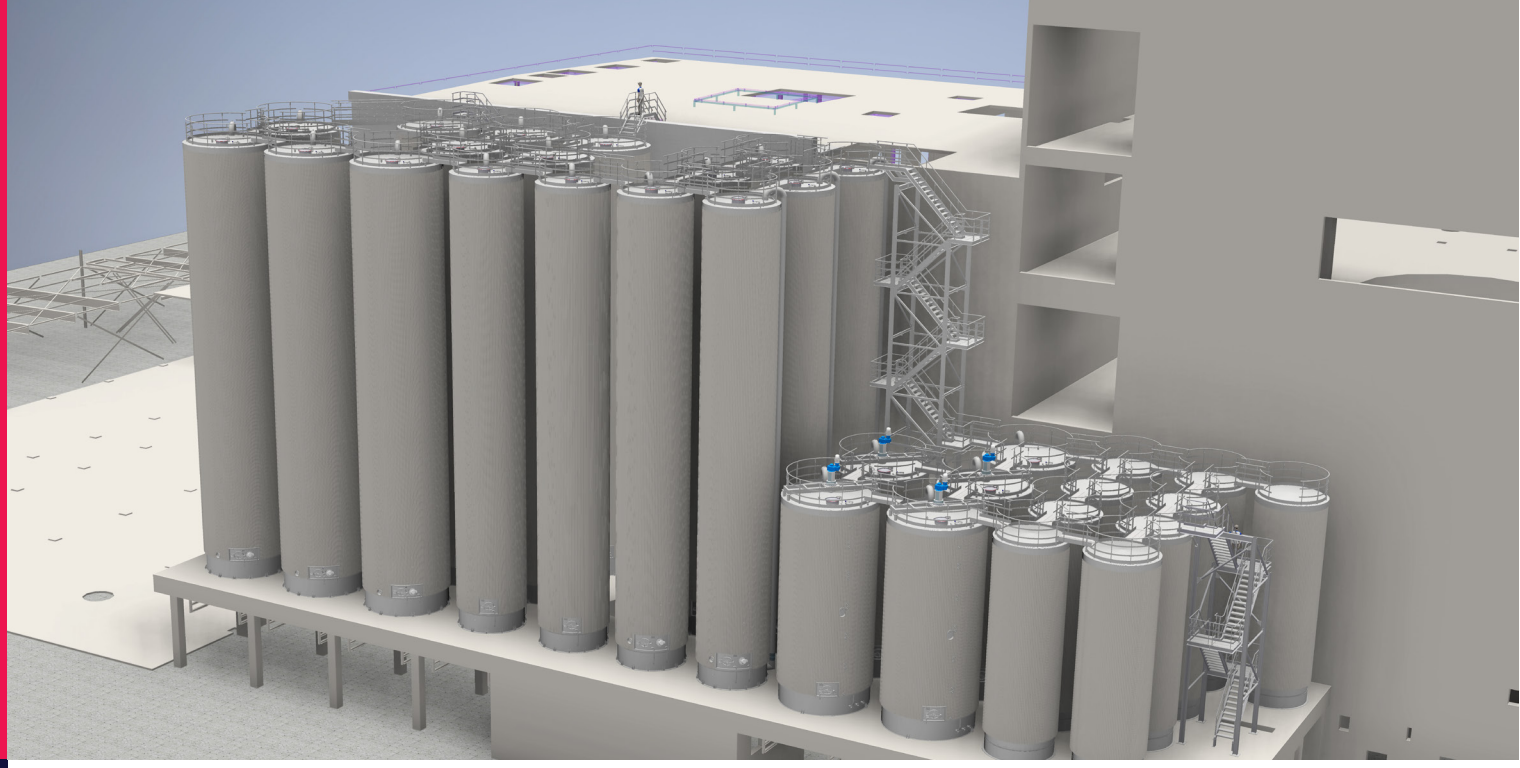

Tanks and equipment for the dairy and food industry

Basics for the selection, equipment and use of storage and process tanks

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Ziemann Holvrieka

Contents

Introduction

Dairy products are one of the most sensitive food at all. Therefore, Ziemann Holvrieka places much higher demands on its own products and services than those generally required by the international industry standard.

