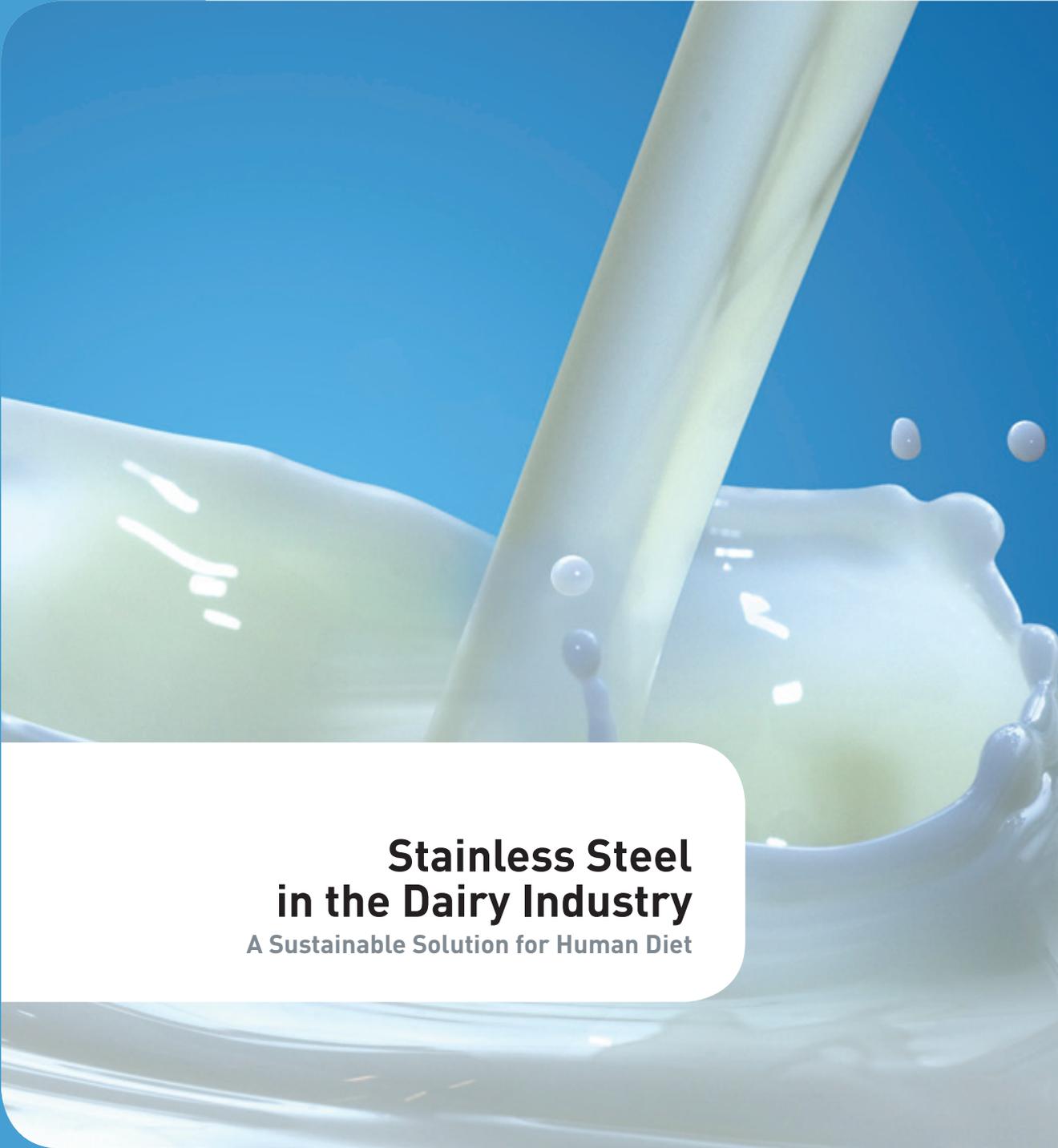


SUSTAINABLE
STAINLESS



**Stainless Steel
in the Dairy Industry**
A Sustainable Solution for Human Diet

Stainless Steel in the Dairy Industry
A sustainable solution for human diet
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Publisher

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introduction

Dairying has been an agricultural practice since people first started domesticating animals. Milk and dairy products are a vital part of the diet for many people. They contain most of the basic elements necessary for children to grow and are an important part of the human diet.



