CHAPTER 9
CLEANING AND DISINFECTION (SANITISATION)

Chapter 9: Cleaning and Disinfection (Sanitisation)

1. Introduction

R 962, 6(4)
SANS 10049, 7.4.5
SANS ISO TS 22002-1,11
CGCSA FSI GMCP B.B.2.2, B.C.1

Food can be contaminated by soiled processing plants and equipment and by an unhygienic environment. To prevent contamination, effective cleaning is required.

Cleaning and disinfection of food contact surfaces and the environment is carried out:

- As part of the achievement of overall contamination control (chemical, physical and microbiological) of a specific ingredient or food product handling by a particular item or line of equipment.
- To maintain the performance of equipment, e.g. filler, within design limits.
- As part of good plant management which has an important effect on employee morale.
- To comply with the specifications of the required product.

These apparently simple and obvious reasons lead to the development of cleaning systems, which require careful technological study and may become complex in order to achieve the required objective.

Clean

The word "clean" means that a surface is without residues, soil or dirt. A surface may be chemically, physically or microbiologically clean.

- **Physically clean** – when all visible "soil" or residues are removed by the cleaning operations. This is usually judged visually and it is important to remember that a surface that looks physically clean is not necessarily microbiologically clean.
- **Microbiologically clean** – when numbers and types of microorganisms are reduced to an acceptable level.
- **Chemically clean** – when chemicals that can have an adverse effect on food safety have been removed by cleaning operations. This may include the breakdown/removal of chemicals used for cleaning and/or sanitisation. Water used for rinsing must be potable, i.e. of such chemical and microbiological quality that it is wholesome and fit for human consumption.

Surfaces may appear clean and still be microbiologically unacceptable. It can also be true that surfaces may not appear clean, but in fact be quite acceptable for certain operations. Microbiological samples (by means of swabs or other methods) of food contact surfaces may have to be taken to verify what the human senses perceive to be clean or unclean.

Checks that can be done on the effectiveness of cleaning procedures include:

- Swabs.
- Surface contact plates.

It is important that the correct methods are used for these tests to ensure accurate results.

Who is responsible for cleaning?

R 962, 6(4)

The management of a production facility must accept that cleaning is an integral part of production. It is therefore necessary to:

- Develop,
- Implement, and
- Maintain cleaning schedules.

Employees responsible for the cleaning operations should inspect their own work and report to their supervisor if the process is not effective. Line supervision should visually check/monitor the cleaning process after completion and record the findings.

Technical (often laboratory) personnel will usually be involved in the development of the cleaning procedures as well as in the microbiological assessment. Tests will also be identified, which can be performed by the production (and cleaning) operators and supervisors.

Periodic sanitation reviews (survey audits) are required in addition to more frequent but less extensive inspections made by plant management. In order to compare reviews over a period of time, some form of report must be compiled and kept on file. The inspection ratings or descriptions such as

"unacceptable", "needs improvement", "acceptable", "very good", which have a previously agreed meaning, can be used. The key factor in compiling records is the intended use.

Once a procedure has been established, there is considerable value in knowing that it has been proven effective. There is also value in knowing the trends of inspections, test and surveys. The objective in studying trends is to take corrective (remedial) action before loss of control of the product(s) or process(es) occurs. The optimal way of doing this depends on individual processing facility. Always apply the rule "the simpler the better", otherwise significant details get lost in a moss of data.

Successful cleaning results from a combination of management skills and the application of technical knowledge. To ensure this, personnel must be selected, trained, organised, motivated and supervised.

2. Water quality

The water used for cleaning product contact surfaces must comply with the requirements of SANS 241, regardless of the source of the water.

R 962 Definitions
R 962, 6(4)
SANS 10049, 7.4.1
SANS ISO TS 22002-1, 6.2
SANS 1678, 5.10
SANS 1679, 5.10
CGCSA FSI GMCP B.B.6

The water quality should be monitored regularly at the point of use to ensure that it does not pose a contamination risk. This applies to municipal water too.

3. Guidelines for cleaning programmes

3.1 General

Cleaning chemicals and cleaning procedures should not be a risk for food safety or product quality. Chemicals should be fit for use in the food industry and the formulation shall adhere to the relevant legislation.

SANS 10049, 7.4.5

Neither household chemicals nor chemicals from non-reputable suppliers shall be used.

This guideline will give you an indication of the basic requirements.

3.2 Cleaning chemicals

It is recommended that all cleaning chemicals comply with the following standards:

SANS 10049, 7.4.5
SANS 1828
SANS 1853

- SANS 1828:2005 Cleaning chemicals for use in the food industry.
- SANS 1853:2009 Disinfectants and detergents – disinfections for use in the food industry.

