WHITE PAPER

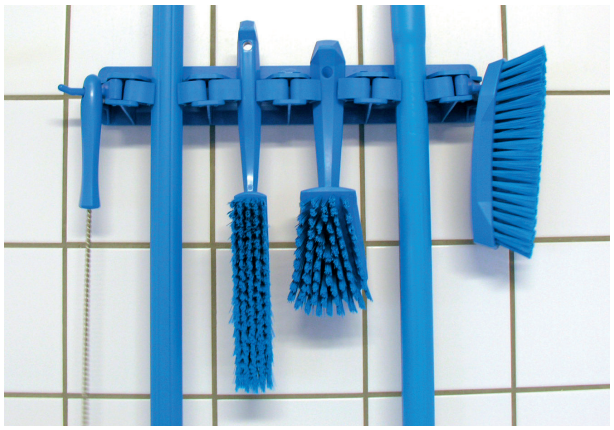
Optimising Food Safety Through Good Cleaning Tool Maintenance

DEBRA SMITH - GLOBAL HYGIENE SPECIALIST,
VIKAN A/S, RÆVEVEJ 1, 7800 SKIVE, DENMARK

KEYWORDS

Cleaning tools;
Equipment maintenance;
Food safety, hygiene and quality;
HACCP prerequisites;
Hygienic design;
Decontamination;
Cross-contamination;
Risk.

Words that are underlined and in italics are defined, in the context of this White Paper, in a Glossary in Appendix 1.



INTRODUCTION

Cleaning is a critical step in the management of food safety and quality. Consequently, the correct maintenance of cleaning tools by the food industry is essential to minimise the risk of microbial, *allergen*, and *foreign body* cross-contamination. This, in turn, aids compliance to relevant regulatory and legal requirements, HACCP prerequisite programs, and audit standards. Additionally, this process can have many other benefits including:

- improving the effectiveness and efficiency of cleaning, thus reducing the downtime required to clean;
- improving food safety, quality and shelf-life;
- reducing waste;
- minimising the risk of product recalls;
- protecting/improving the reputation and income of the food business;
- minimising the risk of prosecution; and
- associated cost reductions.

The importance of good cleaning tools maintenance is recognised by the Global Food Safety Initiative (GFSI) and reflected in their approval of Global food safety schemes, including the British Retail Consortium (BRC); and the Food Safety System Certification (FSSC), which now contain sections specifically related to this.

This White Paper provides useful information and advice on the maintenance of *manual cleaning* tools for use in food processing and service industries, in order to aid compliance with Global food safety schemes and help hygiene staff optimise their cleaning efficacy and equipment control.

CLEANING TOOL MAINTENANCE

What the Global food safety schemes say

BRC Issue 8 (2018)[1]

- Clause 4.11.6 - Cleaning equipment shall be:
  - Hygienically designed and fit for purpose
  - Suitably identified for intended use (e.g. colour coded or labelled)
  - Cleaned and stored in a hygienic manner to prevent contamination
  - Equipment used for cleaning in high-risk and high-care areas should be visually distinctive and dedicated for use in that area.

FSSC 22000

- ISO/TS 22002-1:2009[2] Prerequisite programmes on food safety Part 1: Food manufacturing
  - Clause 8.6 - Preventive and corrective maintenance
    - A preventive maintenance programme shall be in place.
    - The preventive maintenance programme shall include all devices used to monitor and/or control food safety hazards.
  - Clause 11.2 - Cleaning and sanitizing agents and tools:
    - Facilities and equipment shall be maintained in a condition which facilitates wet or dry cleaning and/or sanitation.
    - Cleaning and sanitizing agents and chemicals shall be clearly identified, food grade, stored separately and used only in accordance with the manufacturer's instructions.
    - Tools and equipment shall be of hygienic design and maintained in a condition which does not present a potential source of extraneous matter.
  - Clause 11.3 - Cleaning and sanitizing programmes:
    - Cleaning and sanitizing programmes shall be established and validated by the organization to ensure that all parts of the establishment and equipment are cleaned and/or sanitized to a defined schedule, including the cleaning of cleaning equipment.
    - Cleaning and/or sanitizing programmes shall specify at a minimum:
      a. areas, items of equipment and utensils to be cleaned and/or sanitized;
      b. responsibility for the tasks specified;
      c. cleaning/sanitizing method and frequency;
      d. monitoring and verification arrangements;
      e. post-clean inspections;
      f. pre start-up inspections.
  - Clause 11.5 - Monitoring sanitation effectiveness:
    - Cleaning and sanitation programmes shall be monitored at frequencies specified by the organization to ensure their continuing suitability and effectiveness.