Dairy products constitute one of the five main food groups that together comprise a healthy and balanced diet. Significant amounts of protein are found in dairy products along with most of the micronutrients we need. These include calcium, the B-group of vitamins, vitamin A, iodine, magnesium, phosphorus, potassium and zinc. Milk and dairy foods can also help to improve bone and dental health and may have a role to play in protecting the body against hypertension.

The progress in dairy science and technology has increased the level of hygiene required during the manufacture of dairy products in order to preserve their nutrients. The modern dairy industry requires the use of cleanable, corrosion-resistant stainless steel equipment to meet the needs of milk product consumers everywhere.



WHAT MAKES STAINLESS STEEL A SUSTAINABLE MATERIAL?

Before we can determine whether stainless steel is a sustainable material, we should first define what we mean by sustainability in relation to what is known as the triple bottom-line: People, Planet and Profit.

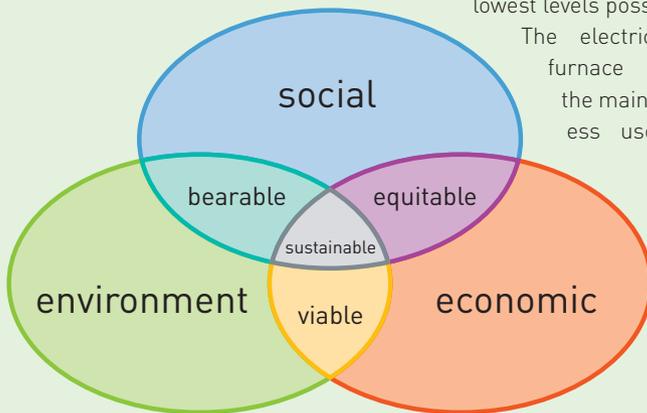
1. People

The material, in its use or in its production process, respects the human being, especially in terms of health and safety. A sustainable material does not harm the people working to produce it, or the people who handle it during its use, recycling and ultimate disposal. Stainless steel is not harmful to people during either its production or use. A protective layer forms naturally on all stainless steels because of the inclusion of chromium. The passive layer protects the steel from corrosion – ensuring a long life. As long as the correct grade of stainless is selected for an application, the steel remains inert and harmless to the people who handle it and the environment. These characteristics have made stainless steel the primary material in medical, food processing, household and catering applications.

2. Planet

The emission footprints of the material, especially those related to carbon, water and air, are minimised. Reuse and recyclability are at high levels. The material has low maintenance costs and a long life, both key indicators that the impact of the material on the planet is at the lowest levels possible.

The electric arc furnace (EAF), the main process used to



Source: Wikipedia

make stainless steels, is extremely efficient. An EAF has a low impact on the environment in terms of both CO₂ and other emissions. The EAF is also extremely efficient at processing scrap stainless, ensuring that new stainless steel has an average recycled content of more than 60%. Stainless steels are easily recycled to produce more stainless steels and this process can be carried on indefinitely. It is estimated that about 80% of stainless steels are recycled at the end of their life. As stainless steel has a high intrinsic value, it is collected and recycled without any economic incentives from the public purse.

3. Profit

The industries producing the material show long-term sustainability and growth, provide excellent reliability and quality for their customers, and ensure a solid and reliable supply-chain to the end consumer. Choosing stainless steel for an application ensures that it will have low maintenance costs, a long life and be easy to recycle at the end of that life. This makes stainless an economical choice in consumer durables (such as refrigerators and washing machines) and in capital goods applications (such as transportation, chemical and process applications). Stainless steels also have better mechanical properties than most metals. Its fire and corrosion resistance make stainless a good choice in transportation, building or public works such as railways, subways, tunnels and bridges. These properties, together with stainless steels' mechanical behaviour, are of prime importance in these applications to ensure human beings are protected and maintenance costs are kept low. Stainless also has an aesthetically pleasing appearance, making it the material of choice in demanding architectural and design projects. Taking into account its recyclability, reuse, long life, low maintenance and product safety, the emissions from the production and use of stainless steels are minimal when compared to any other alternative material. A detailed and precise analysis of the sustainability of stainless steel makes the choice of stainless a logical one. This might explain why, as society and governments are becoming more conscious of environmental and economic factors, the growth in the use of stainless steel has been the highest of any material in the world.

STAINLESS STEEL IS THE ESSENTIAL MATERIAL, FROM FARM TO TABLE



Decades of Experience in Dairy

Milk is an emulsion containing about 87% water. The remaining 13% is made up of fatty acids, inorganic compounds, vitamins, and enzymes which do not dissolve in milk. Fresh milk is an ideal culture medium for microbial flora that can spoil the end product. Thus, the manufacture of milk and milk products is subject to very stringent rules.

These rules cover the way in which the livestock are kept and milked, preparation methods, additives, processing equipment, and the transport tanks that move the milk from the farm to the processing plant.

On its journey from the farm to the consumer, milk comes into contact with the walls of the equipment in which it is being processed or transported. The final product must reach



the consumer meticulously clean and free from all germs. It is for this reason that the dairy industry has employed stainless steel for more than sixty years. The compact and smooth surface of stainless steel prevents bacterial contamination and facilitates cleaning and disinfection.

Why Stainless Steel?



The development of stainless steel in the food industry is explained by the fact that it corresponds exactly to the requirements expected of materials in contact with food. The requirements fall into one of the following three categories:

1. Chemical, bacteriological and organoleptic neutrality with regard to the food product.
2. Ability to be cleaned so the hygiene and appearance of the product is guaranteed.
3. Durability, including resistance to corrosion and aging.

Other factors also contribute towards making stainless steel the preferred material for the entire food processing industry. These include its mechanical characteristics, expansion coefficient, thermal conductivity and ease of use.

Chemical and Biological Neutrality

People are more aware than ever of the impact of the materials used to manufacture and transport food.

Certain materials are widely distrusted because of problems with pollution, allergies and the volume of technical, scientific and medical information available.

A number of studies have found that stainless has no adverse affects on human health, despite its wide and lengthy use in fields such as food, health and human hygiene. Stainless steel is a stable homogeneous alloy composed principally of iron, chromium (13 to 30%) and nickel (0 to 25%).



Cleaning and disinfection

Cleaning involves the elimination of both visible and invisible contamination that adheres to the surface of a material. However, cleaning does not necessarily destroy the micro-organisms that are present on the material.

Full bacteriological cleanliness is obtained only after surfaces are disinfected. Disinfection aims to reduce the microbial population on a surface to a level that is compatible with satisfactory hygiene practice and prevents contamination of the food.

Durability and Corrosion Resistance

Chromium, a component of stainless steel, forms a protective oxide compound on the surface of the metal.

Known as a passive film, this layer slows and even prevents corrosion. If the surface of the metal is damaged, the passive film reconstitutes spontaneously at room temperature through the reaction of the chromium with water and oxygen.

The stability of the passive layer is the determining factor that ensures stainless steels resist corrosion. Stability can be affected by the nature of the corrosive environment. This includes the oxidising power of the material that comes into contact with the stainless, its acidity level, chloride content and temperature.

The corrosion resistance of stainless steel is very important when it is being cleaned or disinfected. When a piece of stainless steel equipment is being cleaned in place, only products that are highly alkaline or acid should be used to obtain perfect hygienic conditions.

Stainless steels' exceptional resistance to corrosion of has enabled the dairy industry to develop widely and rapidly. Stainless behaves quite neutrally and does not alter the taste of fresh milk.



SEGMENTATION OF THE DAIRY MARKET

The market for dairy products can be divided into the following segments:



1. Milk (including raw milk, pasteurised milk, sterilised milk, ultra-high temperature (UHT) sterilised milk, and milk powder).
2. Ice cream.
3. Fresh dairy products (including cream, heavy cream, UHT sterilised cream, fresh cheeses, yoghurt and dairy-free deserts such as flavoured milk, jelly milk, dessert creams, foams, egg custards, crème caramel, and rice pudding).
4. Dairy compounds such as casein, caseinates and lactos-erum or whey).
5. Ripened cheeses (including soft, veined, pressed paste, baked firm, cooked or uncooked).
6. Butters (including raw butter, salted butter, reduced-fat butter, cooking butter).

WHICH STAINLESS STEEL?

Both the equipment and facilities used in the dairy industry today are made from austenitic stainless steels.

ASTM	EN	Type	Chem. Composition (%)
304	1.4301	Austenitic	18Cr, 9Ni
316	1.4401	Austenitic	17Cr, 10Ni, 2Mo

It is generally accepted that a reduction in the roughness of a surface results in less soiling. The soiling is reduced because a smaller surface area comes into contact with the surrounding environment. This is another reason why cold rolled stainless steel is generally used for stainless steels that come into contact with foods.



EQUIPMENT USED TO MANUFACTURE DAIRY PRODUCTS

The equipment required to manufacture various dairy products includes:



- Farm equipment (including milking equipment, barns and sheds, milk tanks...).
- Road tankers.
- Vats (such as storage tanks, maturation tanks, process tanks with agitators...).
- Heat treatment equipment for pasteurisation or sterilisation (for example, plate exchangers, tubular coolers, evaporators...).
- Specific equipment for making dairy products such as cheese and butter (for example, curd slicer, churns, butyrate machines...).
- Other equipment (such as packaging lines, pumps, valves...).

The table below gives a rough idea of the grades encountered for the different equipment used in the dairy industry.

Equipment	End use	Grades
Refrigerated storage tank	All dairy products	304
Centrifuge, Pasteurizer	Milk, Yoghurt, Cream, Butter	304, 316
Plate and tubular heat exchangers	Milk, Cheese, Cream, Butter, Yoghurt	316
Packaging machine	Milk, Cream, Yoghurt	316
Ultra filtration equipment	Cheese	316
Maturation tank	Cheese, Ice Cream, Cream, Butter	304, 316
Cheese racks	Cheese	304
Other equipment	All dairy products	304, 316



CRITERIA DETERMINING THE CHOICE OF STAINLESS STEEL



Stainless steel should be utilised in the dairy industry where the following criteria are important:

1. Hygiene and food safety
2. Improved corrosion
3. Waste water treatment
4. Cost reduction in cleaning and corrosion resistance to acid
5. Sterilisation and pasteurisation at high temperatures

In nearly all equipments needed in the milk and dairy industry (tank, heat treatment equipment, tubular coolers, packaging lines, agitators, etc), stainless steel brings the most effective answer to the multiple requirement for a safe and economical production process.

WHAT THEY ARE SAYING ABOUT STAINLESS STEEL IN THE DAIRY INDUSTRY

The economic advantages and technical merits of stainless steel grades have been appreciated by the milk and dairy industry for a number of years. The following testimonials show that these benefits are becoming more widely understood.

Case Study in Japan

Dairy products go through a diverse range of processes as they are moved from the farms where the milk originates, to the production plants where it is turned into consumer products such as pasteurised milk, cream and yoghurt. Stainless steel is widely used in almost all of the processes the milk passes through on its journey from farm to consumer.

In Japan, stainless steel products are used in all phases of the dairy production process. These phases include:

- Transportation of the raw milk
- Inspection
- Purification
- Homogenisation
- Sterilisation
- Cooling
- Filling
- Final inspection
- Shipment to shops.

Different grades of stainless are used in each phase of dairy production. For example, grade SUS304 (referred to as Type 304) is utilised in products used to receive the milk and in all phases up to and including homogenisation.

In the sterilisation and cooling processes, either grade SUS316 (referred to as Type 316) or SUS316L (referred to as Type 316L) is used. During these processes, the products can reach temperatures as high as 130 °C. These grades of stainless are also used in the production of cheese and butter, both of which contain salt. SUS316 or SUS316L can withstand both high temperatures and the corrosive properties of salt. Equipment used in ice-cream making is usually made from grade SUS304 as it can withstand the cold temperatures required.

Dairy products are very vulnerable to bacteria and have a short shelf-life. To prevent deterioration of the product, all dairy machinery and equipment used in the production process should have the following characteristics:

1. Product integrity: Equipment must have accurate control and measurement devices and there should be no leaks of oil or other contaminants from the equipment into the product.
2. Cleanliness: Equipment must have smooth surfaces that do not allow bacteria to breed. They should also be no higher than the reach of an average person's hands to ensure they can be cleaned thoroughly.
3. Disassembly: Equipment must be easy to take apart so it can be thoroughly cleaned and sterilised.



Milk production plant (Iwai Kikai Kogyo Co., Ltd.)



Multi-process tank (Narasaki Sangyo Co., Ltd.)

4. Inspection: The design of the equipment should enable the visual inspection of the product during the production process.

In addition to hygiene, the characteristics of equipment used in the dairy industry include: resistance to chemical solutions used in cleaning (such as chloride-based sterilising agents, acids and alkalis); strength and workability. Stainless steel meets all of these requirements.

Other materials are often unsuitable because they cannot withstand the harsh conditions found in many food processing applications. For example, sterilisers are subject to a lot of pressure. Alternative materials such as aluminium are not strong enough to withstand the pressure required. There is also a danger that aluminium will leach ions during cleaning-in-place (CIP). Stainless can withstand high levels of pressure and does not leach during CIP.

Testimonial from Synlait Milk Ltd

The dairy industry is very dependent upon the use of stainless steel, for its excellent strength, its excellent corrosion resistance and the hygienic benefits of using a clean and green material. Also, the ability of the correct grade of stainless steel to be used in many dairy plant application - as long as the stainless steel plant is well fabricated and properly cleaned routinely.

The varied applications of stainless steel in a modern milk processing plant can be demonstrated as follows:

Stainless steel is used to manufacture the truck-mounted milk tanker vessels that collect milk from the stainless steel tanks on dairy farms and deliver it to the dairy factory;

The milk receiving plant at the dairy factory is made of stainless steel because of strict international sanitary and hygiene requirements;

The milk and cream processing tanks at the dairy factory are all made of stainless steel;

The large milk powder dryer vessels are made from stainless steel;

All processing vessels for milk powder are stainless steels of various grades (usually types 304 / 316 / 2205);

The milk powder bagging plant, the materials delivery lines are all in stainless steel.

Chris Peacock, Energy Centre Manager, Synlait Milk Ltd



Testimonial from Avery Consulting Associates

One measure of nickel containing stainless steels sustainability is the number of years it has been used for dairy and food processing equipment. Early versions of stainless steel were developed in the early 1900's, but Dr. W. H. Hatfield is credited with inventing in 1924 the nickel containing 18-8 alloy or what is known today as Type 304. In 1929 it is reported the first stainless steel tanker was used for transporting 3000 gallons of milk. This date coincided with the well publicized use of stainless steel in 1929-1930 for the top seven arches of the Chrysler Building in New York City.

The late 1920's was a significant time in the advancement of food sanitation and hygiene by the establishment of 3-A Sanitary Standards in North America. 3-A came about through the cooperative efforts of the International Association of Food Industry Suppliers (IAFIS), the International Association for Food Protection (IAFP) and the Milk Industry Foundation (MIF). One of the main 3-A activities has been the development of 68 Equipment Standards and nine Acceptance Practices. These Standards are recognized and used world-wide by the dairy and food industries.

One of the first Standards was Sanitary Standards for Storage Tanks for Milk and Milk Products dated March 13, 1946. There have been eight up-dated versions, but most of the stainless steel material provisions have seen little change, for example:

- Originally the stainless steel was specified as 18-8, today Type 304 and 316 are standard.
- Originally a carbon content not more than 0.12 % was specified and today the limit is 0.08 %, but in practice the carbon is usually 0.03 % or less.
- The mill finishes allowed and grinding of welds is essentially unchanged.

In essence, the Storage Tanks made to the Standard have passed the test of time for some 64 years.

Examples of long time service life are not easy to obtain but one large dairy and food company furnished a couple of examples of equipment still in service.

- A Type 316 Lay-down cooker installed in 1954 and still in service.
- A Type 304 stainless steel cream cheese former purchased on September 15, 1949 and still in service.



Lay Down Cooker (LOOS Machine & Automation, Colby, WI)

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The most frequent need for new stainless steel equipment in the dairy process industries is related to manufacturing process changes that in turn may require a different design, size change or other modifications. When stainless steel equipment is properly maintained, seldom is the replacement related to material failure, corrosion or just old age. Further more when the stainless steel is finally retired, there is a significant reclaim value.

Richard E. Avery , Avery Consulting Associates, Inc

Testimonial from Packo Inox

Packo Inox began producing milk cooling tanks in 1965. Today, based on its "hygienic competences", the company still produces cooling tanks, along with milk processing equipment, milking machine parts, hygienic centrifugal pumps, pharmaceutical and biotechnology processing equipment and tanks, and food processing equipment.

The use of stainless steel for milk cooling tanks is prescribed by law in Europe. The general public also prefers that products and components used in the agro-food industry are made from stainless steel. Other materials are no longer accepted. Stainless steel has gained a large segment of the food sector because it:

- Does not leach elements
- Has a surface that bacteria cannot adhere to easily
- Is easy to clean and resistant to aggressive foods (such as fruit juices, spinach, fatty acids).

Despite the ease of cleaning stainless steel, cleaning procedures need to be followed carefully to prevent biological fouling. The smoother the surface, the less bacteria can adhere to it. A fine polished finish is better than a rough one. At Packo Inox we even can electro-polish the stainless so it has a very low surface roughness. Packo also masters the CIP or "Cleaning In Place" technology of stainless steel equipment for a controlled cleaning to the highest hygienic standards.

In the past, milk was collected from the farm on a daily basis. Now it is more and more common for the milk to be collected every three days. This means bigger volumes and more efficient collection (only two farms per pick-up, instead of ten in the past). In order to preserve the milk for three days, the finish of the milk cooling tank is a very important factor. The quality of the milk is even more important for [special] cheeses.

Other benefits of stainless steel that are important to the food industry include its mechanical strength and wear resistance. Our products are an important part of the total investment budget in a dairy. Customers want to be sure that they are stable, hygienic, and long lasting.



Batch pasteurizer for hard cheese

The sustainability of stainless is a good sales argument. A milk-cooling tank is used for many years. The life cycle impact of stainless steel on the environment is becoming more and more important. The well designed Packo products therefore have a high second hand value and are found around the globe.

Stainless steel has almost completely pushed aside copper in the dairy industry. Aluminium products were available for a while, but in the long term, the price advantage was not enough to counter aluminium's limited sustainability.

The price of milk is determined by the market, and a premium is paid for high quality milk. Hygiene and ease of cleaning are very important to achieve that premium. Our milk cooling tanks are used all over the world in all kind of environmental and hygienic conditions. They are cleaned with all types of cleaning agents, so highly resistant grades of stainless, such as the proven 304 or even 316, are used.



Vertical milk cooling silotank

We manage to engineer a product with minimum raw materials while ensuring that it has a long life span. We tested lower Ni containing alloys, but we have never introduced other materials in this market. We, and most important of all, our customers, are happy with the proven stainless steels we have been using over 45 years!

Ir. Johan Ameel
CEO, Packo Inox NV

Testimonial from the International Dairy Federation

Stainless steel is generally preferred over other metals. In part this is due to its properties which include ease of cleaning and its resistance to corrosion, chemical products and scratches. However, a major reason for using stainless is its surface which gives a clean and shiny look and does not require paint protection. Therefore there is no risk of contamination and maintenance is reduced.

- Stainless has multiple uses, particularly where the product comes into contact with a metal, or where regular cleaning is required (for example, pumps, packaging machines, or pipelines).
- Due to its corrosion-resistance, stainless steel is stronger and has a longer life span which is vital for our business.
- The dairy sector is a big consumer of water, energy and chemicals. Stainless Steel contributes positively to reduction of waste volumes.

Christian ROBERT
Secretary General
International Dairy Federation, Brussels, Belgium

Testimonial from Brazil

Stainless steel is seen as one of the sustainable catalyzing agents in the milk production chain in Brazil.

The milk production chain in Brazil is of major economic, social and environmental importance. It is estimated that the sector generates four million jobs within the one million small, medium and large dairy producers in Brazil. It is important to make these businesses profitable, in order to keep the workforce in the field and avoid migration to the big cities.

Successful dairy farming requires the integration of agriculture and cattle raising. Producers must efficiently produce the energy and protein demanded by the herd. The milk production chain begins in the agricultural industry and requires equipment, fertilizer, pest control and seed producers. Even in this first phase of the milk production chain, the characteristic properties and attributes of stainless make it an important part of the agricultural process and products.

However, when we talk about the process of producing milk and its derivative products, the role of stainless steel changes from that of supporting actor to leading actor. The machines, equipment and facilities used for milk production use stainless steel intensively.

The vacuum milking machines and cooling tanks on the farm, and the trucks that transport the milk to be processed all use stainless steel solutions. The processing factories which produce UHT milk, powdered milk, cream, cheese, butter, condensed milk, sweets, ice cream and chocolate are intensive users of stainless steel due to its properties, characteristics and attributes. When the products are shipped to the cafeterias, bakeries, supermarkets, and ice cream parlours where they are sold, they are stored and displayed in fridges, freezers and shelves which also intensively utilise stainless steel.

The Brazilian dairy industry has a yearly turnover of approximately USD\$8 billion. This represents around 8% of the country's entire food industry.

Mario A. Porto Fonseca
General Manager ArcelorMittal Inox Brasil Serviços, Brazil

Testimonial from GEA Farm Technologies

GEA Farm Technologies GmbH introduced stainless steel into its products about 50 years ago. Stainless steel is now used for all applications where parts come into contact with milk at a dairy farm. These include the milking claws, pipes, pumps, cooling tanks, and components that are installed in the corrosive environment of the barn (such as parlour frames, stalls, covers, control boxes, and feeding systems).

The reasons for using stainless steel are food safety guidelines and laws, and the dairy farmer's requirements for robust, reliable, long-lasting solutions in a tough environment.

Stainless steel is the only material that has been able to combine the durability, stiffness and resistance against corrosion required in the dairy industry. The most important assets of stainless steel are:

- The durability of material (limited corrosion compared to carbon steel)
- Longevity of milking, cooling and feeding equipment in a corrosive environment
- Limited maintenance requirements for stainless products
- Its perception as a premium product.

The trend in the dairy industry with regard to food safety regulations is to become stricter. In many countries, dairy farming is becoming more specialised. Farmers look for professional equipment that has the lowest total cost of ownership.

Acceptance of alternative materials is limited. Stainless steel is seen as the guarantor of food safety, milk quality and the



highest hygienic standards. However, cost saving requirements, the weight of equipment, and the additional features provided by new materials are reasons that might make manufacturers turn to solutions other than stainless steel.



Farming in general aims to be sustainable. Any governmental support, especially in Europe, is linked to sustainable production which includes sustainable product solutions. Stainless steel is, to a certain extent, a sales argument. Compared to most modern alternatives, stainless steel can be recycled.

As dairy farming is strongly depending on natural resources, there is a clear trend to save water, energy and chemicals. Government initiatives in many countries force our customers to review their production schemes to ensure they are more environmental friendly and reduce the consumption of scarce resources such as water. GEA is developing more efficient product systems that incorporate pre-cooling or heat-recovery systems to reduce energy costs.

At GEA, we favour stainless steel from the manufacturing and engineering perspective. Supply management in terms of availability and predictable pricing is a challenge.

For decades, stainless steel has helped dairy farmers keep the quality of their milk at the highest level. This ensures safety in the food chain and profitability for the dairy farmer.

Markus Buschkühle
Senior Manager, Engineering Service
GEA Farm Technologies, GmbH

Testimonial from the Institut National de la Recherche Agronomique (INRA)

Today the dairy industry utilises a large amount of stainless steel in all its forms, throughout the milk and dairy-product production chain. Stainless steel was introduced several years ago to solve problems such as cleaning resistance and equipment hygiene. Hence, its resistance to corrosion and ease of cleaning have been developed through the improvement of stainless steel's surface properties which make it neutral to chemicals, bacteria and the product it is in contact with.

Since the eighties, laboratories from the Institut National de la Recherche Agronomique (INRA) have worked on the integration of these properties. In the process, INRA and in particular the laboratory from Villeneuve d'Ascq (PIHM) has established close collaborations with industrial equipment manufacturers to develop the properties of stainless.

It is difficult to find alternative products to compete with stainless steel in the food industry. In the dairy industry in particular, processing is often done at high temperature and in harsh conditions. However, in some manufacturing operations alternative materials are employed. Their use is still marginal in processing lines and confined to applications such as seals and diaphragms (made of polymers) or filters and pumps (ceramics). Stainless steels of type 304 and 316 have proven that they can resist the harsh production conditions mentioned.

There is a question as to whether the stainless grades used in the food industry are over-specified. The dairy industry is currently changing its processes to milder conditions preserving the nutritional qualities and integrating hygienically designed systems requiring less tough cleaning conditions. Therefore new 'less-rich' stainless products and compositions could be introduced.

Developments in stainless steel are expected in niche areas for specific applications. At INRA, we think stainless could be developed in two directions:

- Work on the micro-topography or nano-topography of the surface to reduce organic fouling and microbial fouling (biofilm).
- Develop the concept of coatings and focus on surface modifications using techniques such as ion bombardment, plasma treatments, or surface nanotechnology. This would enable a lower grade of stainless to be used as a base of these new surfaces and not directly in contact with food products, provided the resistance (wear) of the coating could be maintained over time.

A comprehensive approach to developing gentler processing techniques for dairy products could enable producers to utilise softer cleaning processes. This would reduce the impact of harsh cleaning products, and stainless steel, on the environment.

Thierry Bénézech
Institut National de la Recherche Agronomique (INRA), France

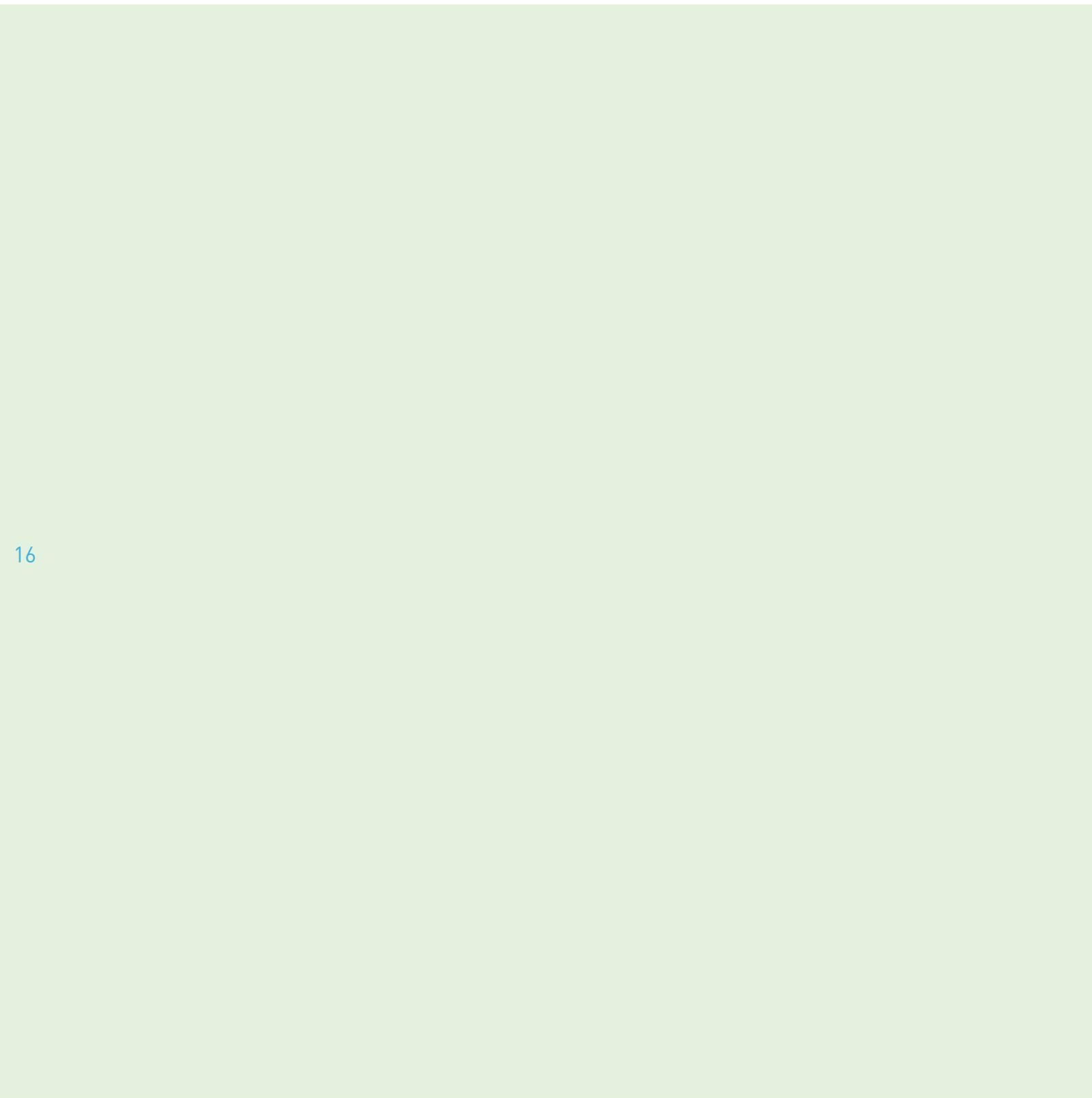
CONCLUSION



Stainless steels have a smooth, neutral surface which does not pick up tastes or smells. Stainless steels are extremely strong so they can withstand tough industrial environments. Today dairy equipment is made of stainless steels because it is easy to clean, disinfect and does not react with the lactic acids formed by fermenting milk.

Strict standards of hygiene are possible at every stage of its use.





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