State-of-the-art production processes ensure, for example, that all storage and process tanks have particularly smooth surfaces. In conjunction with a consistent hygienic design, this ensures maximum biological safety with little cleaning effort.

However, the range of services of Ziemann Holvrieka goes far beyond the production of tanks. Ziemann Holvrieka also advises competently on embodiments, cooling and heating methods as well as on important cleaning issues. Furthermore, Ziemann Holvrieka arranges the complete transportation and installation of tanks.

The present White Paper summarizes this deep and profound design and production knowledge specifically for the dairy industry. The focus is on storage and process tanks. The central questions regarding design, equipment and use are answered in a comprehensive and pragmatic manner. In addition, the White Paper gives insights into the quality features of modern tank production and the materials used in this process.

Which materials are suitable for use in the dairy and food industry?

In the dairy and food industry, mainly chrome-nickel steels with material number 1.4301 (equivalent to AISI 304) or 1.4404 (AISI 316) are used. If required, other steels, such as 1.4541 (AISI 316 L) or 1.4571 (AISI 316 Ti) can also be used.

Due to the high demands on the surfaces in contact with the product, mainly cold-rolled steels are used (see excursus). Hot-rolled steels (see excursus) are used when greater wall thicknesses are required. In this case, hot-rolled steels are subjected to an additional surface treatment.

An overview of the steel grades mainly used in tank construction is shown in table 1.

Materia	DIN	AISI	UNS
1.4301	X5CrNi18-10	304	S 30400
1.4404	X2CrNiMo17-12-2	316 L	S 31603
1.4541	X6CrNiTi18-10	321	S 32100
1.4571	X6CrNiMoTi17-12-2	316 Ti	S 31635

Table 1: Overview of the steel grades used in tank construction.

Excursus: What is cold- or hot-rolled steel?

Before delivery, the steel is rolled to the desired sheet thickness. This is done in a multi-stage rolling process at ambient temperature. In this process, the “cold” sheet receives its final thickness and surface. This cold-rolled steel has a slightly higher strength than its starting material. In addition, its surface is much smoother, which in tank construction is synonymous with a lower grinding and refinement effort. The aim of this refining is a high surface quality, which is a prerequisite for use in the food industry. If a greater wall thickness is required, the steel is hot rolled. During the rolling process itself – as the name implies – the starting steel is heated accordingly.

Hot-rolled steel is rolled with a smaller number of rolling passes. The steel therefore has a rougher surface. For the production of tanks and vessels, therefore, an additional surface refinement is required.

What does surface roughness mean and what is its relevance for tank construction?

Under the microscope, the surface of a rolled steel sheet looks like the profile of a mountain. The distance between "mountain peak" and "valley" is called surface roughness. This surface roughness is given in µm (Fig. 1).

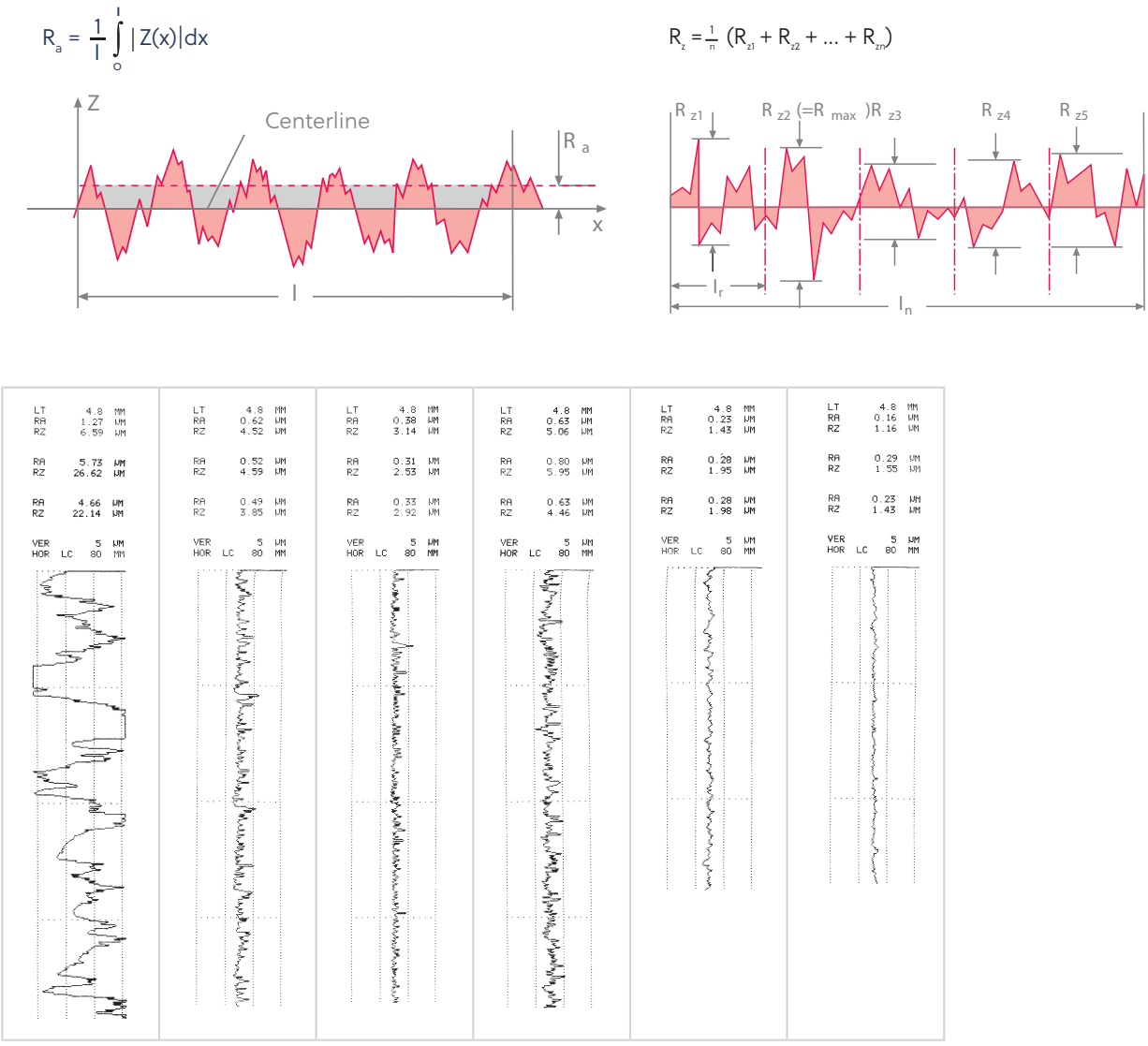

Figure 1: The upper picture shows an example of the graphical representation of different roughness values according to the standard. The lower measurement protocols show the Ra values measured with a stylus instrument. These are an essential part of the quality assurance in the production process.

If the surface roughness is greater than the diameter or the length of a microorganism, this may adhere to the surface and cannot be removed during cleaning or only with great effort. This implies a potential risk of contamination for the product and increased cleaning costs.

In the standard requirements of hygienic plant engineering, such as the EHEDG guidelines, the maximum roughness values therefore are specified in µm. These roughness values are then implemented during the production process of tanks.

The tank builder can influence the surface quality on the one hand by the selected material. Thus, cold-rolled steels have a smoother surface than hot-rolled steels. On the other hand, the surfaces of the tanks are ground to the appropriate value (Fig. 2).

Additional measures, such as mechanical polishing or electro-polishing, can further reduce the surface roughness to values between 0.3 µm and 0.4 µm. For cold-rolled steel, the guide values shown in table 2 can be used, depending on the sheet thickness. For hot-rolled sheets, no roughness values are specified.

Sheet thickness in mm	R_a in µm
2.00 bis 3.00	≤ 0.40
3.01 bis 4.00	≤ 0.55
4.01 bis 5.50	≤ 0.65
5.51 bis 6.00	≤ 0.70
6.01 bis 6.50	≤ 0.80
6.51 bis 6.80	≤ 0.90
6.81 bis 7.00	≤ 1.10
7.01 bis 8.00*	≤ 1.60

Table 2: R_a guide values for cold-rolled sheets.

Basically, the following applies with regard to the surface quality of a storage and process tank:

- Ziemann Holvrieka implements the R_a values of the surfaces according to the customer requirements (Fig. 1).
- The surfaces in contact with the product are optionally also electro-polished.
- By appropriate grinding, hot-rolled steels can be refined to the same surface roughness as cold-rolled steels.

Figure 2: Surfaces can be ground to the required R_a value.

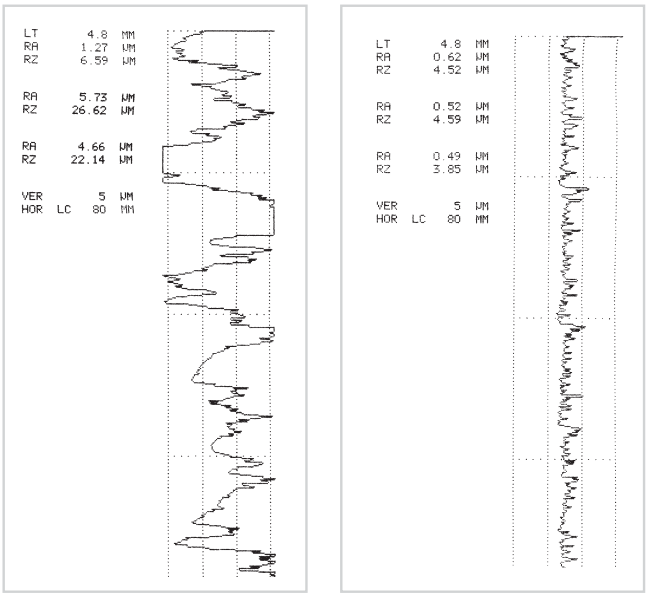

Figure 3: Examples of unprocessed surfaces of a hot-rolled steel 1D (left) and a cold-rolled steel 2B (right) with a wall thickness of 6.0 mm.

Which tank types do exist?

Raw milk storage tanks

Raw milk storage tanks are mainly installed in the outdoor area of a dairy. They are usually insulated (see chapter "insulation") and have an inclined flat bottom. Their capacity reaches up to 500,000 litres. These tanks are installed according to the customer requirements or the existing infrastructure on concrete foundations or supporting skirts. Depending on their intended use, raw milk tanks are equipped with additional functional components, such as:

- Agitators
- Aeration and deaeration devices
- CIP cleaning for tank and agitator
- Connections for filling and emptying
- Connections for measuring and control equipment

Product tanks

Product tanks are special tanks for the characteristic process steps of a dairy, such as curdling, thermisation or mixing. Many dairy products change their structure, viscosity and composition during the production process. In addition to the measuring and control equipment, a product-related mature agitator therefore is required. In a product tank, several and very different mixer types are possible.

For reasons of space, product tanks can also be combined to one tank body. These are called multi-chamber tanks.

Aseptic tanks

Aseptic tanks are used in the production of UHT products. For this reason, special requirements are placed on aseptic tanks in terms of their pressure and vacuum resistance. Moreover, high standards apply in terms of their surfaces in contact with the product.

When designing aseptic tanks, specific requirements regarding the installed functional components must be taken into account. These include, for example, agitators, safety equipment, sterilization/CIP or the measuring and control equipment.

Tanks and vessels for general applications

This tank group includes, for example, CIP tanks, buffer tanks or storage tanks for products and process water.

Figure 4: Raw milk storage tanks are predominantly installed outdoors.

Figure 5: Alternatively, raw milk storage tanks can be installed indoors.

How are tanks equipped for their use in the dairy and food industry?

Insulation

Mineral fibreboards or PU foam plates are mostly used as insulation material. In some applications, the insulation can also be foamed directly. The most cost-effective variant of the outer cladding are aluminium-profiled sheets, which are screwed together (Fig. 7). Alternatively, stainless steel is used as outer cladding, which is welded accordingly (Fig. 8).

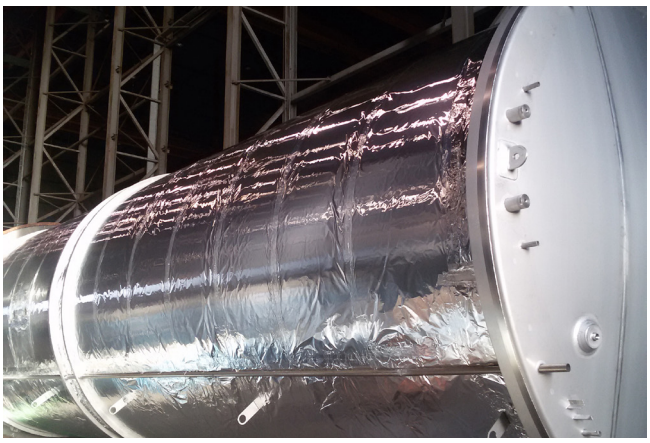

Figure 6: Tanks can be insulated with either mineral fibreboards or PU foam plates.

Figure 7: Mostly aluminium profiled sheets are used as outer cladding.

Figure 8: Alternatively, welded stainless steel is used.

Agitators

The installed agitators are always selected depending on their purpose and the type of product. In practice, the following types have proved their worth: side-entry agitators, blade agitators and turbo mixers.

The agitators are installed either on the side or from above (Fig. 9 and 10). For lateral installation, the agitator is mounted horizontally or at a defined angle.

The agitators are usually driven electrically. Occasionally, magnetic agitators can be found in a dairy.

Figure 9: Agitators are installed on the side...

Aeration and deaeration devices

For the CIP cleaning of a tank, aeration and deaeration devices are absolutely necessary. Only in this way, the volume changes occurring due to the large differences in temperature in the tank interior can be compensated. The necessary supply air volumes and the corresponding free cross sections of the aeration and deaeration devices must be calculated exactly when designing a tank.

Figure 10: ... or from above.

Measuring and control equipment

All connections for the required measuring and control equipment are ideally designed and executed according to customer specifications.

Suppliers such as Ziemann Holvrieka, which are not bound to specific manufacturers, can access the best possible solution for the customer. This applies in terms of their functionality, economy and reliability as well as the degree of innovation.

Heating and cooling

The performance of the heating and cooling technology depends on the product and the user. It is designed individually by the experienced engineers of Ziemann Holvrieka. Pipe segments or thermoplates are usually used (Fig. 11 and 12).

The suitable energy sources are selected according to the requirements and area of application. Moreover, cooled or heated tanks and vessels are mostly insulated.