What you need to do to comply

Cleaning tools as a source and vector of contamination

Typically, cleaning tools are used over large surface areas and are therefore capable of collecting (and subsequently spreading) contamination. There may

be an expectation that any contamination collected by the cleaning tool is subsequently removed as part of the cleaning process. However, unpublished data from Campden BRI used to establish guidance on effective microbiological sampling of food processing areas[3] showed that 47 percent of the cleaning tools sampled were positive for *Listeria monocytogenes*. More recently, in 2017. Schäfer[4] determined that: 67% of equipment and utensils used in a poultry processing plant were contaminated with L. mono. even after cleaning. Whether these observations were due to poor hygienic practices or to the poor hygienic design of the cleaning tools (or both) is unknown. Regardless, these observations have given rise to the concept of cleaning tools as major 'collection' points for the isolation of pathogens.

Decontamination of your cleaning tools – general information

To minimise the risk of cleaning tools becoming a source and vector of cross-contamination they must be appropriately cleaned, disinfected, and maintained. With regard to this,

- Cleaning and disinfection methods/protocols should be developed and validated for cleaning tools, as appropriate, based on risk assessment.
- Cleaning and disinfection of cleaning tools should be conducted to an appropriate, defined frequency/schedule, based on risk assessment.
- Documentation and records of these actions should be kept so that they can be used internally and in support of audits and due diligence defence, if required.

The methods and frequencies of cleaning tool *decontamination* will depend on many things, including:

- What is being cleaned, e.g., *environmental or food contact surface*.
- Type of contamination, e.g., *microorganisms*, allergens, foreign bodies, *product residues* (e.g., meat or fish species, organic or non-organic).
- The *risk level of the food* being produced, e.g., *low risk, high care, high risk, ambient stable*.
- *Type of food product/environment*, e.g., *wet, dry*.
- *Type of clean*, e.g., *interim, daily, weekly, periodic deep clean*.
- *Type of consumer*, e.g., *infants, elderly, allergic, health compromised*.

Wet cleaning

In general, food industry cleaning tools used in wet environments are decontaminated at the end of the production day, or more frequently if required, through immersion in warm water containing a *detergent*; by use of a hose (low, medium or high pressure); and/or use of manual cleaning; or by loading it into an onsite cleaning system, like a tray washer. These actions are usually followed by the application of a chemical *disinfectant*, before the equipment is rinsed and hung up or placed in an oven to dry.

During the day, cleaning tools may also be placed in a '*sanitiser bath*.' The sanitisers used in these baths tend to be a combined detergent-disinfectant chemical that is perceived to help remove soiling and disinfect the tools simultaneously. However, the organic soiling on the cleaning tool can quickly reduce the efficacy of the disinfectant component

of the sanitiser, and act as a protective barrier to the microorganisms present. Consequently, if the tools are not (at least) rinsed before immersion in the sanitiser solution, or the sanitiser solution is not changed at an appropriate frequency, the bath can become a 'soup' of food debris and microbes that can actually increase the risk of cross-contamination from the cleaning tool.

More recently, some manufacturers have started to use industrial dishwashers or washing machines to effect both cleaning and a thermal disinfection step into the decontamination process for cleaning tools. A few food manufacturers also use an autoclave to subject the tools to a thermal *sterilisation* step following cleaning.

Dry cleaning

In some dry goods industries cleaning tools are not wet cleaned at all, for fear that the moisture introduced by the cleaning may not be completely removed by drying, subsequently leading to microbial growth and increasing the risk of cross-contamination.

Instead tools, are used until they are deemed 'unfit for purpose' and then thrown away and replaced. In some high risk dry goods environments, like baby formula manufacture, brushes are sometimes used once and thrown away rather than risk the possibility of cross-contamination. This is an expensive and wasteful practice but it has been deemed the best way to ensure food safety for this critical consumer group.

The decision tree shown below provides a generalised overview of the cleaning processes that could be

Generalised cleaning process decision tree

undertaken for cleaning tools used in dry and wet (high and low risk) environments. However, the best way to ensure that an effective decontamination program is developed is to base it on risk assessment.

Developing a decontamination program based on risk assessment

The key to determining an effective decontamination program for cleaning tools is to base it on risk assessment. This requires the determination of risk based on consideration of the *hazards* present, the *likelihood* that they will occur, and the *severity* if they do, followed by the subsequent implementation of appropriate *controls* to reduce the risk to an acceptable level. It is essential that those involved in conducting the risk assessment have the appropriate level of knowledge, experience and access to existing information to enable them to competently identify the hazards, assess the risk and implement the correct controls. Professional cleaning tool, and cleaning chemical manufacturers/suppliers should be able to offer additional, bespoke information and advice on the most appropriate and effective way to clean/use their products in any given food production environment.