All disinfectants must be registered in terms of the compulsory registration requirements as regulated by the National Regulator of Compulsory Specifications.

Products must carry the SABS mark and the registration number must be printed on the label.

The SABS certificate must be valid and should be cross-checked against the SABS website for authenticity.

When products are diluted, a competent person shall be given the responsibility for measuring the chemical. Measurements should be simplified as far as possible while ensuring that the correct dilution is applied.

When automatic dosing systems are used, these shall be verified to ensure that the correct dilution is dispensed.

Bulk product containers must be labelled to reflect the contents.

All individual containers must be labelled with the supplier's name, registration numbers, SANS code (SANS 1828 and/or SANS 1853 certification) and instructions for use as well as safety details.

No fragranced products are to be used.

3.3 Training

SANS 10049, 7.5.1
CGCSA FSI GMCP B.B.3.3

Personnel require specialised training for cleaning activities, including how to dispense chemicals, how to clean to the required standard and how to work with hazardous chemicals.

SANS 10049, 7.2.11.4, 7.2.11.5,7.4.6
SANS ISO T/S 22002-1, 5.7

Since most detergents and disinfectants are hazardous, personnel handling these materials shall be informed of this fact and the appropriate treatment in the event of an accident.

SANS 1679, 5.9.4
SANS 1678, 5.9.4
CGCSA FSI GMCP B.B.3.2

When required to ensure safety, safety goggles or face shields and gloves shall be available and used when handling detergents and disinfectants.

Material safety data sheets must be available for all products used. The technical data sheet should also be available as this defines the method of usage and required concentrations.

When hazardous materials are mixed or dispensed, an eye wash station and shower facility shall be located close to the point of mixing or dispensing.

3.4 Responsibilities of chemical supplier consultants

Depending on the volumes purchased, most cleaning chemical suppliers offer value-added services to assist customers with the effective use of their products. Ideally, the chemical supplier consultant must visit the facility at least once per month.

The consultant must assist and advise on all aspects of cleaning and sanitation.

All visits must be recorded and any non-conformance should be noted.

The chemical supplier must provide the following training:

- Correct use of chemicals.
- Safety handling of chemicals.
- Cleaning practices.
- Clean-as-you-go policy.
- Stock taking of chemicals (where relevant).
- Cleaning schedules.
- Cleaning methods (CIP, hand cleaning).
- Introduction to microbiology.

A manual must be compiled by the chemical supplier. The file must contain the following information:

- Occupational Health and Safety Act 85 of 1993 (Acceptance letter).
- Copies of SABS registration certificates.
- Products data and safety sheets.
- Training record of staff for the specific facility.

3.5 Cleaning schedules

R 962,6(4)
SANS 10049, 7.4.5
SANS ISO TS 22002-1,11.3
SANS 1678, 6.6.4
SANS 1679, 6.6.4
CGCSA FSI GMCP B.B.3.1

A master cleaning schedule shall be prepared in conjunction with the chemical supplier. It must consist of the following:

- Area to be cleaned with list of all items per area.
- Frequency of cleaning (daily, weekly, monthly, yearly).
- Cleaning method with chemicals used and dilutions.
- Cleaning equipment used.
- Responsible person (staff member).
- Checked by (supervisor or management member).
- Verification checks (swabs, rinse water or other methods used).

See Documentation Development on DVD included

The plant and equipment should be cleaned at least daily. All areas of the plant shall be cleaned, including the exterior and outside structures. Change rooms and toilets shall be kept clean at ALL times.

Records of cleaning must be maintained.

3.6 Dip tanks

SANS 10049, 7.4.5
SANS 1678, 5.14
SANS 1679, 5.14

Sufficient tanks, suitable for the immersion of loose pieces of equipment, shall be available for cleaning purposes. Where these are used for washing during production, they shall be located to prevent any possibility of cross-contamination. The tanks shall be fitted with an outlet pipe for drainage. Records of chemicals used and concentration and date of application must be provided.

3.7 Containers and storage

No food containers, buckets or dispensers must be used for cleaning chemicals, unless they are suitably marked. All containers containing cleaning chemicals and dilutions thereof must be clearly marked. Cleaning chemicals stored in the processing area must be in a dedicated area that is locked.

