Working Group
„Machines and Equipment in the
Confectionery Industry“

Guideline for the design and implementation of technical investment projects in the confectionery industry

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1. Introduction

The setup of processing plants in the confectionery industry requires a high degree of coordination between client and contractor (technical planning firms, architects, machine suppliers, etc.). The economic necessities require a targeted implementation of technical investment projects with regard to technology, time and costs.

Apart from applying modern tools and methods of project organization, the communication between the parties involved must be intensified to meet these requirements.

2. Purpose and area of application

The purpose of this guideline is to provide recommendations and information on the conceptualization and installation of processing plants including initial operation for confectionery manufacturers and suppliers of machinery and supply facilities with emphasis laid on:

- Compliance with the structural planning requirements;
- Favorable (appropriate) design of the interfaces between internal infrastructure and equipment;
- Rules for the construction site.

Again and again, problems occurring at the construction site can only be avoided by implementing a project planning process from the outset that is appropriate for assembly and operation.

The information is based on valid legislation and regulations as well as practical experience. However, it does not release confectionery manufacturers or their suppliers from observing and complying with the applicable laws and regulations.

On a case-by-case basis, measures can become necessary that exceed the extent of these recommendations. This guideline was developed based on the *current* state of technology.

3. Structural planning

3.1. Organization of planning and project handling

The smooth installation of new plants requires a project organization that clearly defines the areas of responsibility for all parties involved in planning and execution. Apart from the overall project leader, individuals with responsibility for partial projects should also be appointed, if necessary.

The use of modern project management methods considerably supports the necessary coordination functions. Among others, project handling includes conducting a failure mode and effects analysis and the compilation of contract specifications. Apart from technical and economical parameters, product-specific requirements (quality descriptions) should possibly also be included in the specifications.

Since there is already comprehensive literature on these subjects, they will not be addressed below.

3.2. Flow of materials

The basis of each new planning project is an optimized flow of materials, which must be developed in a project-specific manner and recorded in a flow chart. Later capacity expansions and possible process changes should be taken into consideration in the planning process from the outset, if possible.

3.3. Planning documentation

In principle, planning results must be documented. It must be ensured that the documentation is fully transparent.

Provisions and future reserves (e.g. possible openings in the ceilings and recesses) should be easily recognizable and shown in the master plans.

3.4. Factory structure

The structural planning of a factory is based on the consideration of the following issues:

- Production program and quantity structure;
- Process engineering requirements;
- Material flows;
- Hazardous materials assessment and handling;
- Hygiene;
- Fire prevention;
- Available space;
- Environmental conditions/requirements;
- Workplace design (noise, temperature, maximum workplace concentration, etc.);
- Costs;
- Other project-specific requirements.

3.5. Internal logistics planning

Escape paths, driveways and walkways including intersections must be shown individually and must consider the statically permissible load. Areas for temporary storage of raw materials, semi-finished products, finished products, reworked items and production waste need to be labeled. Necessary hygiene zones must be considered.

Taking into account the maximum possible throughputs, the layout and frequency of occupation for the logistics

areas must be coordinated with the local operators and documented.

Factory simulations help describe complex production processes.

3.6. Determination of pipeline layout

Prior to execution, the lines for the required media must be determined and coordinated. To avoid collisions at the construction site, this determination should be made at an early date. This particularly applies to:

- Air conditioning ducts including air inlet and exhaust pipes;
- Product pipes and feeding systems;
- Water/waste water pipes;
- Steam/condensate pipes;
- Vapor supply;
- Cooling;
- Compressed air pipes;
- Cable lines;
- Process air ducts (incoming/outgoing air); exhaust fumes.

In some cases, ring lines, stub lines or supply and return pipes may be required. Pressure and system conditions must be examined carefully.

In principle, the layout of lines should be determined mandatory for an entire factory building. This is advantageous for future expansions or changes. The type of pipeline construction should be incorporated in the delivery instructions and become part of enquiries at suppliers.

Special attention should be paid to the fact that the labeling of pipelines (including product pipes) and networks is organized in a binding manner.

3.7. Compliance with legal requirements

The applicable legal requirements regarding construction, fire prevention, occupational safety and environment must be taken into account during structural planning. For specialized subjects, experts must be consulted.

3.8. Internal specifications of the company

Apart from the applicable standards and guidelines, there are frequently company specifications, such as electricity guidelines, etc. These regulations must be provided to the supplier already at the quotation stage for the development of contract specifications to ensure consistent consideration during the planning process.

3.9. Layout planning

Plant operators provide the equipment suppliers with up-to-date plans, thereby facilitating the development of correct plant layouts.

The supplier will examine the planning documents and existing plans in a timely fashion.

As a result, critical areas will be recognized and possible problems can be solved. The possibility of incorporating machinery and equipment must be examined and ensured.