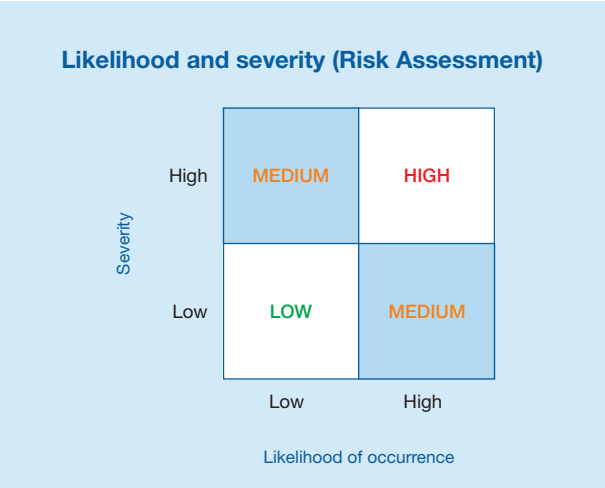
The Hazard Analysis and Critical Control Point (HACCP) system is commonly used in the food industry to identify, evaluate, and control hazards which are significant for food safety. This system can also be applied to the development of a cleaning and disinfection program for control of the hazards associated with cleaning tools in order to minimise risk.

Hazards

Start by identifying any hazards (biological, chemical or physical agents), associated with the cleaning activity, that have the potential to cause harm. Typical hazards, associated with cleaning tools include,

- food debris, including allergens
- plastic (fragments and bristles)
- cleaning chemical residues
- food poisoning and spoilage organism

Likelihood and severity (Risk Assessment)



The risk associated with each hazard is determined by comparing the likelihood of the hazard occurring with the severity if it does. If the likelihood and severity are low then the risk will be low and the hazard may not require control. However, if the likelihood and severity are high then the risk will be high and controls should be considered.

Priority should be given to the control of the high risk scenarios identified.

Assessment of likelihood and severity will be based on knowledge, experience and any existing information available.

Controls

Controls are any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Examples

The following are examples of how to use the risk assessment process to determine appropriate methods (controls) to minimise the food safety risks from cleaning brushes used in dry goods environments.

Although both examples focus on brushes and dry goods, the methods (controls) required to ensure food safety in each example are significantly different.

Cleaning challenge 1.

To clean a soft bristled broom that is used for sweeping loose flour from the floor of a bakery in a dough preparation area.

- Hazards
  1. **Dust** generation - spread of contamination through movement of particles
  2. **Foreign bodies** - bristle loss
  3. **Pest infestation** – of the brush
  4. **Microbial** survival and growth – in the brush

- Likelihood and severity
  1. Dust generation while using and cleaning the brush (if it is dry cleaned) is likely. Flour particles are already present throughout the production area and pose no specific food safety risk. Other particles picked up by the brush from the floor may be contaminated by microorganisms which could spread via the air to food products or food contact surfaces. Risk Assessment = MEDIUM. Controls should be considered.
  2. Loose or damaged bristles from the brush may occur but they will be removed during cleaning and present no specific food safety risk (more of a food quality issue). The brush is used for floor cleaning so any bristles lost are unlikely to find their way into food products. Risk Assessment = LOW. Controls not necessary.
  3. If the brush is not cleaned at an appropriate frequency food debris could build up within the bristles and result in pest (beetle, moth) infestation. These pests could subsequently contaminate food products (foreign body and microbial hazards). Risk assessment = HIGH. Controls required.
  4. If the brush is not cleaned appropriately microorganisms from the environment/flour could survive and grow and turn the brush into a source and vector of contamination. Risk assessment = HIGH. Controls required.

- Controls
  1a. Clean the floor out of production, i.e. when no open food product is present.
  1b. Allow time for any dust generated by floor cleaning to settle before cleaning food production surfaces.
  1c. Clean the brush in an area that is remote from open product and food production surfaces, ideally in a separate, enclosed cleaning area.
  2. Minimise the risk of bristle loss through regular inspection and replacement of brushware and the use of well constructed, durable brush products.
  3. Inspect the brush regularly for signs of product buildup and pest infestation. Clean or replace the brush at a frequency that minimises these hazards.
  4. Wet cleaning of the brush may increase the risk of microbial growth and spread due to trapped water. Dry clean or replace the brush at a frequency that minimises contamination buildup, or use a brush of good hygienic design that can be wet cleaned easily and dried thoroughly.

Cleaning challenge 2.

To clean a medium bristled hand brush that is used for sweeping loose peanuts from a product contact conveyor belt in confectionary production.

- Hazards
  1. **Dust** generation - spread of contamination through movement of particles
  2. **Peanut** residues – in/on the brush
  3. **Foreign bodies** - bristle loss

4. **Pest** infestation – of the brush
5. **Microbial** survival and growth – in the brush