4. Cleaning equipment

4.1 Introduction

SANS 10049, 7.4.5
SANS ISO TS 22002-1,8.5, 11.2
SANS 1678, 6.6.4
SANS 1679, 6.6.4
CGCSA FSI GMCP B.B.3.2

Cleaning equipment must be for industrial and not household use. Brush wear must be inspected for loose bristles and must be included on the master cleaning schedule.

Wooden handles and spaghetti mops should be avoided.

4.2 Storage

SANS 10049, 7.2.11.5
SANS ISO TS 22002-1,11.2
SANS 1678, 5.9.4
SANS 1679, 5.9.4
CGCSA FSI GMCP B.B.3.2

Storage areas for cleaning equipment should be as follows:

- In a dedicated area.
- Readily accessible.
- Away from food.
- Away from packaging material off the floor (shelf or alternative).
- Neat and dry.
- Make provision for chemicals to be locked away.
- Brushes must be clearly marked for the intended use.
- Wire scourers are not permitted.
- Brooms should be hung with bristles facing downwards.

4.3 Rags and cloths

SANS 10049, 7.4.5

When using cleaning cloths and scouring pads, care shall be taken to ensure that they are not a source of contamination, i.e. by being contaminated themselves or by being a source of foreign materials. Cleaning cloths should not be of the woven kind. One-day use or disposable cloths are preferable.

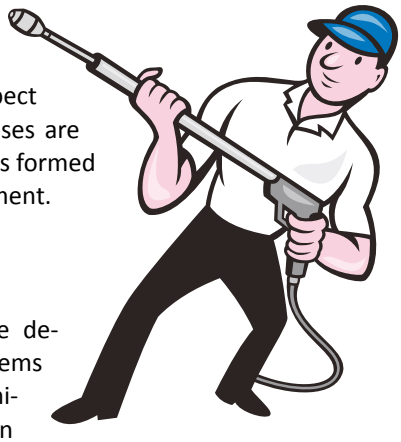
Different colours for different days are ideal to ensure correct usage. Old cloths should be returned when new ones are issued to ensure that these do not become contaminants.

Cloths should preferably not be similar in colour to the product.

4.4 Water hoses

SANS 10049, 7.2.14, 7.4.1
SANS 1678, 5.9.4
SANS 1679, 5.9.4

Keep the use of water to a minimum. Ensure that hoses are off the floor. Inspect hoses regularly. No high pressure hoses are to be used during production. Droplets formed can contaminate products and equipment.



4.5 Colour-coding

SANS 10049, 7.4.5
SANS ISO TS 22002-1, 11.2
SANS 1678, 6.6.4
SANS 1679, 6.6.4
CGCSA FSI GMCP B.B.3.2

What is colour-coding?

Colour-coding assists in meeting the demands of hygiene management systems and is used to prevent cross-contamination, which may occur in production and related areas.

Principles

One specific colour is to be used in a designated area or cleaning zone.

Advantage

To prevent any physical, chemical or microbial contamination that may occur due to transportation of cleaning tools from one room or cleaning zone to another.

Colour-coding concept in practice

With the colour-coding plan we can identify the cleaning zones and define the appropriate cleaning tools for a specific cleaning job as well as determine the best possible placement in the plant.

It is recommended that the tools are placed in special wall brackets in order to increase their durability and to optimise their application.

The placement of the cleaning tools is to be carefully considered (cost-efficiency is affected if the cleaner needs to spend time looking for the tools).

The tools are adapted to the type of work to be performed and to the persons using it. The ergonomic characteristics of tools adapted to special cleaning situations could be designed in such a way as to prevent industrial injuries, which may occur due to inadequate working postures/cleaning tools.

The use of wall brackets will increase the durability of the cleaning tools. Tools kept dry in brackets will reduce the development of any bacteria, thereby reducing damage and, as a result, extending the lifespan.

The implementation of a colour-coding system into a plant will:

- Reduce the occurrence of cross-contamination.
- Reduce cleaning costs.
- Increase durability of the cleaning tools.
- Integrate and promote a food safety management system.
- Inspire the users to take on a responsible attitude towards hygiene.
- Offer a visually simple control measure, which can be used by everyone and in all situations.
- Separate the different zones by means of colours in the milk reception area, pasteurised milk area and fermented products such as cultured milk and yoghurt.

5. Verification of cleaning

SANS 10049, 7.4.5
SANS ISO TS 22002-1,11.5
SANS 1678, 6.7.1
SANS 1679, 6.7.1
CGCSA FSI GMCP B.B.3.1

The dairy processing facility must develop a procedure for checking that cleaning has taken place according to the cleaning schedules.

