SAFE MAINTENANCE – FOOD AND DRINK MANUFACTURING

About maintenance – what is maintenance?

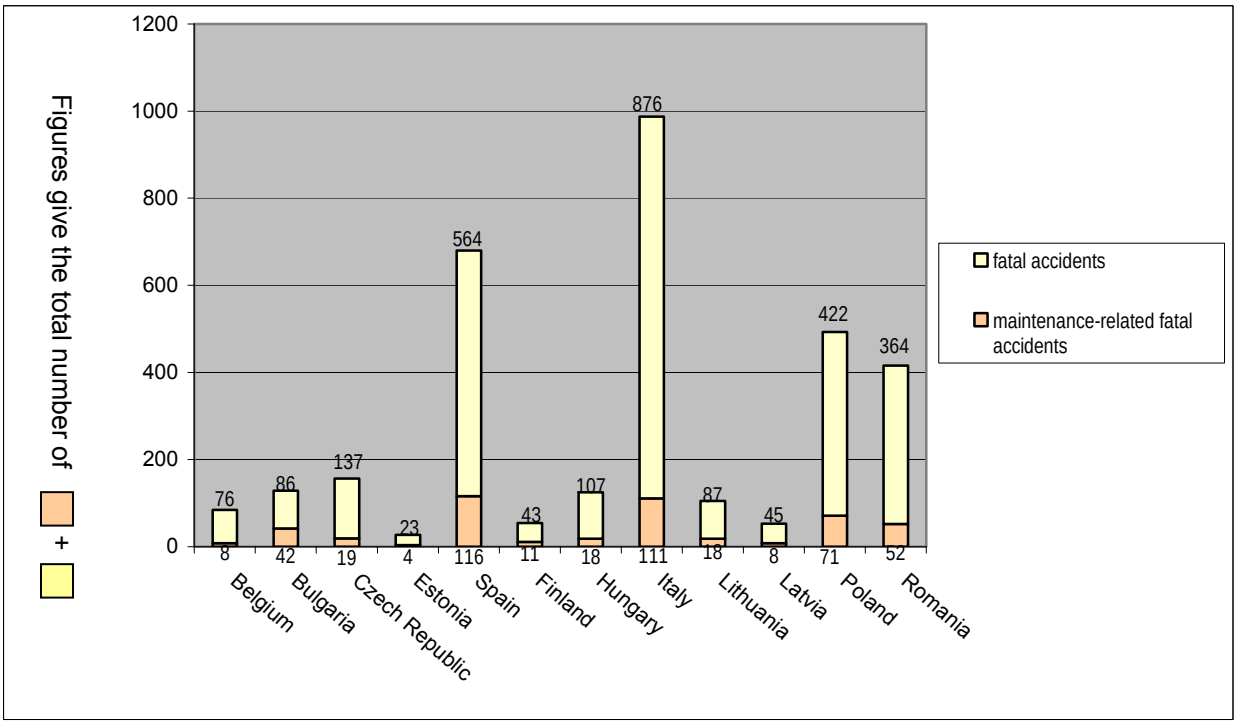
Maintenance is one of the workplace activities that can affect health and safety not only of the workers directly involved, but also of other workers if safe procedures are not followed and the work is not done properly.

Maintenance activities include replacement of parts, testing, measurement, repair, adjustment, inspection and fault detection among other procedures.

Industrial maintenance operations involve specific safety risks for maintenance workers. Such risks arise, for example, from the need to work in close proximity to machinery and processes, the execution of tasks during various times of the day and the infrequency of certain tasks.

The figures in Eurostat from several European countries indicate that in 2006 around 10-15% of all fatal accidents were related to maintenance operations (see Figure 1). Scientific studies indicate that occupational diseases and work-related health problems (such as asbestosis, cancer, hearing problems and musculoskeletal disorders) are also more prevalent among workers involved in maintenance activities.

Figure1. Number of fatal accidents related to maintenance operations



Source: Eurostat, 2006

Maintenance operations can be considered as involving the same risk factors as other operations in industrial working environments, but they also increase certain specific risks. Such maintenance-related risk factors (e.g. working alone or at night) are more likely to arise from the need to make urgent repairs and rectify malfunctions. Other typical risk factors include the frequency of tasks, untidiness and disorder in the working environment, as well as defects in equipment and tools. These factors can also increase the risk of human error although they are often seen as contributing to the probability of any occupational accident.

Introduction

Food and drink manufacturing comprises many different industries. It ranges from fruit and vegetable processing, bakeries, grain milling or dairy processing to sugar refineries and slaughterhouses. The beverage manufacturing includes beer, wine and spirits production as well as soft drinks and mineral water.

Although food and beverages are processed in a strictly controlled environment to ensure a high standard of hygienic and safe food production, it is not at all a 'low risk' sector in terms of the safety and health of workers. Food processing operations can be very hazardous!

According to HSE the food and beverage industry accounted for 23.9% of all manufacturing injuries in 2006/2007. The food and beverage industry has one of the highest injury rates in the manufacturing sector.[1,2]

Analysis of injuries investigated by HSE in this industry highlighted the main causes of injuries.[3] The most common accidents are caused by machinery and plant, with more than 500 accidents reported each year in which conveyors account for 30%, fork lift trucks for 12% and band saws for 5% of the accidents.[4] 66% of accidents caused by machinery in the biscuit manufacturing industry occurred during cleaning and maintenance.[5]

Maintenance (of machinery and plant) in the food manufacturing industry is of importance to ensure

- a safe and healthy working environment
- healthy and hygienic food production.

Picture 1: Maintenance in food manufacturing

Source BGN

The food manufacturing sector is under pressure to increase its processing efficiency, as well as to meet the demands of the consumers for more diversified products. The majority of plants (57%) have reported

that they run two or three different products per line and per day.[6] This requires quick clean-up between runs and poses a big challenge for maintenance. In addition factories often cannot afford to stop their production for long periods so that workers involved in maintenance have to work at weekends or at night. Demands on maintenance in food industry are: cost efficiency, minimum impact on the production, and no negative impact on the cleanliness or quality of the foods being manufactured.[7]

Hazards and preventive measures

The food manufacturing industry employs many different types of workers and the hazards in food manufacturing vary between the different food and beverage industries. But some hazards are common for the whole industry.

- **Hazardous substances**

During the cleaning or maintenance of production machinery, workers may be exposed to **hazardous substances** such as disinfectants and lubricants (hot and cold fluids), and ammonia in refrigeration systems.

Lubricants, greases, oils and hydraulic fluids are needed to protect machinery and moving parts against wear and corrosion and to prevent high temperatures caused by friction. Lubricants may pose a health risk to workers involved in maintenance tasks. They can provoke allergic reactions such as dermatitis or breathing problems.

Chemical food safety can also be affected by poor maintenance: e.g. contamination of food products with cleaner or sanitiser residue, contamination by maintenance tools, rusted metal containers, equipment or utensils or by foreign objects like glass or metal.[8]

Preventive measures:

Dangerous substances should be replaced with less dangerous substances if possible. Maintenance workers must be trained and informed about the chemicals they are working with. Appropriate protective equipment must be available. Use of e.g. disinfectants and lubricants (cooling fluids) or cleaning agents (e.g. caustic soda, nitric acid) may cause eye injuries and requires eye protection. Emergency procedures should be in place.

- **Biological agents**

Maintenance workers in the food manufacturing industry are likely to be exposed to **biological agents** such as:

- Salmonella bacteria. These can occur in slaughtering or meat processing applications, in dairies, fish and seafood processing plants or in places where vegetables that were grown using organic fertilisers are handled.
- Hepatitis A virus is a potential hazard in places where mussels, oysters, shell-fish or salads that are produced using organic fertilisers are handled.9
- The microbiological safety hazards include pathogenic bacteria, viruses and parasites.

Workers involved in maintenance may also come into contact with wastewater. Wastewater released from the food manufacturing industry contains among other substances organic matter such as starch, sugars and proteins, fats, oils, grease, and usually nutrients such as nitrogen (including ammonia) and phosphate. It can also contain biological agents, acids and lye, disinfectants and other chemicals.

Preventive measures:

Good manufacturing practices, effective hygiene practices as well as accurate maintenance can ensure microbiological food safety and the workers' health and safety, for example proper employee hygiene, adequate training, and effective cleaning and sanitising of the manufacturing equipment and environment.[10] Training and information about biological hazards, appropriate personal protective equipment and vaccination and medical checks should be provided.

- **Dust**

In the food and beverage manufacturing explosions and fires can arise because of **flammable dust** and can have devastating and irreversible effects. Dust from flour, grain, custard powder, instant coffee, sugar, dried milk, potato powder and soup powder are examples of highly combustible dusts.[11] A suitable ignition source, e.g. an electrical spark which may occur when pulling a plug out of a socket or a hot surface (e.g. 300°C to 600°C) may cause an explosion.

Preventive measures:

The risk of dust explosion can be eliminated or minimised by following measures:

- as potential sources of ignition, all electrical equipment installed in these areas need to be adequately protected and designed to operate under these conditions
- Cleaning and maintenance intervals of equipment with a dust explosion risk have to be scheduled so that no dust layers thicker than 5 mm can form. At higher dust deposits, the minimum ignition (glow) temperature of the dust is reduced significantly.
- Explosion proof electrical installations, lights, switches, plugs, sockets should be used in high risk areas.
- A permit-to-work system should be used to control hot work, welding etc.

Dust can also cause **respiratory problems** such as occupational asthma as well as irritations of eyes, nose and skin (occupational dermatitis).

Preventive measures:

Exposure to dust can be controlled through

- appropriate equipment design
- keeping production equipment in effective and efficient working order
- installation of exhaust ventilation at the source to reduce dust
- regular checking, testing and maintenance of extraction systems
- appropriate respiratory protective equipment when cleaning and maintaining extraction systems12

- **Machinery related accidents**

Workers may be injured at machinery as a result of insufficient or bad maintenance or while maintaining machines. Typical **accidents with machinery** include:

- Being hit or getting caught by moving parts of a machine
- Getting trapped between moving parts of a machine
- Being hit by material or parts which have been thrown out of the machine.

Workers performing maintenance on a machine can be injured if the machine is accidentally switched on. They are especially at risk if safety guards are removed or if they are working under time pressure (taking short cuts).

Crushed in machine: an engineer suffered fatal injuries when working within the danger area on a palletising machine. The machine started up unexpectedly.[13]

A worker became trapped at a sugar confectionery plant when clearing a blockage in a sweet-making machine.[14]

Preventive measures:

The best prevention is to address hazards at the design stage of machinery and plants. If risks cannot be eliminated, safe systems of work should be in place and followed, including lockout procedures and permit-to-work systems.

- **Confined spaces**

Maintenance workers in the food and drink industry may need to enter confined spaces such as storage tanks, vats, fermentation vessels, grape presses and crushers and similar equipment to carry out maintenance, inspection, cleaning and repair. Working in confined space can be very dangerous: Dangers can arise because of lack of oxygen,[15] toxic gases, liquids and solids that can suddenly fill the space (engulfment) as well as dust (e.g. flour silos) and hot or cold conditions.[16] Poor visibility increases the risk of accidents in confined spaces.

Preventive measures:

In the first place, entry to confined spaces should be avoided, e.g. by doing the work from outside; if entry to a confined space is unavoidable, a safe system of work should be followed and adequate emergency arrangements should be put in place before the work starts.

Workers must be trained and informed about the hazards of confined spaces. The air must be tested before entering. Enough time must be planned to allow spaces to cool down or warm up. Adequate equipment, such as

- personal protective equipment, e.g. respirators
- lighting (approved to explosive atmospheres)17 and
- communications gear must be provided.

Good design, including design of openings, covers and fasteners, can improve diagnosis and accessibility for maintenance operations.

- **Slips, trips and falls**

Slips, trips and falls are the main causes of accidents in the food and beverage industry. Slip injuries in particular happen more often in this industry than in most other industries, mostly due to wet or contaminated and greasy floors (e.g. with food).[18]

Preventive measures:

Preventing spillages through equipment design and adequate maintenance,. keeping walking and working surfaces clean and dry, and providing workers with anti slip footwear where still necessary are key issues to prevent slips, trips and falls.

- **Physically demanding work**

Maintenance in food and beverage manufacturing may involve physically demanding work. Worker involved in maintenance are at risk of developing **musculoskeletal diseases,** because frequently they have to work in awkward positions when maintaining machines that are difficult to access or enter confined spaces.

Preventive measures:

Good ergonomic design of machines and equipment helps minimise the risk of MSDs. Workers can play an active role in the MSD prevention process by participating in training and by being involved in planning and implementing changes to work tasks or jobs.

- **Heat and cold**

Some sub-sectors of the food and beverage manufacturing involve **working under extreme temperatures.** Workplaces that can be very hot include bakeries, industrial kitchens and smoke houses.

Cold and damp workplaces are common in the meat and poultry processing industry and in the dairy industry; extremely cold working conditions are encountered in the frozen and chilled food industry or production of freeze-dried products. The processing of freeze-dried coffee extract requires intensive maintenance and cleaning to ensure uninterrupted production.[19]

Preventive measures:

The risks associated with working in extreme temperatures can be minimised by regulating the length of exposure, providing periodic breaks and specialised personal protective clothing suitable thermal clothing if necessary

In walk-in refrigeration units, chill units and freezers, adequate egress routes should be provided. Doors should be openable from the inside and equipped with lighting so that the door is visible when closed.

- **Psychosocial risk factors**

Maintenance workers often work under time pressure, at unsocial hours (shiftwork), without sufficient instructions, in awkward conditions, and in case of outsourced maintenance sometimes in unfamiliar work environments.[20] Under these working conditions maintenance workers may suffer from **work-related stress.**

Preventive measures:

Realistic time and resources have to be allocated for maintenance work. Workers must be trained and informed about their task and safe work procedures.

Design of machines and production lines

Many accidents occur during machinery maintenance. Especially in the food industry frequent access to machinery is required to assist product flow, clear blockages or spills, and carry out cleaning.[21,22] Safe maintenance starts with the design and planning of machines and installations: machinery and plants have to be designed so that they can be maintained and cleaned safely.

Challenges for machine designers regarding safe maintenance are, for example, easy access to machine parts that have to be inspected or replaced, easy access of routine points for routine lubrication and adjustment without removal of safe guarding systems, clear arrangement of complex components, e.g. avoiding overlapped power cables, lockout and safe guarding systems.

Although machines may be designed for safe maintenance, poorly maintained workplaces may eliminate the benefits. Proper workplace design is also essential to prevent accidents and to ensure safe maintenance.[23]

Legislation

European directives set minimum standards to protect workers. The most important is **Directive 89/391/EEC** of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work that sets out the risk assessment process and a hierarchy of prevention measures that all employers are required to follow.

The framework directive is supplemented by 'daughter' Directives, of which the following are especially relevant for safe maintenance in the food manufacturing:

Directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work. It lays down minimum safety and health requirements for the use of work equipment by workers at work and regulates safe maintenance work.

Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace regulates the minimum requirements for personal protective equipment used by workers at work.

Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

Directive 98/24/EC - risks related to chemical agents at work

of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work.

Directive 2004/37/EC - carcinogens or mutagens at work

of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work

Directive 1999/92/EC - risks from explosive atmospheres of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres

Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work.

Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).

Council Directive 2006/42/EC on machinery lays down the essential health and safety requirements in relation to design and manufacture in order to improve the safety of machinery placed on the market. The Directive stipulates that machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse.

In addition specific directives adopted to protect young workers, pregnant workers and temporary workers also apply to maintenance activities.

For more information on legislation consult http://osha.europa.eu/en/legislation

OSH management in maintenance

The specific details of maintenance vary between industry sectors and depending on tasks. But there are some common principles of OSH management to ensure safety and health of workers:

- Integration of OSH management into maintenance management
- Structured approach based on risk assessment
- Clear roles and responsibilities
- Safe systems of work and clear guidelines to follow
- Adequate training and competence
- Involvement of workers in the risk assessment and maintenance management process
- Effective communication

There are five basic rules to follow to safe maintenance (based on the model by the Swiss OSH authorities SUVA.[24]).

1. Plan

Maintenance should start with proper planning. A risk assessment should be carried out and workers should be involved in this process.

Issues to be covered at the planning stage are:

- The scope of the task – what needs to be done, and how it will affect other workers and activities in the workplace
- Risk assessment: potential hazards have to be identified (e.g. dangerous substances, confined spaces, moving parts of machinery, dust in the air), and measures need to be developed to eliminate or minimise the risks See also: http://osha.europa.eu/en/topics/riskassessment
- Safe systems of work have to be defined (permits to work, lock-off systems)
- The time and resources that the activity will require
- Communication between maintenance and production staff, and all other parties concerned
- Competence and adequate training

Guidelines should be drawn up indicating what should be maintained and how often.

2. Make the work area safe

The work area needs to be secured by preventing unauthorised access, for example, by using barriers and signs. The area also needs to be kept clean and safe, with power locked-off, moving parts of machinery secured, temporary ventilation installed, and safe routes established for workers to enter and exit the work area. A guideline for safe lockout procedure is published by the Health & Safety Executive for Northern Ireland (HSENI).[25]

3. Use appropriate equipment

Appropriate tools and equipment should be provided and used, including personal protective equipment when the risks cannot be eliminated.

Employers should ensure that:

- the right tool and equipment for the job is available (together with instructions in using it, if required)
- it is in appropriate condition
- it is suitable for the work environment (e.g., no sparking tools in flammable atmospheres)
- it has an ergonomic design

All personal protective equipment must:

- be appropriate for the risks involved, without itself leading to any increased risk
- correspond to existing conditions at the workplace
- take account of ergonomic requirements and the worker's state of health
- fit the wearer correctly after any necessary adjustment.

4. Work as planned

Safe work procedures have to be communicated, understood by workers and supervisors and applied correctly. The work should be monitored so that the agreed safe systems of work and sites rules are observed. This is especially important if the maintenance is done by subcontractors. Safe procedures need to be followed, even when there is time pressure: shortcuts could be very costly if they lead to accidents, injuries, or damage to property. Procedures need to be in place for unexpected events. Part of the safe system of work should be to stop work when faced with an unforeseen problem or a problem exceeding one's own competence.

5. Make final checks

The maintenance process needs to end with checks to make sure that the task has been completed, that the maintenance procedure has left the item in a safe and functioning condition.[26] The functional capability of the plant, machines or equipment has to be tested and protective measures have to be replaced. The final step involves completing a report, describing the work that has been performed and including comments on any difficulties that have been encountered, together with recommendations for improvement.

Good practice examples in preventing harm in maintenance in food and drink manufacturing

Software makes maintenance easier and improves plant security in the food manufacturing

Cheese dairies use a lot of different plants and machines. A wide range of maintenance- and replacement intervals, repair or check-up intervals pose a big challenge for maintainers regarding logistic and organisation (picture 1). A cheese dairy needed a programme for optimal maintenance of their plants so they developed software tailored to their specific needs. A central register that can be accessed by the internal database of the company was established. The new software enables the company to find out when plants were last checked and whether any problems were found. The software also helps establish fixed dates for maintenance. In addition, the software shows the maintenance timetable not only for production machinery but also for other equipment, cranes and vehicles, and even fire extinguishers.[27]

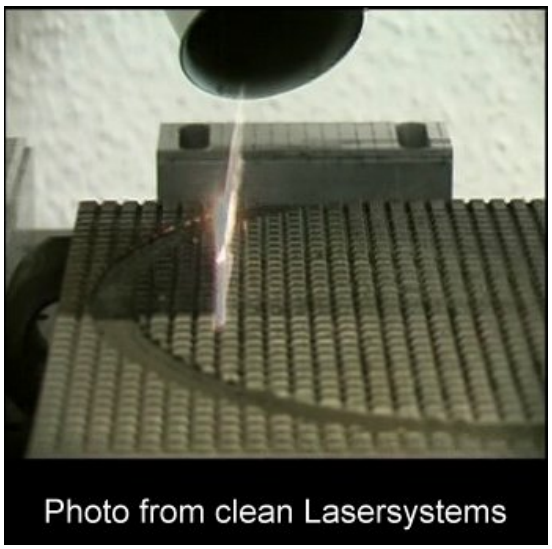
Picture 2: Cheese dairy plant

Source: BGN

Waffle irons in baking lines – substitution of dangerous substances

Waffle irons on baking production lines have to be cleaned regularly. Typically waffle irons and forms were cleaned with soda or by wire brushes. This resulted in wear and tear of the waffle irons (bearings grease was removed) so that the line had to be switched off, and sometimes pieces of wire from the wire brushes were found in the line. To substitute the caustic soda and therefore to prevent occupational diseases and accidents as well as environmental impact, waffle irons in a baking line are now automatically cleaned during baking operations by a solid-state laser (picture 2). A cleaning agent is not needed. After cleaning the baking process can continue.[28]

Picture 3*:* Clean Lasersystem: solid-state laser for waffle irons



Source: CleanLASER

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