- Likelihood and severity
  1. Dust generation while using and cleaning the brush (if it is dry cleaned) is likely. Peanut is an allergen which can cause anaphylaxis and, in severe cases, death. Peanut particle spread to other non-peanut products or product contact surfaces could pose a serious food safety risk. Risk Assessment = HIGH. Controls required.
  2. As an allergen, any peanut residues in the brush that cross-contaminate to non-peanut products or products contact surfaces could pose a serious food safety risk. Risk Assessment = HIGH. Controls required.
  3a. Loose or damaged bristles from the brush may occur. The brush is used for food contact surface cleaning, so any bristles lost may pose a risk to food quality. Risk Assessment = MEDIUM. Controls should be considered.
  3b. Loose brush bristles may be contaminated with peanut residues which may cross-contaminate to non-peanut foods especially if the same production line is used for both. Risk Assessment = HIGH. Controls required.
  4. If the brush is not cleaned at an appropriate frequency food debris could build up within the bristles and result in pest (beetle, moth) infestation. These pests could subsequently contaminate food products (foreign body and microbial hazards). Risk assessment = HIGH. Controls required.
  5. If the brush is not cleaned appropriately microorganisms from the environment/ product could survive and grow and turn the brush into a source and vector of contamination. Risk assessment = HIGH. Controls required.

- Controls
  1a. Clean the peanut line out of production, i.e. when no open non-peanut product is present.
  1b. Allow time for any dust generated by cleaning of the peanut line to settle before cleaning non-peanut line production surfaces.
  1c. Clean the brush in an area that is remote from open product and food production surfaces, ideally in a separate, enclosed, peanut only cleaning area.
  2. Use separate, colour-coded brushes for peanut product line cleaning.
  3. Minimise the risk of bristle loss through regular inspection and replacement of brushware and the use of well constructed, durable brush products.
  4. Inspect the brush regularly for signs of product buildup and pest infestation. Clean or replace the brush at a frequency that minimises these hazards.
  5. Wet cleaning of the brush may increase the risk of microbial growth and spread due to trapped water. Dry clean or replace the brush at a frequency that minimises contamination buildup, or use a brush of good hygienic design that can be wet cleaned easily and dried thoroughly.

Validation, Monitoring, and Verification of cleaning tool decontamination

There is a requirement within ISO/TS 22002-1:2009' to *validate*, *monitor* and *verify* cleaning tool decontamination.

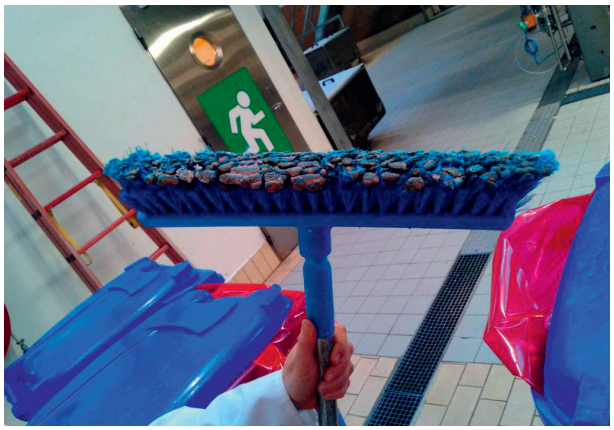
- **Clause 11.3** - Cleaning and sanitizing programmes:
  - Cleaning and sanitizing programmes shall be established and validated by the organization to ensure that all parts of the establishment and equipment are cleaned and/or sanitized to a defined schedule, including the cleaning

of cleaning equipment.
- Cleaning and/or sanitizing programmes shall specify at a minimum:
  a. areas, items of equipment and utensils to be cleaned and/or sanitized;
  b. responsibility for the tasks specified;
  c. cleaning/sanitizing method and frequency;
  d. monitoring and verification arrangements;
  e. post-clean inspections;
  f. pre start-up inspections.

- Clause 11.5 - Monitoring sanitation effectiveness:
  - Cleaning and sanitation programmes shall be monitored at frequencies specified by the organization to ensure their continuing suitability and effectiveness.

Validation

Validation, in the context of this White Paper, is the development of a consistently effective and appropriate method of cleaning tool decontamination. Different methods may need to be developed for different types of cleaning tool or for the same type of cleaning tool used for different tasks. The method development may require a degree of trial and error to ultimately determine a consistently effective method that achieves the level of decontamination required.



In compliance with ISO/TS 22002-1:2009 each different method should detail the,

- items of cleaning equipment (types and usage) that the method is suitable for;
- cleaning and disinfection chemicals to be used (water; detergent and disinfectant, including supplier, name, and product code). The temperature, concentration and contact time of the chemicals used should also be provided;
- decontamination equipment to be used, e.g., brush, tray washer;
- decontamination method/actions, e.g., scrubbing, rinsing;
- decontamination frequency, e.g., daily, weekly;
- level of decontamination required and how this should be measured and recorded.

Monitoring

Monitoring, in the context of this White Paper, is the use of methods that determine whether the validated cleaning methods have been conducted effectively, in a time frame that allows for rapid detection and correction of any shortfall in the decontamination achieved. Should shortfalls be identified, the decontamination procedure can be repeated immediately until the desired level is achieved.

Examples of monitoring methods include the use of,

- Visual inspection.
- Adenosine Tri-Phosphate (ATP) rapid detection sampling swabs.
- Protein rapid detection sampling swabs.
- Allergen rapid detection sampling devices.