R 961, 11
SANS 5763
Chapter 7

The effectiveness of cleaning and disinfecting of equipment should be checked regularly by inspection and microbial counts (swabs) to ensure that the levels of microorganisms do not exceed 10 bacteria per 100 mm2.

SANS 10049, 10.1
CGCSA FSI GMCP B.A.5.1

Records are required for cleaning and the verification of cleaning. Appropriate corrective action should be taken if the results of cleaning are not satisfactory.

6. Cleaning-in-place (CIP) systems

SANS 10049, 7.2.14
SANS ISO TS 22002-1,8.5,11.4
Chapter 3.1

Refer to Chapter 3.1 for more information on cleaning systems in place.

7. Recommendations

The following is taken from SABS 049:2001, which has been superseded by SANS 10049. This information is very helpful in understanding the principles of cleaning.

A.5 Cleaning and disinfecting of facilities

A.5.1 The risk of contamination of food should be taken into account when deciding on a cleaning programme. The rate of microbial growth depends on the nature of the food, pH, temperature and water activity.
NOTE: Under ideal conditions, the number of microorganisms in food can double every 20 min, which means that one microorganism can produce over two million microorganisms in seven hours.

A.5.2 Special attention should be paid when establishing a cleaning programme for powder-conveying lines where the powder is

hygroscopic, as build-up of damp-contaminated powder can occur, which might contaminate the product occasionally. Such contamination can be difficult to detect.

A.5.3 Vacuum cleaners or dust extraction units can also be a source of contamination and it is recommended that the contents thereof be subjected to regular microbiological analysis. The results from regular analysis can be used to help monitor the level of pathogens in the environment of the factory. The use of centralised vacuum systems is not recommended since the pipework can be a potential source of contamination.

A.5.4 If high-pressure hoses are required in a cleaning programme, these should be used at the start of the cleaning process, since they might aerosolise microorganisms.

A.5.5 Brushes used on equipment should be readily distinguishable from brushes used on floors. Different coloured bristles could be considered. Since *Listeria* tends to be carried into factories on footwear, unless brushes are properly controlled, they are a means of transfer onto the equipment.

A.5.6 Sampling utensils and manual agitators should be stored in a suitable sterilant solution. The utensils and agitators should be rinsed free of organic matter and dried before immersion in the sterilant, and then rinsed again before being reused. The sterilant solution should be checked for efficacy at least daily, if long-lasting, or renewed daily. A chlorous solution is not suitable for aluminium and certain grades of stainless steel since it causes pitting.

A.5.7 The cleaning of equipment and processing areas should include the following steps:

a) **Pre-cleaning:** This involves the preparation of an area or equipment for cleaning by the removal of raw material or food products, protection of sensitive components and packaging materials from water, and the removal of food waste or scraps.

b) **Pre-rinsing:** This involves rinsing with water to remove any remaining large pieces of loose soil.

c) **Cleaning:** This involves the treatment of surfaces with an appropriate detergent to remove soil.

d) **Rinsing:** This involves rinsing with water to remove all soil and detergent.

e) **Disinfection:** This involves the application of chemicals or heat (or both) to destroy most microorganisms on surfaces.

f) **Post-rinse or final rinse:** This involves a final rinse with clean water to remove disinfectant, where applicable.

A.5.8 Cleaning cloths should not have fraying edges. The use of disposable cloths is recommended. For easy identification, the disposable cloths should be of a contrasting colour to the food produced.

B.4 Selection of detergent and disinfectant

The selection of a detergent or a disinfectant for a particular task will be dictated by the following:

a) The type of soil.

b) The solution application conditions.

c) The surface.

The corrosion resistance of the surface greatly influences the class of detergent or disinfectant that may be selected. The influence of surface materials on the selection of detergents and disinfectants is detailed in Table B.1 and Table B.2.

NOTE: The suppliers or manufacturers of detergents and disinfectants should be consulted when such products are being selected.

Table B.1: The influence of characteristics of metallic surfaces on the selection of cleaning materials

Surface material	Surface characteristics	Cleaning material considerations
Stainless steel	Hard, non-porous, scratch- resistant	All alkalis satisfactory; use acids and chlorine with care
Steel	Hard, non-porous, sratch- resistant	All alkalis satisfactory; use only corrosion-inhibited acids
Aluminium	Hard, non-porous, scratch- resistant	Use only mild corrosion-inhibited alkalis; acids can also corrode
Nickel alloys	Hard, non-porous, scratch- resistant	All alkalis satisfactory; use acids with care
Galvanized Galvanised steel	Hard, non-porous, moderately scratch-resistant	Care is needed with some alkalis; use only corrosion-inhibited acids
Anodized Anodised aluminium	Hard, non-porous, moderately scratch-resistant	Mild acids and mild alkalis satisfactory
Tinned steel and tinned copper	Hard, non-porous, moderately scratch-resistant	Use only mild corrosion-inhibited alkalis; use acids with care

