BASIC FACTORS FOR FOOD PROCESSING EQUIPMENT HYGIENIC DESIGN AND ITS CLEANABILITIES WITH MINIMAL CONTAMINATION RISK

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Abstract

In this paper basic factors with respect to the manufacturing suitable for food processing equipment have been presented and considered for specific food processing lines.

All of these factors have been graphically shown and numbered in the figure one. They have to be specifically taken into consideration for so call open food production productivity area, and for open processing equipment as well. It is the most important at the area when raw food material is being prepared as food ready to eat. It can also be analysed through many other technological food production lines, but the particular importance have to be seen among food branches as following: fish fresh, frozen and meat processing, cheese, meat slices, meat raw or cooked dicer and strip cutter, meat separation from bones and trimming, dry apple slices, confectionery, potato chips and slices, tomato, cucumbers and other vegetables cut out to pieces, bakery, many dairy final products. In general for all cutting, slicing, sawing, mixing, grinding, injection, flow divider multiple processing track for fillings meat, fish, cheese or vegetables products unit operations, when that equipment should be dismantled every day for cleaning.

In conclusions it has been stated that all basic food processing equipment factors have to be verified and assessed two times. For the first time at the beginning of the design machinery concept of all equipment types, together with building and surrounding plant requirements, quality of raw materials, operations staff qualification and expected from them demand to fulfil the GHP for any kind of final food products. For the second time, at the end of that food production needs as above pointed out, regarding the EU 96/IPPC Directive, with respect to the level of waste like solids including dust, gases and liquids in keeping the ongoing way zero level waste campaign to safe environment.

Key words: Equipment design factors, Hygiene surface clean abilities, Tools blunt and sharpness, Contamination risk area.

1. Introduction

Food production is one of the most complicated and sophisticated engineering processing of raw materials due to their sensitivity and chemical activity, and because of the very high demand for the hygiene and sanitation requirements for both processes parameters and machinery together with auxiliary technical outfit, and the surroundings data where the food production periodically or continuously is going on. Moreover, hygiene is the process of considerable importance in all food industry branches, due to the increasing cost placed on both the food producers and for food equipment manufacturers.

The main reason for rising up the cost is the expected safety and possible extension of the shelf life of the food products. It is also strictly related to the fouling, cleaning and disinfection processes, usually accepted as the cause creating potential impact on the product quality, and food processing plant operational performance. The best concept for realising such a place for food production is known as the closed food production cycle. In another words it means that all what is needed for the food productivity plant, i.e., energy, raw materials and water, remain inside that area, and any kind of waste are not leaving the food production area, and not creating the waste problem for environment.

2. Basic equipment food processing factors

The basic food processing factors influencing on the equipment parameters during the unit processes in food production under technological conditions are presented in Fig. 1.
The **first** factor include the full information about raw materials for instance meat, fish, fruit, vegetables, sweetness, bakery, and others to be cut out to pieces and further processed for specific kind of final food product. It means to possess all data based on traceability continuing information process about the raw materials quality collected from their receiving area up to the consumer, using micro and nano electronic devices applied as it is described by the ISO 22519 standard. These traceability data have to contain the compatibility between the local and international law requirements regarding protected designation of origin (PDO), protected graphical indication (PGI), and traditional speciality guaranteed (TSG) of agricultural and other raw products sources. It is also important because food belongs to the very high complex system, and also is known as a very dissipative one. Therefore, the control of food material properties have a major role in the processing behaviour, in growth of micro-organisms, and is a key factor of many food quality aspects [7, 8].

The **second** factor is related to the operations staff qualifications and to the specific demand expected from them in any kind of supporting service during the food engineering process for variety of unit operation processes in the technological lines. In general, basic requirements for personnel directly engaged to the equipment service are written in the GHP (Good Hygienic Practice) standard. Among other things, it is necessary to wear clothing, the best made of natural woven, with different colours that indicate the processing place at the divided productivity area. In particular these persons should possess specific medical health checking with respect to the zones at the production plant and for the described micro-organisms level there to avoid any of food contamination risk coming from human beings at the different region they will be working on. Details for such specific staff requirements are given in the EU Instruction No. 2073/2005 issued on 11th November 2005 which is in power form 1st January 2006, with further amendments.