Verification

Verification, in the context of this White Paper, is the use of methods, in addition to monitoring, which determine whether the validated cleaning methods have been conducted effectively and/or are still effective.

These tend to involve sample analysis where the results can take longer (days) to obtain, and the review of monitoring data (trend analysis).

Examples of verification methods include the use of,

- Periodic review of visual inspection check/sign off sheets.
- Periodic review of ATP, protein, allergen swab test results.
- Microbial sampling and analysis.

Should individual monitoring and verification results, and/or a review of past results indicate an acute or chronic hygiene issues it should prompt the implementation of *corrective actions*. These could include a review of the validated decontamination method, and the monitoring and verification sampling methods.

Records of method validation, monitoring, and verification, and of the results, reviews and corrective actions taken should be kept for auditing/due diligence purposes.

Cleaning tool preventative maintenance – inspection and replacement

Both BRC and FSSC 22000 require cleaning tools to be maintained through appropriate decontamination, inspection, replacement and storage.

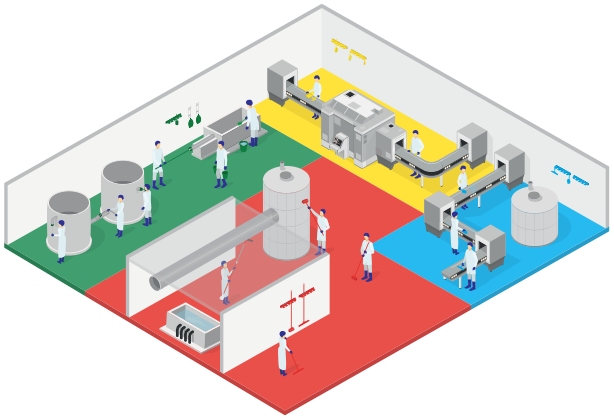
Cleaning tools should be regularly (to a defined schedule, as part of the cleaning and disinfection program) inspected for damage and ware, and replaced as appropriate, based on risk assessment. It is recommended that descriptions/images of what is acceptable and what is not, and records of tool inspection and replacement be kept for auditing/due diligence purposes.

Do not make poor quality repairs to damaged equipment as this can increase the safety risk to the food product.

Cleaning tool storage

Storage of cleaning tools can help minimise damage to the equipment and cross-contamination. It also improves efficiency by providing a place for the tools to be stored and quickly found when needed.

Use of colour-coded cleaning tool storage systems and colour zoning plans can provide a visual check that only tools colour-coded for use in that area are used. It also aids compliance with HACCP prerequisite programs with regard to allergen and microbial control, and provides auditors with evidence of equipment control. Some cleaning tool manufacturers can help develop appropriate colour zoning plans.



Cleaning tools can either be stored on colour-coded wall racks or on shadow boards, which can provide a quick visual check as to whether something is missing from a cleaning station. Shadow boards can also be colour-coded so that they provide a visual check that the right-coloured tools are being used and stored in the right area.

To minimise the risk of cross-contamination brushes, squeegees, scrapers etc.. on racks and shadow boards should be stored:

- Head down
- With heads distant from other equipment handles
- In a single row so that equipment above does not drip onto equipment below
- On racks and shadow boards that are regularly cleaned and disinfected, as appropriate.

Racks and shadow boards should be either freestanding; mounted at a distance from the wall that allows the wall and the back of the rack

board to be cleaned; or secured to the wall by an easy attach/detach mechanism that makes them easy to remove and clean behind.

Shadow boards should be made of waterproof/non-absorbent material. Ideally, both the board and the printing inks used for the shadows should be food-safe approved and appropriately temperature and cleaning chemical-resistant.

The use of coloured stickers should be avoided as they can peel and flake (creating a foreign body issue) or bubble and crack (creating a crevice for contamination to accumulate in).

Note:

This White Paper focuses on the maintenance of cleaning tools. However, the selection of appropriate cleaning tools is equally as important from an audit compliance and maintenance point of view. Further advice on how to select cleaning tools that are fit for purpose with regard to being hygienically designed; food grade; and colour-coded/visually distinctive can be found in Appendix 2 – Further information and advice.

Author: Deb Smith,
Global Hygiene Specialist, Vikan

APPENDIX 1 - GLOSSARY

Definitions, in the context of this White Paper.

- *Cleaning*
  - The removal of debris (including allergens) as appropriate from surfaces and equipment.