Table B.2: The influence of characteristics of non-metallic surfaces on the selection of cleaning materials

Aggregates	Concrete	Hard, porous, scratch-resistant	Mild alkalis satisfactory, acids unsatisfactory
Mortar		Moderately hard, porous, scratch-resistant	Mild alkalis satisfactory, acids unsatisfactory
Glass		Very hard, non-porous, scratch-resistant	No detergent or disinfectant restrictions
Fibreglass		Hard, non-porous, scratch-resistant	Mild alkalis or mild acids satisfactory
Ceramics	Ceramic tiles	Hard, non-porous, scratch-resistant	No detergent or disinfectant restrictions
Quarry tiles		Hard, non-porous, scratch-resistant	No detergent or disinfectant restrictions
Plastics	Vinyl-coated metals	Soft, non-porous, poor scratch resistance	Alkalis and mild acids satisfactory, high temperature may affect surfaces
Epoxy-coated metals	Moderately hard, porous, moderate scratch resistance		No detergent or disinfectant restrictions
Rigid plastics	Moderately hard, non-porous, poor scratch resistance		Mild alkalis or mild acids satisfactory
Flexible plastics	Soft, porous, poor scratch resistance		Mild alkalis or mild acids satisfactory, high temperature may affect surfaces
Rubbers	Rigid rubbers	Moderately hard, porous, poor scratch resistance	Sensitive to non-ionic detergents and solvent-type cleaners
Flexible rubbers	Soft, porous, poor scratch resistance		Sensitive to non-ionic detergents and solvent type cleaners
Paints	High- gloss solvent-based paints	Soft, non-porous, poor scratch resistance	Use only mild alkalis or mild acids High temperature may affect surfaces

Cleaning and disinfection

C.1 General principles

C.1.1 Good hygiene demands effective and regular cleaning of establishments, equipment and vehicles to remove food residues and soil that might promote the growth of pathogenic and spoilage microorganisms and act as a source of food contamination. This cleaning process could, where necessary, be followed by, or associated with, disinfection to reduce the number of microorganisms remaining after cleaning to a level that will not cause harmful contamination of food. The cleaning and disinfecting stages can be combined by the use of a detergent-disinfectant mixture, although this process is generally considered to be less efficient than a two-stage cleaning and disinfecting process.

C.1.2 The methods employed for cleaning and disinfection should be such as to be considered satisfactory by the administering authority.

C.1.3 The procedures for cleaning and disinfection should be properly established by a hygiene specialist after consultation with production management, plant engineers and manufacturers of detergents and disinfectants. The procedure for cleaning and disinfection should be designed to meet the particular needs of the process and product concerned, and should be set out in written schedules that should be made available for the guidance of employees and management. Procedures should be established not only for cleaning and disinfecting the establishment, equipment and vehicles, but also for the cleaning and disinfecting of the equipment that is used for cleaning, such as brooms and buckets.

There should be adequate supervision by management to ensure that the procedures set out are carried out in an effective manner at the specified intervals of time.

C.1.4 A single individual who is a permanent member of staff of the organisation and whose duties should preferably be independent of production, should be appointed to be responsible for cleaning and disinfection procedures and for supervision.

C.1.5 Industrial detergents and disinfectants require careful handling. Alkaline and acidic products should not be mixed. Hypochlorite solutions should not be mixed with acidic products, as chlorine gas will be released. Operators handling strongly alkaline or acidic products should wear protective clothing and goggles and should be thoroughly instructed in handling techniques. Containers in which such substances are kept should be clearly marked and stored separately from food and packaging materials. Manufacturers' instructions should be carefully observed.

C.2 Cleaning

C.2.1 General

Cleaning is carried out by the separate or combined use of physical methods, for example, scrubbing or turbulent flow, and chemical methods, for example, the use of detergents, alkalis or acids. Heat is an important adjunct to the use of physical and chemical methods. Care should be taken in the selection of the temperatures, which will depend on the detergents and the nature of the soil and working surfaces. Some synthetic organic materials can absorb constituents of food such as milk fat, and the amount absorbed increases with an increase in temperature. Effective cleaning is achieved by applying the following steps in the order given:

a) Remove gross debris from surfaces by brushing, vacuuming and scraping or by other methods, followed where necessary, by the application of potable water. The temperature of the water used will depend on the type of soil to be removed, but in general warm water (45 to 60°C) or hot water (>75°C) is more effective than cold water (<30°C).

b) Apply a detergent solution to loosen soil and bacterial film and hold them in solution or suspension.
c) Rinse with potable water to remove loosened soil and detergent residues.
NOTE 1: Care should be taken that the use of abrasive material does not alter the character of the food contact surface and that fragments from brushes, scrapers and other cleaning materials do not contaminate the food.
NOTE 2: After cleaning has been carried out in terms of (a), (b) and (c) above, it may be followed by a disinfection process as described in C.3.