Figure 11: Pipe segments

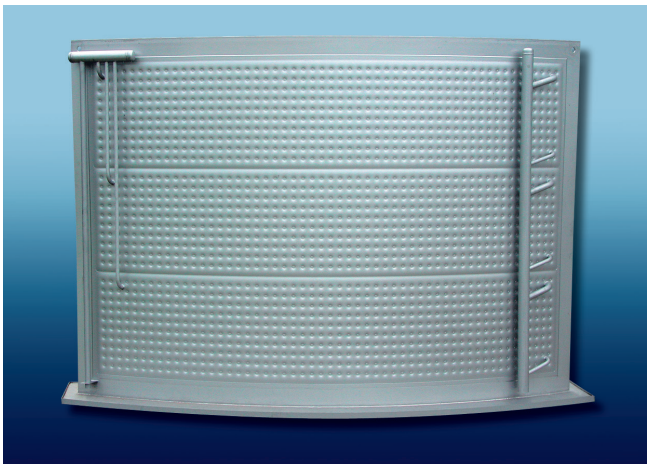

Figure 12: Thermoplates

CIP cleaning

The CIP cleaning is designed individually, depending on the product type and tank type. All relevant process and legal requirements are taken into account.

The cleaning modules are selected according to the size of the tanks or vessels and the characteristics of the products to be produced (Fig. 13).

For the actual cleaning so-called spray heads or cleaning turbines are installed. During the engineering of the tanks, the type, size, number and design of these cleaning modules are clearly defined.

Figure 13: The selection of the cleaning modules depends on the size of the tanks or vessels and the products to be produced.

How are tanks implemented?

Tanks with flat bottom or tanks with skirts are usually installed and anchored on concrete foundations. Large storage tanks such as raw milk tanks rest on concrete foundations.

Depending on the customer requirements and infrastructure, these tanks are also equipped and installed with skirts. Product tanks are equipped with feet or a skirt with height adjustment, on which the tanks are installed.

Which regulations regarding hygiene and quality must be considered

National and international regulations such as EHEDG and HACCP prescribe a consistently hygienic design of all tanks and vessels.

The design of the surfaces in contact with the product must be taken into account and is implemented by the manufacturer according to the customer's request (see "surface roughness"). During tank production, the quality of the surface, which is in contact with the product, is closely monitored. This is done by means of a stylus instrument, which measures and clearly documents the surface profile. Further surface inspection and quality assurance can be made by means of bacteriological tests.

What must be considered with regard to the engineering?

For each project, the specifications of a storage and product tank are precisely recorded, calculated and defined. The most important parts of the engineering of a storage and process tank are as follows:

- Calculation in accordance with the regulations
- Calculation of stability (wind loads, anchoring devices, snow loads, seismic loads, etc.)
- Exact calculation of the requirements for heating or cooling equipment (exchange surface, heat and coolant requirements)
- Calculation of the ventilation cross sections required for the CIP cleaning

Conclusion

The different process and storage tanks play a central role in the construction of a new production facility, in an expansion or replacement investment. In order to solve this challenging task in its entirety, Ziemann Holvrieka offers the necessary key competences to the global dairy and food industry, such as:

Experienced manufacturer with all relevant approvals for the production of process and storage tanks

Engineering with worldwide expertise and profound process know-how

State-of-the-art production facilities for outstanding and documented quality

International specialists for installation, assembly and service

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Tim Elbert is a certified mechanical engineer and bachelor of technical business management. In 2001, he started a training as a metalworker specializing in design engineering at Ziemann Holvrieka in Bürgstadt. After completing his vocational training, he worked as a metalworker for a few years, before completing his further education as a state-certified mechanical engineer and bachelor of technical business management. Between 2013 and 2017, he worked in the quotation department. Since 2017, he works as a sales engineer for tanks. Today, he advises international customers from the beverage and food industry.

About Ziemann Holvrieka

Ziemann Holvrieka can look back on a history of more than 170 years. The company is one of the world's leading manufacturers of tanks and process technology for the brewing, beverage and food industry.

The customers include local producers and international corporate groups. Furthermore, Ziemann Holvrieka offers a wide range of tanks and process technology for chemical applications as well as for the pharmaceutical industry. Last but not least, Ziemann Holvrieka is the reliable partner for modernizations, capacity expansions and turnkey projects thanks to its many years of experience, global references and innovative solutions.

Thank you for your time.

For all enquiries, please contact one of our sales team at a Ziemann Holvrieka office near you.

Scan the QR code or visit www.ziemann-holvrieka.com

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