- *Cleaning type*
  - Manual cleaning
    - Cleaning is done by a person without the use of mechanised cleaning equipment (e.g., vacuum cleaners or foam-washer equipment). Manual cleaning usually takes more time and requires the application of friction to the surface being cleaned.
  - Interim clean
    - Removal of gross food debris through brushing, wiping, scraping and rinsing. The purpose of this type of clean is usually to remove gross food debris when changing from one similar product to another so as to prevent cross-contamination of the second product with the first, e.g. white pasta with green pasta; mixed salad leaves with single salad leaf; dry snack flavor change. It can also be conducted at shift change over time, even if there is no change in product type, in order to remove food buildup and allow efficient continued production.
      It is generally a quality clean, not a safety clean, i.e. it is not designed to remove pathogens or allergens, however more stringent cleaning is required to prevent cross-contamination of products where, for example, meat residues from different species could be of concern, or prevent meat residues from cross-contaminating vegetarian products. These are also quality issues but in this case cross-contamination from one product to another could have a religious, ethical or legal impact.
  - Daily clean
    - Usually conducted at the end of the production day. This is a full clean involving removal of gross food debris and, as appropriate, rinse, clean, rinse, disinfect, rinse, dry, verify. This type of clean is designed to remove product debris and, as appropriate, microbial and allergen safety hazards.
  - Weekly clean
    - As above but, as determined through risk assessment, conducted less frequently.
      or
    - Involving partial equipment strip down and more in depth cleaning than a daily clean.
  - Periodic deep clean
    - Usually involves a factory shut down with full equipment strip down, check and maintenance (foreign body control), and deep clean to remove longer term product build up, and, as appropriate, microbial and allergen safety hazards.

- *Consumer type*
  - Infants - A very young child or baby (generally less than 1 year old).
  - Child - A young human being below the age of puberty (generally under the age of 14 years).
  - Elderly - Generally an adult over the age of 65 years.
  - Allergic - An individual who experiences an adverse reaction when exposed to an allergen (see above).
  - Health compromised - An individual with a physical impairment or disease that makes them more susceptible to food borne hazards.

- *Corrective actions*
  - The specific actions be taken to re-gain control (eliminate the cause of non-conformities) when the results of monitoring or verification identify that something is

not in control (according to the defined specification).

- *Decontamination (Sanitisation)*
  - The cleaning and, as appropriate, the disinfection or sterilisation of surfaces and equipment.

- *Detergent*
  - A group of synthetic, organic, liquid or water-soluble cleaning agents that combine with impurities and dirt to make them more soluble. Unlike soap they are not prepared from fats and oils, are not inactivated by hard water, and have wetting-agent and emulsifying-agent properties.

- *Disinfectant*
  - A chemical that kills or deactivates most viable microbes. Most effective against vegetative bacteria, some fungi and viruses are more resistant. Generally not effective against bacterial spores.

- *Disinfection*
  - The process of killing or deactivating microbes, especially with a chemical, to an acceptable level.

- *Hazard*
  - Microorganisms
    - Bacteria, viruses or fungi capable of causing food spoilage or food borne disease.
  - Allergens
    - A food substance that can cause an allergic reaction. Currently in the UK the following are identified as food allergens. Other countries lists vary.
      - Cereals containing gluten, namely: wheat (such as spelt and Khorasan wheat), rye, barley, oats
      - Crustaceans for example prawns, crabs, lobster, crayfish
      - Eggs
      - Fish
      - Peanuts
      - Soybeans
      - Milk
      - Nuts; namely almonds, hazelnuts, walnuts, cashews, pecan nuts, Brazil nuts, pistachio nuts, macadamia (or Queensland) nuts
      - Celery (including celeriac)
      - Mustard
      - Sesame
      - Sulphur dioxide/sulphites, where added and at a level above 10mg/kg in the finished product. This can be used as a preservative in dried fruit
      - Lupin which includes lupin seeds and flour and can be found in types of bread, pastries and pasta
      - Molluscs like clams, mussels, whelks, oysters, snails and squid.
  - Foreign bodies
    - Any extraneous matter, whether of physical, chemical or biological nature, found in food that usually renders it unfit for human consumption. Legally the term refers to all contamination of a non-microbial source, including human hair, parts of insects, paper, paint, glass and cleaning fluids. It also includes particles of the wrong food, e.g. a butter bean in a tin of peas.
  - Product residues
    - Remnants of one type of food that could cross-contaminate to another.

- *Monitoring*
  - The use of methods that determine whether the validated cleaning methods have been conducted effectively, in a time frame that allows for rapid detection and correction of any shortfall in the decontamination

achieved. Should shortfalls be identified, the decontamination procedure can be repeated immediately until the desired level is achieved.
  - Examples of monitoring methods include the use of,
    - Visual inspection
    - Adenosine Tri-Phosphate (ATP) rapid detection sampling swabs
    - Protein rapid detection sampling swabs
    - Allergen rapid detection sampling devices