C.2.2 Cleaning methods

C.2.2.1 Manual cleaning

Removable parts of machinery can be manually cleaned by the removal of soil by scrubbing while using a detergent solution. For small items of equipment, soaking in a detergent solution in a separate receptacle may be necessary to loosen the soil before the scrubbing process.

C.2.2.2 Cleaning-in-place (CIP)

Equipment and pipe runs can be cleaned in place with water and detergent solution, without dismantling the equipment or pipe runs. The equipment should be properly designed for this cleaning method. A fluid velocity of 1,5 m/s with turbulent flow is required for effective cleaning of pipe runs. As far as possible, parts of equipment, such as pipe dead ends, that cannot be cleaned satisfactorily by this method should be identified and eliminated. If this cannot be done satisfactorily, these parts should be dismantled for cleaning to prevent the build-up of soil and resulting contaminants.

C.2.2.3 Low-pressure high-volume spray

Water or detergent solution can be applied in large volumes at pressures of up to approximately 680 kPa.

C.2.2.4 High-pressure low-volume spray

Water or detergent solution can be applied in low volumes at pressures of up to approximately 6 800 kPa.

C.2.2.5 Foam or gel cleaning

A detergent in the form of foam or gel can be applied and allowed to remain for 15 to 20 minutes and then be rinsed off with a water spray.

C.2.2.6 Washing machines

Some containers and equipment used in food processing can be washed by machines. These machines carry out the cleaning procedures set out above (see C.2.2.1 to C.2.2.5) with the added advantage of disinfection by a hot water rinse at the completion of the cleaning cycle. Good results can be obtained with a machine, provided that the effectiveness and efficiency of the machine is maintained by adequate and regular servicing. The strength of detergents or detergent-disinfectants in washing machines for utensils should be controlled.

C.2.3 Detergents

Detergents should have a good wetting capacity, and they should also have the ability to remove soil from surfaces and to hold the soil in suspension. They should also have good rinsing properties so that residues of soil and detergent can be easily removed from equipment.
There are many types of detergents and advice should be sought to ensure that the detergent used in any particular circumstance is suitable for removing the type of soil resulting from a particular food process and that it is used at the correct concentration and temperature. The detergent used should be non-corrosive and compatible with other materials, including disinfectants used in the procedure for disinfection. Whilst cold solutions of detergent might be effective in some circumstances, removal of fat residues requires the use of warm or hot solutions.
The deposition of mineral salts on equipment might form a hard scale (“stone”), especially in the presence of fats or proteins. The use of an

acidic or alkaline detergent (or both, sequentially) might be necessary to remove such deposits. The "stone" can be a major source of bacterial contamination. It can be easily detected by its fluorescence under ultraviolet light, which will highlight deposits usually missed by ordinary visual inspection.

C.2.4 Drying after cleaning

C.2.4.1 If equipment is left wet after cleaning, microorganisms might grow in the water film. It is important to ensure that equipment is left dry as soon as possible after cleaning and, where possible, to allow equipment to air-dry naturally. Single-use disposable tissue or absorbent materials, if used for drying, should be used once only and then discarded.

C.2.4.2 Adequate drainage points should be provided in equipment that cannot be dismantled and drying racks should be provided for small pieces of equipment that are dismantled for the purpose of cleaning.

C.2.4.3 Any equipment that unavoidably remains wet for a period during which significant microbial growth might occur should be disinfected immediately before use.

C.3 Disinfection

C.3.1 General considerations

While disinfection results in the reduction of numbers of living microorganisms, it does not usually kill bacterial spores. Effective disinfection does not necessarily kill all microorganisms present, but reduces their numbers to levels at which they can be reasonably assumed to present no risk to human health. No disinfection procedure can exert its full effect unless its use is preceded by thorough cleaning. Disinfectants should be chosen according to the types of microorganisms to be killed, the type of food being processed, the material of food contact surfaces and, where appropriate, the criteria mentioned in C.3.4. The selection of a disinfectant is also affected by the character of the water available and the method of cleaning employed. The continued use of certain chemical disinfectants might lead to the selection of resistant microorganisms. Therefore, the alternating use of different disinfectants should be considered.