3.10. Plant design in compliance with hygiene and maintenance requirements

Helpful information is provided by the following recommendations of the working group:

- Hygiene requirements for machines and equipment in the confectionery industry /1/
- Foreign matters in confectionery /2/
- Air conditioning in production and storage in the confectionery industry /3/

(Source: VDMA Trade Association for Food and Packaging Machinery, Frankfurt/Main).

Plant accessibility for cleaning and maintenance should be coordinated with the machine suppliers in advance. The required spaces including areas for assembly tools should be shown in the layout. The spaces between the machines must be adjusted accordingly.

4. Designing the materials supply of confectionery plants

Confectionery production companies process a variety of different raw materials and semi-finished products. For the technical design and construction of the interface between the supply or storage of raw materials and semi-finished products and the processing plant, the following items are relevant:

- Physical state of materials (solids, liquids, gases or pastes);
- Flow or transport properties depending on temperature and moisture;
- Granulation and bulk density for predominantly solid raw materials;
- Production process (continuously, discontinuously, type and number of process steps);
- Quantity throughput;
- Microbiological and other technical safety requirements in product handling.

4.1. Classification of materials fed into processing plants

- Gaseous compounds are pure gases (e.g. nitrogen dioxide) or gas mixtures (e.g. processed air). They are transported via pipe or hose systems and portioned via valves.
- Liquid compounds include fluids (e.g. drinking water, liquid fat, etc.), suspensions (e.g. liquid chocolate) or solutions (e.g. sugar/glucose solution). They are transported via pipe and hose systems and portioned via valves or fed into the processing plants directly from containers.
- Paste-like/semi-solid materials include melts (e.g. paste-like fats), brines, gels, emulsions, finely dispersed substances (marzipan, fondant). They are mostly transported and portioned via pipe systems or fed into the processing plants directly from containers.
- Depending on the granulation of the particles, solid materials can be powdered (flour, starch, powdered sugar), granular (granulated sugar, salt) or chunky (nuts, crispies, almonds, etc.). Possible transport systems to the processing plants include pipe or hose systems, bucket conveyors, conveyor belts, big bags, sacks and individual containers.

4.2. Basic requirements regarding equipment for materials supply systems

- No dead spaces in general;
- Good accessibility for cleaning;
- Connections and seals must be free of crevices;
- Products must be protected from environmental contamination;
- Corrosion must be avoided by using appropriate material combinations;
- Food contamination through migration from parts that come in contact with the products (plastic parts, conveyor belts, seals, etc.) must be avoided;
- Use of approved lubricants and oils.

Apart from the general requirements, the following special requirements additionally apply.

4.2.1. Requirements for pipeline construction

- Self-discharging, with slope;
- Sufficient clearance to walls, ceilings or floors for all supply pipes;
- Must allow individual disassembly/blockage (product flow) but have as few detachable connections as possible (hygiene plant design);
- Select appropriate pipe connection flanges (possibly aseptic flange; flat gasket with sloped flange);
- Use protective pipes for wall openings;
- Plan a sufficient number of supports;
- Avoid changes in cross-section, if possible;
- Piggable construction for multi-product plants (taking into account the choice of valves, flanges, radii, weld seam design, etc.);
- Pay attention to the maximum possible pressure loss in pipelines;
- Short pipelines, large radii, correct pipe cross-sections.

4.2.2. Requirements for containers

- Self-discharging, plan for sufficient floor clearance;
- Construct container bottoms with a radius > 3 mm to the container wall (groove);
- Bottom slope ≥ 3°;
- Closed construction with lid (to prevent introduction of foreign matter);
- Stirrer drives must be installed in way to avoid contamination through lubricants;
- Provide pressure resistance for double-wall containers;
- Ensure appropriate cleaning.

4.2.3. Requirements for measuring devices in pipelines or containers

- Install without dead space;
- Install with accessibility for assembly;
- Possibly weld in measuring sleeves;
- Weld in sensor (pay attention to flow direction).

4.2.4. Requirements for pumps and valves

- Avoid dead water spaces and gas inclusions through vertical arrangement;
- Self-discharging features.

4.2.5. Additional requirements for tempered systems

- Must allow individual disassembly/blockage (product flow and tempering medium);
- Install insulation with smooth surfaces, easy to maintain;
- Take into account thermal expansion.

4.3. Examples for design of interfaces between raw material feed and processing plant

Recommendations for the design of raw material feed interfaces are presented individually for selected raw materials in the table below. These are examples of what should be observed during implementation and how it shall be done.

Raw material	*Transport system*	*Raw material feed to production plant*	*Recommended materials for parts coming into contact with the product*	*Hygiene/cleaning requirements*	*Maintenance issues*
Flour (15 % relative moisture)	Pipeline Container with scales Screw conveyor For continuous feed from pre-dosing vessel with differential scale	Feeding opening on top, batchwise as bulk or continuously as constant product stream	Stainless steels 1.4301 1.4571 1.4541	Dry cleaning; design with no dead space; avoid bridge-formation (cross section, observe container angle)	Ensure easy inspection; silo/storage vessel must be lockable (locking flap)
Chocolate (temperature 40-50 °C)	Positive displacement pump, pipeline, heated valves (short valves possibly also unheated) Ring or stub lines depending on type of chocolate and throughput; if possible piggable	Preferably from the top batchwise/ continuously into the reservoir of the pre-crystallization plant	Preferably stainless steels 1.4301 otherwise standard steel	Smooth surfaces, no dead space	Ensure easy inspection of tanks; all units such as tanks, pumps, etc. must be lockable individually
Icing sugar (temperature 15-30 °C)	Pipeline Container with scales Screw conveyor	Preferably from the top batchwise	Stainless steels 1.4301 1.4571 1.4541	Dry cleaning; design without dead space; avoid lump-formation by integrated stirrers; (recrystallization)	Ensure easy inspection; silo/storage vessel must be lockable (locking flap)
Syrup (temperature 15-85 °C)	Pipeline, heated if needed	Preferably from the top batchwise/ continuously	Stainless steels 1.4301 1.4571 1.4541	Smooth surfaces, no roughness, no dead space	Ensure easy inspection of tanks; all units such as tanks, pumps, etc. must be lockable individually
Nuts (temperature 20-25 °C)	Transport carts with tilting device/ conveyor/storage vessel/dosing unit	Preferably from the top batchwise	Stainless steels 1.4301 1.4571 1.4541		No specific requirements
Whole eggs	Reusable containers -> containers for intermediate transport	Preferably from the top batchwise	Stainless steels 1.4301 1.4571 1.4541		Containers must be easy to clean with hot water/ hot steam and easy to disinfect; self-discharging
Prepared oil- and water-free process air	Pipelines; hoses		Stainless steels 1.4301 1.4571 1.4541 food-grade plastics	No dead space, non-return valve function	

Raw material	*Measures for detection and rejection of foreign matters*	*Noise protection*	*Process safety*	*Plant safety*	*Others*
Flour (15 % relative moisture)	For silo systems: upstream sifting and metal detector	Equip containers with vibration motors instead of beaters	Check humidity and temperature in pneumatic conveying systems; avoid over-heating the conveyed product	Ensure potential equalization; check and maintain installed explosion-proof equipment according to inspection plan; at least standard IP65	Avoid accumulation of dust outside the equipment (risk of dust explosion)
Chocolate (temperature 40-50 °C)	For liquid transport and storage: install metal detector and sieve in feeding section		Consistent temperature management in additional heating system	Ensure potential equalization	
Icing sugar (temperature 15-30 °C)	For silo systems: install metal detector and sieve in conveying section	Equip containers with vibration motors instead of beaters	Check humidity and temperature in pneumatic conveying systems; condition conveying air	Ensure potential equalization; checking and maintenance of installed explosion-proof equipment according to inspection plan; at least standard IP65	Avoid accumulation of dust outside the equipment (risk of dust explosion)
Syrup (temperature 15-85 °C)	For liquid transport and storage: install metal detector and sieve in feeding section		Constant temperature management in additional heater		
Nuts (temperature 20-25 °C)	Upstream assurance: absence of foreign matters				
Whole eggs	Upstream assurance: absence of foreign matters		Keep process organization measures		
Air	Change filter depending on contamination or maintenance intervals		Ensure minimum pressure of 6 bar		

5. Rules for the construction site

Construction sites include both construction projects in existing production plants and new construction projects.

5.1. Organizational measures

a) Supplier and client appoint contact persons in charge;
b) Before start of the construction work, the supplier's responsible supervisor will receive basic instructions from the client. This supervisor must ensure that all his workers and all subcontractors' workers receive all instructions.
c) Basic instructions include:
   • Instructions on corporate regulations regarding
     - Hygiene;
     - Occupational safety;
     - Fire prevention;
     - Environmental protection.
   • Instructions on authorizations.
   • Information about the premises.

5.2. Occupational safety

a) External personnel must check in with the responsible department when entering the factory premises (e.g. the technical department, contact person in charge).
b) All individuals must comply with the corporate safety regulations of the client and the supplier as well as with the regulations issued by the workers' compensation board.
c) In case of personal accidents and all other accidents, the company's accident service or occupational safety officer must be informed immediately, e.g. via an emergency telephone number.
d) Everybody must wear individual safety equipment in accordance with regulations.
e) All assembly tools/devices must comply with occupational safety regulations.
f) Supplier's personnel in cooperation with the client ensure proper setup and operation of the construction site.
g) Use of operating equipment such as lifts, cranes, fork lifts, etc. requires the agreement of the client's project supervisor in charge. The contractor must present the required qualifications.
h) The maximum driving speed specified for the factory site (e.g. 15 km/h) must not be exceeded. Passenger cars and/or trucks may only be parked in designated areas.
i) Visitor IDs must be carried visibly at all times.