The **third** factor include the water quality properties. In this case it is necessary to stress that hygiene and sanitation in the food industry is not simply concerned with cleaning. Hygienic requirements embraces the plant, equipment and buildings design, including both construction and layout, the supply of services such as bacteriological acceptable water supplies, including installation facilities for cleaning and sterilisation, and waste disposal facilities. The quality of water properties can be varies. For instance, if the water is bacteriological acceptable and has been softened, only detergent need to be added, but if the mineral content of the water is high, water conditioners like sequestering agents such as sodium polyphosphates must be added to prevent precipitation on pipeline and equipment surfaces.

Water supplies to the food industry may be as either ground or surface waters. It is necessary to underline that micro-organism are commonly encountered in surface water, usually including diatoms, fungi, algae, protozoa, and variety of non-pathogenic bacteria. If introduced into processing plant, living microorganisms and their decomposition products may give rise to off-colours, tastes and odours in both foodstuffs and food equipment. Even more, pathogenic bacteria may not cause spoilage of food products but also food poisoning. Water used in food processing plant can be classified as: general purpose water, process water, cooling and boiler feed water. Many food factories purchase their water supplies direct from municipal authorities, and for it use further treatment may be necessary. The ways of necessary treatments for the water satisfactory quality production, depends on the use for which the water is required. The major impurities requiring removal are: suspended matter, micro-organisms, organic matter like colour, testes and odours, dissolved mineral matter, iron and manganese, and dissolved gases. In general, organic matters, colours, tastes and odours are unacceptable in water to be used for food processing, regarding all hygienic food production aspects. All natural waters contain dissolved mineral common matter like sulphates, chlorides and bicarbonates of sodium, magnesium and calcium. For water treatment purposes and its quality needed in hygienic and safety food processing as well as to achieve minimal contamination risk after cleaning and sanitation processes, it is also convenient to
examine the effects of the following soluble impurities: alkalinity, hardness, and iron and manganese. In the EU Directives and Veterinary Medical Instructions EU-18/2000, the level of water hardness should be at the range between 60 to 500 mg/L, the level of iron in water cannot exceed the value of 0.2 mg/L, the level of magnesium in water have not to be higher than 0.05 mg/L, and the alkalinity value similar to potable water, i.e., pH about 7.0 [3].

The fourth factor is related to the air flows in the food production area and air data needed for its delivery and movement parameters. Air flows can increase contamination risk inside and around food factories, and it is the potential source of microbial hazard. Usually, the risk from airborne contamination can be identified using HACCP standard procedures, during the assessment of the entire unit food production operations when identifying Critical Control Points in all places where equipment is located and in the space around it. If the airborne contamination places are pointed out, their location should be taken into account as a prior to changes to the air delivery and handling equipment, especially for air parameters description and food process conditions to be achieved. From this point of view the air conditions in the air handling system should be maintained at all times, including production and whole cleaning procedure. In another words it means that adequate air temperature and pressure during manufacturing time together with air flows around the food products have to be continuously controlled. Also as equally importance is the unit operation staffs understanding the air enter places into factory and their own footpath movement closely to the servicing equipment by them. The assessment of the air flows movement is particularly importance in the high-care food production area, when air flows can disperse droplets from cleaning operations existing in the air as aerosols. These kind of droplets in the air may have micro-organisms on their surfaces or inside, and can deliver contaminant to the food product. There is a lot of washing and cleaning operation in the food plant area that can be a sources of contamination namely: boot and hand washing when entering to the factory, tray and equipment washing, floor and product washing. Additionally, the airborne contamination can be found in the moving or rotating parts of equipment such as like: mixers, fillers, conveyors, motors, slicers, blenders, as well as in the packaging materials, personnel clothing, and in the inappropriately designed and maintained air delivering and handling systems. To achieve the minimal airborne contamination risk the hazard analysis should be continuously carried out at the raw materials delivery area, on the unit operations equipment located along technological line area, on the whole factory structure with all layouts and the personnel movement, and including principally the air handling equipment. In the air handling system the following criteria are playing major role for its specific parameters: temperature, air distribution, filtration, time and spatial variations, relative humidity, cleaning requirements, and controlling with monitoring the cooperation between all system components, and times when the normal food production is not continue. Particular values of the above indicated specific parameters depend on the types of final food products, on the workplace healthy, safety and prevention of the discomfort conditions, on the air flow rate sufficient for fresh air required by people and for amount of air exchange regarding the high or low risk zone operations to prevents any increase of the airborne contamination. The main components of the air delivery are as follows: panel type filter, dehumidifier cooling coil, humidifier, droplet eliminator, heating coil, fan section, air distributor, bag type filter, and HEPA filter that can be present as a whole in the system or some of them in a different configuration. At the high risk production zone special attention should be paid to chosen the HEPA filter that is build up with the highest filter grade and design for removal particles bigger than one over one thousand micrometres [1].