The most common and effective disinfecting process is the use of moist heat. Chemical disinfectants should, however, be used if the use of heat would not be practicable. The procedures described in C.2.2 can also be used for the application of disinfectants.

C.3.2 Disinfection by application of heat

C.3.2.1 The application of moist heat to raise the surface temperature to at least 70°C is one of the most common and most useful forms of disinfection. High temperatures, however, will denature protein residues and bake them onto the surface of food equipment. It is essential that all soil resulting from food residues be removed by thorough cleaning before heat is applied for disinfection.

NOTE 1: Hot water is regarded as water that has a temperature in excess of 75°C, warm water as having a temperature in the range 45 to 60°C and cold water as not exceeding a temperature of 30°C.

NOTE 2: Time and temperature are inversely related where disinfection by the application of heat is concerned.

C.3.2.2 Hot water disinfection is the method commonly used throughout the food industry. Removable parts of machinery and smaller items of equipment can be submerged for a suitable time in a sink or tank that contains water at disinfection temperature, for example, for 2 minutes at 80°C. The disinfectant rinse in mechanical washing machines should reach the specified disinfection temperature and the period of immersion should be sufficient to allow the equipment surfaces to reach this temperature. Water at disinfection temperature will scald

bare hands and therefore basket racks or some other type of receptacle should be used where the process is manual.

C.3.2.3 Where steam is used, the upper layer of the surface to be disinfected shall be raised to a high disinfection temperature for a suitable time. In most cases use is made of wet steam in contrast to superheated steam, which is dry and reaches very high temperatures (>110°C) but is difficult to maintain and necessitates an extensive piping system. Lances producing steam jets are useful to disinfect surfaces of machinery and other surfaces that are difficult to reach or that shall be disinfected in situ. The heating of surfaces during the application of high-temperature steam promotes their subsequent drying. The use of steam can present problems since condensation on other equipment and other parts of the structure might result. High-pressure steam can strip paint from painted surfaces and lubricants from the working parts of machinery. Moreover, some types of materials, such as plastics, are unsuitable for treatment with steam. Steam jets can be dangerous in unskilled hands and should only be used by trained personnel.

C.3.3 Chemical disinfection

The following factors affect the performance of chemical disinfectants:

a) **Inactivation by soiled conditions:** The effectiveness of most chemical disinfectants is reduced by the presence of soil and other soiling matter and, in particular, organic materials. Disinfectants will not be effective at all where there is gross soiling since microorganisms are physically protected by the soil and the disinfectant is chemically neutralised by the organic matter. Disinfection with chemicals shall, therefore, always follow or be combined with a cleaning process.

b) **Temperature of solution:** In general, the higher the temperature, the more effective the disinfection will be. A warm or hot solution of disinfectant is therefore preferable to a cold solution. There are limitations to the temperature that may be used, and the manufacturer's guidance should be followed. iodophors release iodine at temperatures above 43°C, which can result in the staining of materials. When hot solutions of hypochlorite or other chlorine-based disinfectants are used, the corrosive action of chlorine is increased and chlorine rapidly escapes from the solution, resulting in a neutralised disinfectant solution.

c) **Time:** All chemical disinfectants need a minimum contact time to be effective. This time will vary according to the activity of the disinfectant and the temperature during application.

d) **Concentration:** The concentration of the chemical solution that is required will vary according to the conditions of use and should be suitable for the particular purpose and environment in which it is to be used. The solutions should be made up strictly in accordance with the manufacturer's instructions.

e) **Stability:** All disinfectant solutions should be freshly prepared in clean containers. Topping up existing solutions or prolonged keeping of ready-to-use dilute solutions might render the disinfectant solution ineffective or allow it to become a reservoir of resistant organisms. Disinfectants might be inactivated if mixed with detergents or other disinfectants.