- *Product risk category*
  - Low risk and ambient stable
    - An area in which low-risk or ambient stable foods are produced. Low risk and ambient stable foods are unlikely to be implicated in food poisoning, generally have a low Water Activity (a_w) and include:
      - foods that have been preserved, e.g. smoked or salted fish
      - dry goods, those that contain minimal amounts of moisture, e.g. bread, flour, biscuits
      - acidic foods, e.g. pickled foods, vinegar, fruit
      - fermented products, e.g. salami, pepperoni
      - foods with high sugar/fat content e.g. jam & chocolate
      - tinned food, whilst unopened.
  - High risk or high care
    - An area in which high risk or high care foods are produced. High risk and high care foods can be defined as "any ready-to-eat food that will support the growth of pathogenic bacteria easily and does not require further heat treatment or cooking". These types of foods are more likely to be implicated in food poisoning incidents. Such foods usually have a high a_w, are usually high in protein, require strict temperature control and protection from contamination, e.g.,
      - cooked meat and poultry, e.g. beef, pork, ham, lamb, chicken, turkey, duck.
      - cooked meat products such as; meat pies and pasties, pate, meat stock and gravy, cook-chill meals.
      - dairy produce such as; milk, cream, artificial cream, custards, products containing unpasteurised milk, ripened soft and moulded cheeses.
      - egg products such as; cooked eggs, quiche and products containing uncooked or lightly cooked eggs, e.g. mayonnaise, mousse, home-made ice cream.
      - shellfish and other sea-foods, e.g. mussels, cockles, cooked prawns, raw oysters
      - Farinaceous dishes including cooked rice, pasta, couscous.

- *Sanitiser*
  - UK – a term sometimes used to describe a combine detergent-disinfectant cleaning chemical.
  - US - Type of antimicrobial that (according to EPA specifications) kills or irreversibly inactivates at least 99.9 percent of all bacteria, fungi, and viruses present on a surface.

- *Sterilisation*
  - Any process that kills or deactivates all microbial agents (including fungi, bacteria, viruses, spore forms, prions, unicellular eukaryotic organisms such as Plasmodium, etc.) present on a surface. Sterilisation can be achieved through heat, chemicals, irradiation, high pressure, and filtration. Sterilisation is distinct from disinfection and sanitisation in that it kills or deactivates all microbial agents present. One standard sterilisation procedure involves the use of an autoclave that generates pressurised (15 psi) saturated steam at 121℃ for 15 minutes.

- *Surface type*
  - Food contact surface
    - Any surface in direct contact with food, or any surface in the immediate vicinity (above, below, alongside) from which contamination could reasonably be expected to cross-contaminate to open food or food contact surfaces.
  - Environmental surface
    - All other surfaces within the production environment.

- *Type of food product/environment*
  - Wet
    - Foods that have a *water activity* (a_w) greater than 0.9.
    - Environments that require cleaning with significant quantities of water.
  - Dry
    - Foods that have an a_w of less than 0.9.
    - Environments that are cleaned with minimal or no water.

- *Validation*
  - The development of a consistently effective and appropriate method of cleaning tool decontamination (see main text for more detailed explanation).

- *Verification*
  - The use of methods, in addition to monitoring, which determine whether the validated cleaning methods have been conducted effectively and/or are still effective.
    - Examples of verification methods include the use of,
      - Periodic review of visual inspection check/sign off sheets
      - Periodic review of ATP, protein, allergen swab test results
      - Microbial sampling and analysis

- *Water activity, a_w (in food)*
  - Water activity or a_w is the partial vapour pressure of water in a substance divided by the standard state partial vapour pressure of water. In the field of food science, the standard state is most often defined as the partial vapour pressure of pure water at the same temperature. Water in food which is not bound to food molecules can support the growth of bacteria, yeasts and moulds (fungi). The term water activity (a_w) refers to this unbound water.
- The water
  - The water activity of a food is not the same thing as its moisture content. Although moist foods are likely to have greater water activity than dry foods, this is not always so; in fact a variety of foods may have exactly the same moisture content and yet have quite different water activities.
  - Measuring water activity (a_w)
    - The water activity scale extends from 0 (dry) to 1.0 (pure water). Most foods have a water activity in the range of 0.2 for very dry foods to 0.99 for moist fresh foods. Water activity is usually measured as equilibrium relative humidity (ERH).

Typical a_w of some foodstuffs

Type of Product	Water Activity (a_w)
Fresh meat and fish	0.99
Bread	0.95
Aged Cheddar Cheese	0.85
Jams and jellies	0.80
Plum pudding	0.80
Dried Fruit	0.60
Biscuits	0.30
Milk powder	0.20
Instant coffee	0.20

- The water activity (a_w) represents the ratio of the water vapor pressure of the food, to the water vapor pressure of pure water, under the same conditions, and it is expressed as a fraction. This ratio is multiplied by 100, to obtain the equilibrium relative humidity (ERH) that the foodstuff would produce if enclosed with air in a sealed container at constant temperature. Thus a food with an a_w of 0.7 would produce an ERH of 70%.

