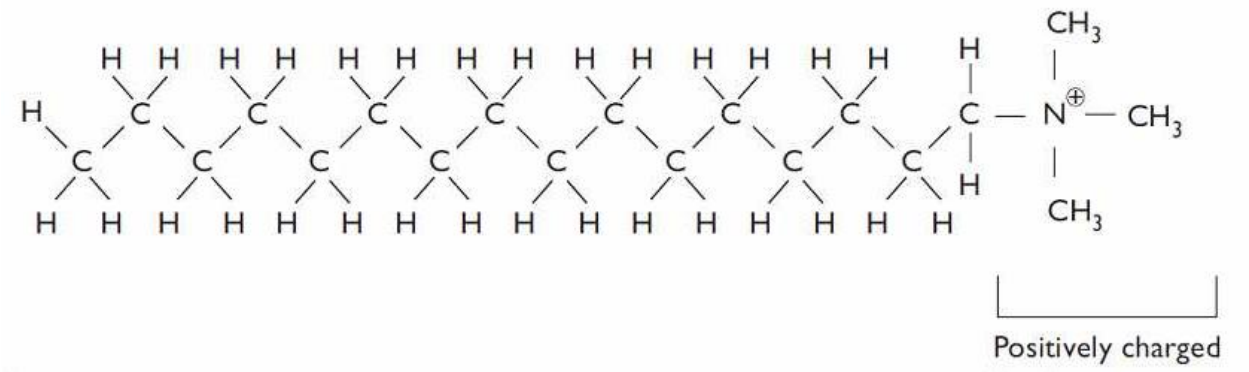
Cationic Detergents :

Structure and Chemical Composition

These detergents consist of a long hydrocarbon tail with a positively charged head, which is usually a quaternary ammonium group (alkyl ammonium group). There can be one or two long alkyl chains connected to the nitrogen, with two or three methyl groups. The negative ion is often a halide (e.g. Br^- or Cl^-). Sometimes the positive head is a pyridium group. A possible (typical) chemical composition is:

$CH_3(CH_2)_nN^+(CH_3)_3Cl^-$



Uses:

1. These detergents carry a positive charge when dissolved in water.
2. Manufactured from weak alkalis and strong acids. They are acidic in nature with a pH value less than 7.

Advantages:

1. Have low-foam characteristics.
2. These detergents carry anti-static properties and are effective in repelling dust. The positive charge in a cationic solution repels the positive charge carried by dust in the atmosphere.
3. Very effective as a bactericide, disinfectant and deodorizer.

Disadvantages:

1. More expensive than anionic and non-ionic detergents.
2. Used alone, these detergents are very ineffective. They are usually combined with non-ionic detergents for better cleaning effectiveness.

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3. These detergents CANNOT be blended with anionic detergents, as each will cancel the other out, rendering the detergent completely ineffective.

Amphoteric Detergents

Uses: Also called ampholitic detergents.

1. These detergents have both acidic and alkaline properties.
2. Mainly used in specialty formulations.
3. Limited quantities are used in shampoos, medicated liquid soaps and aerosol shampoos.

Advantages:

1. These are greatly affected by changes in pH. They behave like anionic detergents at pH values greater or equal to 8. They behave like non-ionic detergents at pH values between 8 and 6.They behave like cationic detergents at a pH below 4. NOTE: At a high pH, detergency powers are increased; at a low pH, detergency powers are reduced.
2. Non-toxic, non-irritating, germicidal and compatible with anionic, non-ionic and cationic detergents.

Disadvantages: Fairly expensive.

Caustic Materials

Uses:

1. Caustic materials are based on caustic soda, sodium hydroxide, caustic potash or potassium hydroxide.
2. EXTREMELY strong materials with a high pH value.
3. Used where VERY STRONG alkaline solutions are required such as in clearing blocked drains.
4. Available in solid or concentrated liquid forms.
5. Caustic potash is hygroscopic (absorbs water from the air) and is NOT recommended for use in powdered formulations that are to remain moisture-free
6. CAUTION: Never use caustic materials on floor coverings. The strong alkalinity will produce irreversible damage.

Disadvantages:

1. Can produce irreversible discoloration.

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2. Safety hazard to user: Corrosive to flesh and flammable when in contact with organic solvents.
3. Produces a significant increase in temperature when dissolved in water at high levels.
4. Difficult to rinse from surfaces. However, caustic potash is more soluble than caustic soda.
5. Lack the ability to absorb liquid ingredients in powdered formulations.
6. Extremely corrosive to soft metals such as aluminum and zinc and ceramic or glazed surfaces.
7. Avoid contact between caustic soda and liquid surfactants - contact may result in a decrease in its effectiveness and discoloration in the product.

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