C.3.4 Chemicals suitable for disinfection in food premises

Chemical disinfectants that are liable to taint the food, such as phenolics, should not be used in food premises or vehicles. Care should be taken to ensure that chemical disinfectants do not cause harm to personnel and, when used in places where live animals are kept or transported, such as lairages and vehicles, do not cause distress to the animals. Among the disinfectants more commonly used in the food industry are those listed in (a) to (e).

a) **Chlorine and chlorine-based products,** including hypochlorite compounds, if properly used, are the most suitable for food plants

and vehicles. They can be obtained as liquid hypochlorite solutions containing 50 000 to 120 000 mg of available chlorine per gram, or they can be combined with a detergent in a chlorinated crystal form. They can also be specially stabilised for longer storage life. These disinfectants act rapidly against a wide range of microorganisms and are relatively cheap. They are the most suitable for general-purpose disinfection in food premises. These disinfectants should be used at concentrations of 100 to 250 mg of available chlorine per litre. This group of disinfectants is corrosive to metals and also has a bleaching action. Therefore, surfaces disinfected with them should be subjected to a final rinsing as soon as possible, after allowing an adequate contact time. Chlorine disinfectants are readily inactivated by the presence of organic soil.

b) **Iodophors** are always blended with a detergent in an acid medium and they are, therefore, particularly suitable in those circumstances where an acidic cleaner is required. They have a rapid action and a wide range of anti-microbial activity. A solution of about 25 to 50 mg per litre of available iodine at a pH value below 4 is usually required for the disinfection of clean surfaces. Iodophors are readily inactivated by organic matter. They give a visual indication of their effectiveness since they lose their colour when the residual iodine has dropped to ineffective levels. They are not toxic when used in normal concentrations, but might add to the total dietary iodine load. They have little taste or smell, but might combine with substances in the food to cause taint. It is therefore, inadvisable to use iodophors where they might come into contact with food or food contact surfaces. Iodophors might have a corrosive action on metals, depending on the particular formulation of the iodophor and the nature of the surface to which the iodophor is being applied. For these reasons, special care should be taken to rinse iodophors away after use.

c) **Quaternary ammonium compounds** also have some detergent characteristics. They are non-toxic, colourless and are relatively non-corrosive to metal but might have a bitter taste. They are not as effective against Gram-negative bacteria as are chlorine, chlorine-based disinfectants and iodophors. The solutions tend to adhere to surfaces and thorough rinsing is necessary. They should be used at the concentrations recommended by the manufacturer. For normal use, recommended dilutions are between 1:50 and 1:250, depending on the particular product. Higher concentrations are necessary when these compounds are used with hard water. They are not compatible with soaps or anionic detergents.

d) **Amphoteric surfactants** are comparatively new disinfectants that consist of active agents with both detergent and bactericidal properties. They are of low toxicity, are relatively non-corrosive, tasteless and odourless and should be used strictly according to the manufacturer's recommendations to obtain disinfection. They are inactivated by organic matter and are not as effective as chlorine-based disinfectants or quaternary ammonium compounds.

e) **Strong acids and alkalis** have a considerable anti-microbial activity in addition to their detergent properties. Particular care should be taken that they do not contaminate food. After an adequate contact time, all surfaces that have been treated should be rinsed thoroughly with potable water.

NOTE: Acids are extremely corrosive to concrete.

C.3.5 Disposal of disinfectants

The chemicals listed in C.3.4 fall under the hazardous classification, according to the Hazardous Substances Act, 1973 (Act 15 of 1973). As such, they are classified as Class 1 Hazardous Waste, and should be

disposed of in accordance with the guidelines set out in the series, *Minimum requirements for waste* published by the Department of Water Affairs.

C.4 Checks on effectiveness of procedures

C.4.1 The effectiveness of cleaning and disinfection procedures should be verified by microbiological monitoring of the product and food contact surfaces. For monitoring the efficacy of the cleaning of plant, equipment and utensils, use SANS 5763. Similar regular microbiological monitoring of the product at all stages of production will also give information on the effectiveness of cleaning and disinfection procedures as well as the hygienic handling of the product.

C.4.2 When sampling for microbiological monitoring of equipment and food contact surfaces, the use of a quenching (neutralising) agent is required to eliminate any residual disinfectant (see SANS 5763).

C.4.3 The following symbols and surface counts can be used as guidelines to indicate satisfactory cleaning operations when using the swab technique (SANS 5763):

S = satisfactory: 0–15 organisms per 1 000 mm^2.
FS = fairly satisfactory: 16–75 organisms per 1 000 mm^2.
UNS = unsatisfactory: more than 75 organisms per 60 mm^2, or the presence of the undesirable organism indicated.
TNTC = too numerous to count.
X = the presence of the undesirable organism indicated.
– = not detected.

NOTE 1: These counts are for guidance only and could vary in different areas.

NOTE 2: An undesirable organism can be any organism that the management of the establishment regards as detrimental to the facility. In most cases, however, *Escherichia coli* is regarded as the undesirable organism and is used as an indicator of faecal contamination.

IMPORTANT LINKS

HACCP

Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION

Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling