DETERGENTS AND SANITIZERS

DTC 311 (Chemical Quality Assurance)

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Introduction

Milk is a good source of many nutrients like proteins, salts, lactose and vitamins, which are responsible for the fast growth of micro-organisms and scaling of heat exchangers etc. In dairy operations main processing treatment given to milk is heating which causes the scaling on the surfaces of heat exchangers and pipes. Milk traces compounds, if left in the pipes and valves lead to the deterioration in the quality of milk as well as processing operation. Therefore, the cleaning and sanitation of the dairy equipment is of utmost importance to meet the sanitary and phyto-sanitary (SPS) requirements of the industry. The efficiency of cleaning and sanitization is directly related to the strength of the detergents and sanitizers used in the cleaning and sanitization purpose of dairy plants. Cleaning and sanitary practices are regarded as integral part of GMP and GHP, which is pre requisite of prevalent food safety management system (FSMS) such as HACCP.

Primary objective of cleaning and sanitation is to control access of microbes to food environment which has been bearing on public health aspect and efficiency of food processing operations.

Cleaning

Dirt, soil, organic matter protects the microbes from environmental stress particularly physical, chemical sanitizers used in food processing industries. Cleaning refers to removal of soil, dirt which includes garbage, loose soil, milk, blood, fat residues, organic and inorganic deposits. Cleaning is carried out prior to sanitizing process to achieve maximum efficiency of sanitizers.

Methods of Cleaning

Cleaning process refers different types of detergent and energy in the form of pressure, hot water and physical removal like scrubbing, etc. Cleaning method has evolved a lot to meet the demand of various product specific food industries

DETERGENTS

Cleaning efficiency is improved by employing various chemical detergents. Selection of detergent depends on many factors such as nature of soil, corrosiveness property of detergent, rinsability, compatibility with other sanitizers and safety issues during handling of the detergent.

A detergent is a substance which posses

(i) It is used to enhance the cleansing action of water

(ii) It is an emulsifier, which penetrates and breaks up the oil film that binds dirt particles,

(iii) It capable of wetting surface(s) to allow it to penetrate the soil deposits and break the soil into fine particles (deflocculation) and to hold them in suspension so that they do not redeposit on the cleaned surface(emulsification)

(iv) must have good sequestering power to keep calcium and magnesium salts in solution.

There are two types of cleaning detergents: Acid detergents and Alkali Detergents

Alkaline or acid that are often formulated with surfactants, chelating agents, and emulsifiers to enhance the effectiveness of the detergents. The most effective detergents in the dairy today are formulated with alkaline solutions that have chelators and surfactants. a wetting agent, which helps them to float off.

Alkaline detergents

The alkaline detergents are generally covered of basic alkali, polyphosphates and wetting agents. None of the basic alkalis, higher phosphates or wetting agents can meet all the requirements of a good cleaner when used alone. The basic alkalis, like soda ash, caustic soda, trisodium phosphate and sodium metasilicate form the bulk of most of the common dairy cleaners. Two or more of alkali detergents are used in combination to overcome the weaknesses of a single compound and to give certain desirable properties to the blended product.

Caustic soda

Caustic soda is high in germicidal action and dissolving action on milk proteins, but it lacks deflocculating and emulsifying power as compared with other alkalis. In addition, caustic soda is objectionable for cleaning by hand because it is the most corrosive alkali.

Soda ash

Soda ash, is the most common constituent of dairy detergents today, and is the most inexpensive form of alkali. It is a poor water softener and has fair deflocculating and emulsifying action. It has the advantage of being a good buffer. It useful in solutions that are used over extended periods, as in hand bottle washing. When soda ash is used in hard water, calcium carbonate is precipitated and this precipitate causes hard water spotting and helps

develop milk stone deposits on dairy equipment. It is obvious that soda-ash cannot be used in large proportions in cleaners to be used in extremely hard water.

Trisodium phosphate

Trisodium phosphate, have a popular constituent in dairy cleaners because of its ready solubility and high deflocculating and emulsifying powers. It is a reasonable water softener because of the flocculent character and insolubility of the calcium and magnesium phosphates formed. When compared with metasilicate or soda ash, trisodium phosphate is also relatively corrosive on tin unless metasilicate is present as a protective agent in the mixture. Its concentrations are limited @ 0.5–1.5% to minimize phosphate levels in wastewater.

Sodium metasilicate

Sodium metasilicate, has high active alkalinity and excellent deflocculating and emulsifying properties. It, like trisodium phosphate, is only a fair water softener. The calcium and magnesium silicates formed in hard water are flocculent and insoluble in solutions. It is the strongest alkali next to caustic soda, it is relatively non-corrosive and has the property of protecting metals against corrosion by other alkalis. Metasilicate is highly effective in holding the soil in suspension during the washing operation so that complete cleaning is possible.

Acid detergents

The use of acid detergents is restricted to the removal of milk stone, water scale. Acid detergents are more effective against bacteria than alkaline detergents.

The two most common types of acid detergents used are:- Nitric acid and Phosphoric Acid.

Nitric acid

Nitric acid is used to remove milk-stone and other inorganic deposits, it also has biocidal properties when used either as a pure acid or in more stable, less hazardous mixtures with phosphoric acid. In addition, nitric acid attacks proteins. Nitric acid has benefit of forming a protective layer of chromium oxide on the surface of food processing equipment made up of stainless steel which contains chromium, thus preventing the leaching of iron ions into the milk. Commercially available aqueous blends of 5-30% nitric acid and 15-40% phosphoric acid are commonly used for cleaning food and dairy equipment to remove precipitated calcium and magnesium compounds. Nitric acid should not be used in >1% concentration for stainless steel surfaces.

Phosphoric acid

Phosphoric acid is used widely as the basis of acid cleaning materials and finds greatest application in the removal of milk-stone and similar deposits on surfaces such as protein deposits. Its performance is greatly enhanced by adding an acid-stable surfactant, which promotes penetration of surface deposits and also assists in the process of rinsing at the end of the cleaning process. It is used at a concentration between 2-3% w/v phosphoric acid for cleaning. Small quantities of complex organic acids are often added to enhance its effectiveness.

Characteristics of Ideal Detergent

• It must possess capacity to form maximum suspension and deflocculation of soil.

• Ability to prevent scale formation in hard water.

• It must ensure optimum rinsing.

• It must maintain relatively stable degree of acidity and alkalinity.

• It should be compatible with sanitizers being used.

• It should be non-toxic and should not tend to taint or discolour the food.

• It should be bio degradable and economical.

Sanitizers

According to United States Environmental Protection Agency (EPA) specifications, these are the compounds or type of antimicrobial that kills or irreversibly inactivates at least 99.9 percent of all bacteria, fungi, and viruses present on a surface. Most sanitizers are based on toxic chemicals such as chlorine, iodine, phenol, or quaternary ammonium compounds, and which may never be taken internally.

The most commonly used sanitizers are the compounds of chlorine and iodine.

Sanitation

Food contact surfaces are subjected to sanitation after cleaning. Sanitation plan involve the use of several physical and methods to reduce pathogenic and spoilage microbes to the acceptable microbiological standards. There are two methods are employs-

(i) Physical methods

 Hot water

 Steam mixed hot water

 UV radiations

(ii) Chemical methods- These sanitizers are more frequently used and includes

 Chlorine based sanitizers

 Iodophores

 Hydrogen peroxide

Characteristics of Ideal Sanitizer

• It must be stable in presence of organic residues and hard water.

• It should be non-corrosive and non-staining to the skin and surface.

• It should not cause taint to food products.

• It should be non-toxic.

• It should be water soluble and easily rinsable.

• It should be compatible with other chemicals.

• It should be readily available in the market.

Chlorine compounds

These compounds include mainly liquid chlorine, hypochlorites, inorganic chloramines, and organic chloramines. Chlorine-based sanitizers form hypochlorous acid in solution. Chlorine compounds are broad spectrum germicides which act on microbial membranes, inhibit cellular enzymes involved in glucose metabolism, and oxidize cellular protein. Chlorine active at low temperature, is relatively cheap, and leaves minimal residue or film on surfaces.

Iodine compounds

This sanitizer exists in many forms and usually exists with a surfactant as a carrier. These mixtures are termed as iodophors. The most active agent is the dissociated free iodine. This form is most prevalent at low pH. Iodophors, like chlorine compounds, have a broad

spectrum effect. These compounds are active against bacteria, viruses, yeasts, molds, fungi, and protozoans. These compounds are also more specific against non- spore forming bacteria.

Disadvantage

Iodine is highly temperature-dependent and it is limited to lower temperature applications.

Quaternary ammonium compounds (QACs)

These compounds are generally positively charged cations, hence their mode of action is related to their attraction to negatively charged materials such as bacterial proteins. QACs are active and stable over a broad temperature range. Because they are surfactants, they possess some detergency. Thus, they are less affected by light soil than are other sanitizers.

Factors affecting the cleaning efficiency

There are many factors affecting the cleaning process efficiency and are needed to be considered before developing GMP and GHP for dairy processing plants.

Some of the important factors are-

1.Sanitary design consideration of plant-

Plant layouts and other details should be properly sanitary designed to achieve the goals of sanitation.

Sanitary designs should take into consideration aspects like- interior and exterior of the plant, its location, waste disposal and drainage, construction material especially of food contact surface, separate clean and dirty areas.

Spatial design should also be considered to access 360º to equipments and installation. proper ventilation, air flow and lighting should be pay with due attention in sanitary design plan.

2. Sanitary design of tools and equipments-

Sanitary design of tools and equipments facilitate easy and efficient cleaning.

Dead spots or inaccessible spots on equipments and tools may serve potential source of contamination. So designing should eliminate the possibility of dead spots.

3.Material and state of food contact surface-

Food contact surface must be of such materials to assure cleanliness and desired level of sanitation.

Poorly maintained, cracked surfaces hinder the efficient cleaning operations and favorthe biofilm formation.

Scratch resistant material allows easy cleaning like stainless steel.

4.Quality of Air and Water-

Quality of water and air also effect cleaning efficiency of dairy plants.

Conclusion

Milk is a good source of many nutrients like proteins, salts, lactose and vitamins, which are responsible for the fast growth of micro-organisms and scaling of heat exchangers etc. In dairy operations main processing treatment given to milk is heating which causes the scaling on the surfaces of heat exchangers and pipes. The primary objective of cleaning and sanitation of food plants is to control access of microbes to food environment which has been bearing on public health aspect and the efficiency of food processing operations. Cleaning method has developed a lot to meet the demand of various product specific for dairy and food industries. Cleaning process employs different types of detergent and sanitizers. Acid and alkali detergents are used for cleaning of food plants. In addition, sanitizers are also used for cleaning purpose. There are many sanitizers are used such as physical and chemical. Mostly chemical sanitizer are used for sanitizing purpose.

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