5.3. Fire prevention

a) The ban on smoking on the factory premises must be strictly observed.
b) Work involving open fire and work involving fire hazards (welding, soldering, grinding, cutting, etc.) require authorization by the client's representative and must be done in compliance with the required protective measures. Appropriate extinguishing materials, e.g. a fire extinguisher, must be at hand. If necessary, a fire watch must be organized.
c) The client's fire prevention regulations must be strictly observed.
d) Make sure that instructions regarding escape paths, evacuation routes and gathering places have been provided.
e) Special regulations apply for particular risk areas (e.g. explosion-proof plants, wooden roofs, etc.).

5.4. Environmental protection

a) Waste water and other solid and liquid substances that accumulate during installation and initial operation must be disposed of in accordance with regulations.
b) The regulations regarding air and noise emissions including the location-specific threshold values must be observed.
c) Hazardous materials (e.g. technical oils, technical gases, acids, alkaline solutions, etc.) must be labeled, stored and handled in compliance with regulations.

The client's project supervisor must be informed about the introduction of such materials into the factory. The supplier is responsible for correct use and storage.

5.5. Hygiene

The following applies particularly to construction sites within operating factories:

a) Each worker must keep his or her workplace clean. All company hygiene guidelines, especially with regard to the production area, must be observed exactly.
b) In production areas, clean, closed work clothing and complete headgears must be used. If required by company regulations, beard covers must be used.
c) For reasons of hygiene and occupational safety, wristwatches, necklaces, rings, arm and ankle bracelets are not allowed. This also applies to piercings.
d) Personal items, e.g. purses, newspapers, glass or ceramic objects, flowers, private cell phones, etc., must not be brought into hygiene/production areas.
e) Consumption of food, beverages, chewing gum,

candy, etc. in production and storage areas is not permitted.

f) There is a strict no-smoking policy in all production areas and toilets (sanitary zones). Smoking is only permitted in designated smoking zones.

g) Prior to work, all skin injuries must be covered with metallized adhesive plasters. Bandages must be protected from moisture, dirt or damage. In no case, products may be contaminated.

h) Before entering the production areas or resuming work after breaks or toilet use, washing and disinfection of hands is mandatory.

i) Never use tools consisting of or involving wood or wood components (spatulas, brooms, brushes). For brushes and brooms, the bristles must be firmly connected to the body of the brush.

j) For cleaning purposes use only lint-free cleaning cloths, preferably labeled in different colors for the separate cleaning of
   - Production plants;
   - Technical facilities;
   - Sanitary areas.

k) Never use wooden pallets in hygiene areas. Never place plastic containers or boxes on floors but only on trolleys or plastic pallets.

l) Prevent the intrusion of flies, moths or other pests. Windows and doors may only be left open if they are protected by fly screens. Doors and gates should be opened only as briefly as possible.

m) Change heavily soiled work clothing.

n) Workers are not permitted to wear nail polish.

o) Wear clean and safe shoes at all times.

p) The sampling of products directly at the production plant requires prior authorization. Employees must not open finished packages or remove products.

q) Do not place disassembled machine parts directly on the floor.

r) Do not place any tools or foreign objects on transport systems or plant parts.

s) Workers must use only clean tools/devices.

t) Only clean components must be installed.

u) Transport packaging must be removed from the production rooms.

v) Any contamination must be limited by immediately absorbing, extracting or otherwise removing the contaminant in question.

w) Only lubricants, additives or detergents approved by the client may be used.

x) The facilities must be cleaned (well-swept) by the contractor's workers every day. Additional cleaning measures must be initiated in cooperation with the client, if needed.

y) The contractor must dispose all waste materials daily in an appropriate manner.

z) The contractor must hand over the construction/assembly site in clean condition (at least well-swept).

5.6. Authorizations

a) Illustrated technical documentations, sketches, etc. require the client's agreement. Assembly reports are exempt from this requirement.

b) The contractor's workers may only enter areas for which they were previously authorized.

6. Disclaimer of liability

a) Liability/insurance aspects were not taken into consideration in the development of this guideline. We strongly recommend that the contractor takes care of a respective insurance policy.

b) Unless previously published or part of general technical knowledge, all technology and expert knowledge must be kept confidential.

c) All laws and regulations must be observed.

d) does not claim to be complete in any way.

7. References

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