The fifth factor embody of the designing food engineering equipment parameters and its attributes. This factor can be divided into the sub-factors with expected specific requirements as for:

- The tools types used in the cutting out into pieces the raw fresh or frozen materials, with their basic made of material, surface roughness, with shape and suitable value sharpness or blunt of knife-edge. In Figure 1 for example there is the tool as a disc knife presented. Usually, this tool is made of from the stainless tool steel, at least the knife-edge. The shape of knives-edges differentiate from the smooth line on the circumference to the many teeth on the circuit with different subdivision and knife-edge angle, that both influencing on the cutting process effectiveness. For instance the efficiency of cutting process in commercial filleting of fish is affected by the type of deformation of the fish tissue under and around the shape of the cutting edge. This deformation depends on the the shape of the cutting edges, conditions of the blade, cutting speed, and cutting resistance of scales, skin, fish meat and bones. The cutting resistance may vary and is influenced by many factors that determines the rate of the cutting edge blunting. In the cutting process it is necessary to apply a sufficiently large force to overcome the resistance of the raw material due to its elastic and plastic deformation, as well as frictional and cohesive forces. In case for fish product the cutting forces on the disc knife are composed of: force initiating the cutting process (i.e., causing contact stress at the knife/fish interface), forces of frontal resistance on knife edges, frictional forces on the surface of knife wedge, and frictional forces on side surfaces of the knife (including cohesion and
adhesion). The maximum resistance during cutting process occurs on the cutting edge, on so-called intermediary surface created by the external rounding with the arc radius \( r \) in the knife angle. The main effect of change in the knife sharpness is noticeable on this surface. Blunting is a process of continuous change in the knife micro-geometry. These changes are strongly influencing on the quality of cutting process, and also on the fouling knives surfaces with accumulation or deposition of raw materials components (among others fat, protein, biofilms) that subsequently are later on deposited to stagnant equipment areas. The quantity and variety of fouling should define the parameters for cleaning process and the proper strategy for accumulated soil removal from any of unhygienic part of equipment. It have been recognised that the hardness of the knife surfaces is good enough with the range value 55 to 60 HRC, with roughness value of those surfaces from 1.2 to 1.4 \( \mu m \). The sharp knife should have a radius \( r = 5 \mu m \), and for the fish filleting knives blunting limit are about 40 \( \mu m \) as still acceptable for high quality fish products.

The way of tool(s) fixing in the body together with the motor, gearbox and coupling localisation, bearings, and power transmission needed for the tool revolution speed and its control movement in the horizontal and vertical direction. In general, tools with other components needed to perform their expected processing function should have as much as possible free access for daily inspection, routine service and to allow easy maintenance and efficiency of the cleaning process. Some of the above mentioned components, of the power transmission mainly, are working as an open equipment. Therefore they have to be equipped with special covers and mounted with screw and bolt with cap nut for not accumulating soil. The type and size of bearings depends on the range and direction of forces acting on the element supported by them. In case of rotational shafts with attached there for example disc knives, in contact with raw material during cutting process, and under continuously clean water flow, for necessary lubrication the best are so-called self-lubricating bearings.

The distribution and arrangement of single or multi-unit operational sections in the equipment body. It should be done in the way with respect to the sequences of cutting process step by step in agreement with the idea described by technologist receipt for receiving certain part of the pieces of meat (fish, chicken, pork or beef meat, and poultry). For instance, the fish fillets can be received when de-heading fish, cutting of a belly and to take away intestines, the bones removal after cutting skin in several places of the fish surface, and finally to remove the skin with scales (or without removal it).

The food-grade lubricants used for the equipment parts in motion. It is necessary to stress that the food-grade lubricants need to be dispelled and overcome, i.e., not only to assist in improving production performance of the equipment elements in motion, but also to reduce contamination risk. The food contamination can occur from drips off chains, oil leaks from seals and gearboxes and from hydraulic hose failure, as well as realise from compressed air containing an oily mist. Moreover, it is the common knowledge that processing equipment incorporates many moving parts requiring lubricants to obtain reliable and effective operations. Additionally, lubrication quality play a major impact on life of equipment and the cost of maintenance. In the food industry recently more popular became the food grade synthetic lubricants that are odourless, tasteless, and remaining effective in the sub-zero cold of freezers and the heat of ovens. In general opinion application of the synthetic lubricants, improving lubricants properties and performance together with good water resistance, in compare with food-grade mineral oil-based lubricants. Apart from, the food-grade lubricants are harmless if accidentally consumed in quantities below the described maximum level. For example, the U.S. Food and Drug Administration (FDA) prescribed that level of 10 ppm.

The arrangement of the cleaning and disinfection installation as required for system used to keep the equipment in hygiene conditions to eliminate the risk of cross contamination at the tools and others equipment surfaces open for soil like residual parts of raw materials left after unit operations and airborne contamination as well. The modern food processing plant is being designed to permit the cleaning operation in one of two different ways either by: dismantling and cleaning or through the system known as C.I.P. Factors influencing the degree and effectiveness of cleaning,
whether by dismantling or C.I.P., include: temperature, composition and concentration of detergent solutions, contact time between detergent solutions and the soil deposit, degree of stream turbulence promoted, the nature of thickness and adhesion forces relevant to the physical shear stress of the soil layer, and required water quality properties. For example, in cleaning: using water and detergent their quality are suited to the soil, the hardness of water, the construction of equipment material, and cleaning technique used; in sterilisation, i.e., for disinfection and sanitisation, using the heat in steam or hot water as sterilising medium, or a chemical sterilisation substances (bactericide, disinfectant, sanitizer). The cleaning and disinfection processes are required after running every food engineering operations. Equipment must be cleaned and the soil deposits like sugar, fats, proteins and salts must be removed to avoid the contamination risk and pollution of the following process. The C.I.P. kitchen system allows the preparation of cleaning solutions with adequate concentration and temperature. The C.I.P. usually contains multiple tanks with stored concentrated cleaning solutions. Typical cleaning blocks consist in: flashing with tap water, flushing or recirculation with cleaning the first solution, usually with an alkali solution, flushing or recirculation with cleaning the second solution, usually with an acid solution, and final rinse with deionised water or water for injection. In between and at the end these cleaning step procedure, the equipment is blown out with air. Apart from, the C.I.P. system is equipped with heat exchanger, city water installation, steam pipes, drain and pressurised air installations. Generally, smooth surface without crevices, edges and fissures are easier to clean. Cleaning processes require the measurement of recognised soil components in the food engineering process, and the measured values must be below the accepted level for certain type of final food products, and relevant to the production zone where manufactured. Good C.I.P. systems are characterised by efficient cleaning, short cleaning times, low water consumption and with less chemical agents used due to the less environment pollution [5, 10].

The electrical and compression, over-pressure or vacuum air and other gases pressure installations together with additional appliances like pumps, compressors, thermal insulation blocks, cupboards, steering and control systems, cables, and measurements devices, and monitoring system with HMI (Human Machine Interface) as well. All the above mentioned elements belong to the open processing equipment, and they are under influences of dust, liquid, condensed water, soil, and splashed components of food products. If transfer to the outer surface of the equipment may have caused possible food contamination. It is the main reason to re-design the existing outer surfaces of motors, pumps, thermal insulation blocks, protection the distance between the rotating elements including the air movement around that may contain a lot of air-born contaminants, and many others. In case of cables and their connections, the roughness of surfaces must be smooth, and free of discontinuities and defects, including cable trays. Electrical and pressure installations should have adequate space for cleaning, no sharp edges and designed in the way do not create any problem in the relation to electromagnetic or electrical compatibility. The measurements, sensors, signal devices, and monitoring systems must be designed for easy cleaning and properly located in the equipment to avoid dead ends or other not cleanable areas. Monitoring system can be seen as the continuous determination of the food material components present in the engineering processes as well as to give relevant data about process parameters like temperature, pressure, density, flow rate and many others. It can also be equipped with sensors to monitor the level of equipment fouling and identify the conditions where cleaning is required for hygienic and safety food production together with effective equipment working parameters control for the high production performance without contamination hazard.

The body, frame and supporting structure elements, regarding shapes and geometry of the equipment with access to the places seen as possible to fulfil effective cleaning and sanitation requirements. Generally, it can be assumed that the most effective cleaning and hygienic results depend on the type of materials, surface geometry structure, required surface roughness and the methods used to achieve the best cleanliness of the equipment parts. The materials, especially product contact materials must be inert to the product, free of imperfections, and antimicrobial and detergents agents under conditions of use. Apart from, they must be corrosion resistant, non-toxic, smoothly finished and mechanical stable. The special stainless steels that can be finished in variety of ways are the standard in the food industry, and indispensable for applications where requirements as to cleanliness and sterilisation are critical. This material lends itself to forming, stretching, welding, and possess its own chromium oxide ‘passive film’ layer that affords good permanent protection against corrosion. The equipment surface quality is usually measured by the degree of roughness and state of stress that are crucial for the durability of material. The methods properly used for surface finishing, directly impacts the desire properties, the appearance and its cleanability. The techniques most frequently used are mechanical finishing like: grinding, engine turning, polishing, honing, lapping, shot peening, and roller burnishing. There are also chemical-electrical finishing like: pickling, passivation, and electro-polishing (electrolytic or anodic polishing). Surface roughness is described by the parameter Ra, but it is not the texture of a surface. This means that
two different equipment pieces can differ in texture, and therefore in other properties, but can exhibit equal Ra values. The definition of Ra as well as Rt and Rz, all reported in μm or μin, can be found in the EN-ISO 4287/1-1999 and in DIN 4762. The geometrical surface profile can be characterised not only by measurements of surface roughness but also by assessment of its waviness and shape deviation. All of them depend on the two parameters: h-as elevation height and s-as width elevation. The quotient is differ for them and relevant value are written in the above standard. The value of Ra is an essential criterion for food product safety and process reliability in all food engineering processes applications governed by the required highest hygienic standards. But in practice it also means the real engineers problem for hygienic equipment design. They should seek to find and implement the optimal relationship between the desired surface tolerance and the manufacturing cost to achieve it. It is general agreement that the food product contact surfaces should have surfaces finished with an acceptable Ra value of ≤ 0.8μm, and to be free of pits, folds and crevices in the final equipment fabricated form. The body, frame and supporting structure elements, regarding shapes and geometry of the equipment should be design in the way using in the first place the round profiles that in the cross section area are like: triangle, square, circle, diamond, and rectangle. The connection between elements of the equipment design structure should be done in a such way that product debris, any soil, dust, can easily be cleaned and washed down ([2], [4] and 6]).

The safety service, the way of dismantling equipment parts for special cleaning procedure and their assembling also during the life maintenance service, and enclosure to provide a degree of protection, if surrounding any of unit operation place. In general, equipment should be designed, constructed, fabricated and maintained in a cleanable conditions to prevent the ingress, survival and multiplication of micro-organisms. These expected equipment features have to be verified and proved by proper measurements before the installation, post installation and after every case of its dismantling and its assembling in the food processing lines. In other words, all surfaces in the product contact area must be accessible for cleaning and inspection. The equipment should be designed to allow disassembly as easy as possible, especially if there are components with inaccessible surfaces. All equipment surfaces should be shaped to eliminate water pooling and to be self-draining. The maintenance service requirements should be adequate to the system of the food production needs. During the planned maintenance, items of equipment to be critical to the food product safety, its hygiene, legality and quality, shall be judged and carefully checked as being a potential cause of the product contamination hazard [6, 11 and 12]. The sixth factor include the packing and packaging systems. Package and the packaging systems are placed at the most restricted zone in the food production area. It is the place where the best final food products quality achieved and confirmed in the QACP (Quality Assurance Control Points), will start to be in the closely contact with the packages materials to protect that quality in accordance with limit time for consumption. It means that the amount of micro-organisms left in the food products after thermal treatments like pasteurisation or sterilisation that indicated their so-call shelf life will be confronted with the CR (Contamination Rate) left at the package surface materials. Therefore, it is the matter of the utmost importance to keep the packing area at the highest possible restrictions regarding the hygienic and amount of the soil and any other physical, chemical or bacteriological contamination. Before the final quality food product will be packaged in variety of package shape and form, the amount of bacteria and other micro-organisms should be validated by the CFU factor or by any methods used in the test laboratory. Besides, the amount of micro-organisms left in the final food products, can indicated the level of the CR at the packages surfaces as accepted with respect to the period of their shelf life. The packages materials should preserve food content, freshness, colour stability, and other quality attributes, acts also as barrier to micro-organisms. Moreover, to be light and radiation resistance, without interaction between the product and package materials, suitable for pasteurisation, sterilisation and aseptic filling processes. Packing have to be stable in shape, regarding packaging system forming feature used, and with hermetic durable closure, and easy to open.

The seventh factor comprise the premises with plant that must be designed, constructed and maintained to control any risk of product contamination and comply with any relevant legislation. The required building parameters inside the production plant can be divided into the sub-factors with expected specific needs as for:

Floor. In the food industry floors, have to withstand the heavy objects dropped on them, with many pallets and steel-wheeled trolleys moved over them, and water with chemicals left there in different inside factory temperature. Therefore, the floor surface materials must retain their structural integrity, and must be maintained in a good conditions, easy to clean and if necessary, disinfect. This will require the use of non-absorbent, washable, non-toxic, and impervious materials. From designing point of view, i.e., hygienic benefits and safety for employees in food production area, floors should be with minimal number of joints to avoid or restrict bacterial accumulation, where appropriate must allow adequate surface drainage, and not damage, slip and sanitation resistance, non-electrostatic.
**Interior walls.** The surfaces of interior walls should be flat and smooth, white or light coloured, solid, not hollow, with restrict cavities behind surface finish, and adequate radius wall to floor junction. Windows, if necessary in the production area, should be placed from floor level above 1.2 m, and protected against breakage, pest ingress, and condensation effects. When attached with window sill, should be sloped internally in the range 30 to 45°. The tap water point’s distance have to be placed regarding the length of hose as equal or less than 15 m. The distance between equipment and walls depends on the internal transportation system, personal movement, different media installation (pipes, cables, wire).

**Ceiling.** The ceiling should be design with adequate radius to wall junction and with required correct site lighting. The lamps located there have to be recessed in the way to avoid collection of the air-born contamination and accumulation of condensed water on the lighting system surfaces to restrict local drops to the equipment. Special care should be taken to the fresh and make up air deliver devices located in or closely to the ceiling design structure. They contain air handling unit with filters, ceiling mounted chillers, grilles, ducting or textile ventilation, recirculation, return and exhaust air, and where applicable the dust extraction equipment.

**Waste collections and drainage system.** The distance between drainage channels should be at least 5m, with grille at least one at the floor area between 35 to 40 m², and equipment located at the floor with slope from both side is counted as 2% for higher water consumption or 1% for lower water capacity. In general, the drainage system at the food production area must be design with respect to the following: production sewage should flow through the system equipped with the settle tank fulfil with sand and debris catcher, production sewage can flow together with the sanitation sewage behind the production building but after the preliminary cleaning the seconds ones, sewage drainage channels cannot be located at the floor under the fixed (not moveable) processing operation equipment. The design concept to build up the drainage system for the sewage collection have to include the steps namely: collect- clean- hold- separate- release- utilize- as much as possible valuable components from the food processing area, and the rest to neutralised before dump in to environment with accepted level for its safety contamination risk.

The **eight** factor contain the internal transportation system between the unit operational equipment’s located in the food technological production lines for delivery raw materials, semi-food products, and final food products taken out to the storage. Regarding the hygiene, safety and minimal contamination hazard, required design features for the system transportation between unit operation, from raw material entrance to the plant area, and to the final food products store delivery, are very similar like for the internal transport system. It means that handling conveyor may vary with different types of surface belts, shapes and made of materials. There are belts with the materials especially recommended for direct surface contact with food. Among others, modular plastic belts, wire belts, tensioned synthetic flat belts made of PU, rubber, PVC, as well as flat belts positive driven. There are some specific design requirements expected for this handling conveyors due to their cleanability, hygiene and minimising the contamination hazard. In some cases regarding the hygienic risk, there are significant places in the conveyor construction i.e., the power supply, gearbox and power transmission. Recently, to avoid in that area often appeared there cross contamination risk reasons (corrosions, grease, colour covers surface pitting), all that drive conveyor parts are located now in the drum-motors, that are characterised by very good hygienic and exploitation parameters. Besides, for that conveyors to assure good cleaning access, open side frame and supporting structure, hygienic return path with fold-able or flip out the side rails that belt can be lifted up, should be seen as the best solution for common use at the food production plant [9].

### 3. Conclusions

- It is important for expected hygienic factors that at the beginning of designing idea and after manufacturing the real equipment for food processing, several rules and requirements should be taken into account. Namely, there are: all ISO Standards from general 9000-2008 to the very specific ones like for example ISO 22000(5), EFSIS standards, and EN ISO 14159 with EN 1672-2 in particular; EU Directive 42/2006 in general for machinery, and others like 3A, NSF, FDA, HACCP, EHEDG Guidelines as well as many additional ones in terms of the local law specific restriction for hygienic and sanitation food production. Quantification of the above expected data level for recognition of hygienic risk can be done through the test process equipment certification as a whole of any particular part of it.

- It is also the matter of equally importance that at the final stage of food production that basic factors should be verified and assessed, and to be in comparison with data mostly adequate for that, described in the EU Directive 96/IPPC (Integrated Pollution Prevention Control) with many amendments till now, in the and ISO 14000 together with EMAS standards, regarding the special attention to waste affecting environment for all streams going out from the food production plant that affecting surroundings closely to the productivity area. These streams are: liquids, solids and gaseous with dust particles waste.
- The European Commission Authority through the European Food Law (Instruction No. 178/2002) and together with published Directives and Instructions as well as by the EHEDG Documents and Guidelines, together with 3A, CCFRA, NSF International Guidelines, and others third party certifiers like EFSA, GHI activities, through their issued Reports, where greater details on individual items are given, can be very useful and supporting every endeavour to achieved at the starting point, and at the end of it, including all presented above basic factors with respect the food engineering processes conditions for hygienic, sanitation and safety food production with zero or at least minimal contamination risk.

- Achievements of the good hygienic food engineering conditions with recognised contamination risk, required daily checking equipment, with monitoring and analysing the hazard level through the test laboratory, and deserve often closely examination. All surfaces either in the closed or at the open area, in the contact or closely to it, with raw materials, semi-products and final food products, must be cleanable to the microbiological level. When measured, it is recommended as less than 1 CFU per square centimetres or less than 1 CFU per 10 mL in rinsed element and when it is checked by residual ATP or using swabs, and by any other testing methods for detection some left at the surfaces remaining products components (protein, fats, carbohydrate and their composition).

4. References