APPENDIX 2

Further information and advice

Selection of cleaning tools that are fit for purpose with regard to,

- *Hygienic design*
  Please refer to 'Decontamination of food industry cleaning brushware – a matter of hygienic design[5]' and 'The Hygienic Design of Food Industry Brushware - the good, the bad and the ugly[6]'. These publications are available to download from the Vikan Knowledge Centre on our web site https://www.vikan.com/uk/knowledge-centre/download-centre/

- *Food grade*
  Please refer to Vikan Food Safety Information 'Are your cleaning tools food safe and compliant with legislation?[7]'

- *Colour-coded/visually distinctive*
  Please refer to Vikan White Paper 'Guidance on the use of colour coding to improve food safety and quality[8]'.

The European Hygienic Engineering Design Group (EHEDG)

Founded in 1989, the EHEDG is a consortium of equipment manufacturers, food industries, research institutes, as well as public health authorities. EHEDG are based in Germany, Europe, but have a presence in over 55 countries Worldwide. The principal aim of EHEDG is to promote the production of safe food by improving hygienic engineering and design in all aspects of food manufacture. The EHEDG actively supports European legislation, which requires that handling, preparation, processing, and packaging of food is done hygienically using hygienic machinery and in hygienic premises.

EHEDG Guideline Document No. 8. Hygienic equipment design criteria[9].' Is a particularly useful publication which outlines the principles of hygienic design. It is available as a free download, in numerous languages, from the EHEDG website.
www.ehedg.org

3-A SSI

In the USA the first standards for the hygienic design of equipment used in the dairy industry were introduced in the 1920s. These standards became known as '3-A standards' for the three 'associations' or interest groups that cooperated to improve equipment design and sanitation - regulatory sanitarians, equipment fabricators, and processors.

Today, 3-A SSI is a US based, independent corporation dedicated to advancing hygienic equipment design for the food, beverage, and pharmaceutical industries through education.
www.3-a.org

What 3-A SSI does:

- Leads the development of standards for equipment and accepted practices for processing systems through a modern consensus process based on ANSI requirements.
- Represents the interests of regulatory sanitarians, equipment fabricators, and processors in 'Promoting Food Safety Through Hygienic Design'.
- Administers the Third Party Verification (TPV) inspection programs required for the 3-A Symbol Authorization, 3-A Process Certificate, and Replacement Parts & System Component Qualification Certificate to help ensure conformance to standards and accepted practices for equipment design and performance.
- Provides special 'knowledge resources' on hygienic equipment design to enhance professionalism and to serve the public health.

ISSA—The International Sanitary Supply Association

ISSA is a Worldwide Cleaning Industry Association with over 90 years of experience and more than 7,000 distributor, manufacturer, manufacturer representative, building service contractor, in-house service provider, and associated service members. It cultivates alliances with local, regional, and national associations as well as industry, government, and other leading corporate and community entities around the world. The organization's vision is to be the leading resource for information, education, networking, and commercial opportunities for firms within the cleaning industry worldwide.

ISSA also offers educational products, industry standards, publications, and legislative and regulatory services that specifically focus on the professional cleaning industry.

The association is headquartered in Northbrook, IL, USA, with regional offices in Petersham, Australia; Mainz, Germany; and Shanghai, China.
www.ISSA.com

NSF international

Founded in 1944 NSF International (formerly the National Sanitation Foundation) develop public health standards and certification programs that help protect the world's food, water, consumer products and environment. Their mission is to protect and improve global human health. As an independent, accredited organization, NSF develop standards, and test and certify products and systems. They also provide auditing, education and risk management solutions for public health and the environment.
www.nsf.org

REFERENCES:

1. British Retail Consortium. (2018). Global Standard Food Safety, Issue 8. August 2018.
2. International Standards Organisation. (2009). ISO/TS 22002-1:2009. Prerequisite programmes on food safety, part 1: food manufacturing (last reviewed in 2016).
3. Holah, J.T. (1998). Effective microbiological sampling of food processing areas. Guideline No. 20, Campden & Chorleywood Food Research Association.
4. Schäfer, D., Steffens, J., Barbosa, J., Jamile Z., Rogério L. C.(2017). Monitoring of contamination sources of Listeria monocytogenes in a poultry slaughterhouse. LWT - Food Science & Technology. Dec 2017, Vol. 86, p. 393-398.
5. Smith, D.L. (2015). Decontamination of food industry cleaning brushware – a matter of hygienic design. New Food, Vol 18, Issue 3.
6. Smith, D.L. (2015). The hygienic design of food industry brushware - the good, the bad and the ugly. Journal of Hygienic Engineering and Design, Vol. 12, pp. 8-17.
7. Smith, D.L. (2015). Are your cleaning tools food safe and compliant with legislation? International Food Hygiene, 26:4, 9-10.
8. Smith, D.L. (2013). Guidance on the use of colour-coding to improve food safety and quality. Vikan White Paper.
9. European Hygienic Engineering & Design Group. (2018). EHEDG Guideline Document No. 8. Hygienic equipment design criteria, 3rd Edi. Frankfurt, Germany.