

Stainless Steel in Agricultural Applications



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1 Why stainless steel in agriculture?

From a simple feeding pail to the most advanced fully robotised milking equipment, stainless steel is found on farms in numerous applications, where it is an alternative to plastics, light metal and above all galvanised steel. There are good economic reasons to go from steel to stainless: standard galvanised parts have a limited useful life. Their corrosion protection depends on an applied zinc layer. The steel is protected by a galvanic reaction: zinc is less “noble” a metal than iron. For that reason, the oxygen involved in the corrosion process will preferentially react with the zinc and leave the steel unaffected. This principle involves two limitations:

- (a) When the protective zinc layer is removed through accidental damage or machining, the unprotected steel is exposed to the environment and will rust.
- (b) The galvanic action progressively consumes the protective zinc layer. The design life of the steel product depends on the thickness of the metallic coating; however it is always limited.

In a robust farming environment mechanical damage is difficult to avoid. For this reason, intrinsically corrosion resistant materials like stainless steel have multiple advantages.



*From buckets to high-tech milking equipment, stainless steel plays a role in agricultural applications.
Photo: DeLaval (UK), www.delaval.co.uk*

Stainless steel does not age – its corrosion resistance remain unchanged over the entire service life of the product.

Among the many options, stainless steel sticks out from among the others by its surface properties. Standard bright finishes are particularly easy to clean. The absence of rough surfaces is particularly appreciated in dairy applications, where the microbiological quality of the raw milk is essential.



Photo: Indipets, <http://fivegallonideas.com>



2 Fences, gates and partitions

Farm buildings include light structures like fences, gates and partitioning walls. Some of the most advanced systems use stainless steel tubular structures because components are easy to pre-fabricate and assemble – also by welding – locally. Their surfaces have excellent cleanability and provide a high resistance against shock and abrasion.



Photo: Niihara (Japan), www.niihara.co.jp



Photo: PureEnsure (India), www.pureensure.in



Photo: Symaga (Spain), www.symaga.com

3 Feeding

Formability and weldability are key requirements for the fabrication of equipment. The material is an asset. The formability of a metallic material is indicated by elongation at fracture. It indicates by what percentage a material can be stretched before it breaks. In the case of stainless steel, this value can be in excess of 50%, depending on the grade. For comparison: usual carbon steel alloys mostly have values around 25% or less and aluminium alloys usually below 10%. The outstanding ductility of stainless steel is one reason why the material is so commonly used for parts of complex shape. It is ideally suited for fabrication processes like break-pressing, deep drawing or spin-forming.

The excellent weldability of stainless steels is another advantage. Except for the removal of weld discolouration, no further post-welding treatment is required. Especially austenitic stainless steel is quite forgiving. This is important when parts have to be welded on site, where optimal conditions are difficult to guarantee.

Mechanical joining involves boring holes into the sheet, tube or section. In the case of corrosion-protected carbon steel, the resulting local removal of the protective metallic or organic coating (i.e. the galvanic layer or the paint) requires repair to avoid premature corrosion. However, the quality of these repairs depends on the skill and care of

the person who applies them. Repaired coatings are rarely as good as the original ones. In the case of stainless steel, there are no such concerns as the material is corrosion resistant through and through and cut edges are as corrosion resistant as the other surfaces.

This combination of intrinsic advantage makes stainless steel an interesting option for smaller and medium sized fabricators involved in the manufacture of custom-made equipment. The additional cost, logistics and time for corrosion protection are avoided.



Stainless steel outperforms other usual metallic materials in terms of weldability and formability.

Photos: Farming Machines China (PR China), www.farming-machinechina.com.

4 Watering

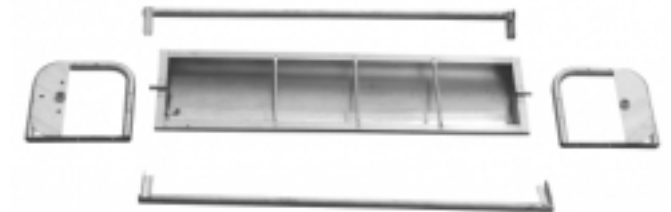
In an effort to provide livestock with a constant supply of clean, oxygenated water which maximises production performance, stainless steel has become common in watering systems. The formability of stainless steel makes it easy to produce rounded edges which reduce the risk of injury to the animals. Stainless steel float bowls have a proven design featuring a deep dish and smooth lip design, which make it excellent for horses, dairy cows and cattle. Watering nipples, for instance for piglets, consist of a stainless steel body together with a stainless steel dome screen and stainless steel spring.



Piglets habituate very quickly to the use of bowl waterers and drinking nipples.

Photos: FormTec (USA), www.farmtec.com

Larger tipping models are made to facilitate emptying and cleaning. Regular maintenance may involve repeated disassembly and assembly, which goes along with considerable abrasive stress to the connections. Coated solutions are prone to damage and wear. Stainless steel solutions prevent connections becoming weak spots in the design.



In the case of stainless steel, there are no protective coatings which are susceptible to damage and wear.

Photos: R.E. Buildings (UK), www.rebuildings.co.uk (left), Agri-Service (Germany), www.agri-service.de (above and below right)



Watering bowls must be mechanically resistant. The cold-working of austenitic stainless steel lends the fabricated components additional strength. The reason is another specific mechanical property of stainless steel – a phenomenon known as work-hardening. In areas where the material is formed, its strength goes up. The increase depends on the degree and the speed of the shape change. The resulting higher strength can make it possible to reduce wall thicknesses, which translates into lighter weight and less material cost.



*Stainless steel bowls can be found on pastures, in cowsheds and stables alike.
Photos: Nelson Manufacturing Company (USA), www.nelsonmfg.com*

5 Electrical and mechanical equipment

Farm buildings require ventilation. Manure and urine make the atmospheric conditions quite corrosive. Stainless steel is therefore a good solution for ventilation ducts and their fasteners.

The elevated temperatures typical of cowsheds and piggeries accelerate corrosive reactions. Stainless steel metal frames increase the useful life of heating and ventilation equipment like hot air blowers, which provide optimal temperature conditions for instance for calves and piglets.

The waste heat in the exhaust air of cowsheds or piggeries can also be used for the heating of adjacent buildings, for instance for frost protection. Stainless steel ducts and heat exchangers are an optimal material choice



*The corrosive atmospheric conditions in livestock breeding make stainless steel a useful material for heating and ventilation equipment.
Photos: Source : DAV Impianti (Italy), www.gruppozeta.com/Dav.html (top and centre), Elster Kromschöder, (Germany), www.ermaf.nl (bottom)*



6 Skin care

The wellbeing of farm animals is closely related to their productivity and health. It is normal behaviour for cattle to rub their skin against trees and other objects. That is what static or rotating brushes imitate in a farm environment. No particular incentive is needed – cows feel naturally attracted by the brushes and use them to clean their skin or get rid of insects. The design must, of course, be quite sturdy and this is why stainless steel is an ideal option. In rotating versions, brushes are driven by electrical motors, which must be protected against impact. Their housing should last as long as the mechanical components and again stainless steel is an excellent choice.

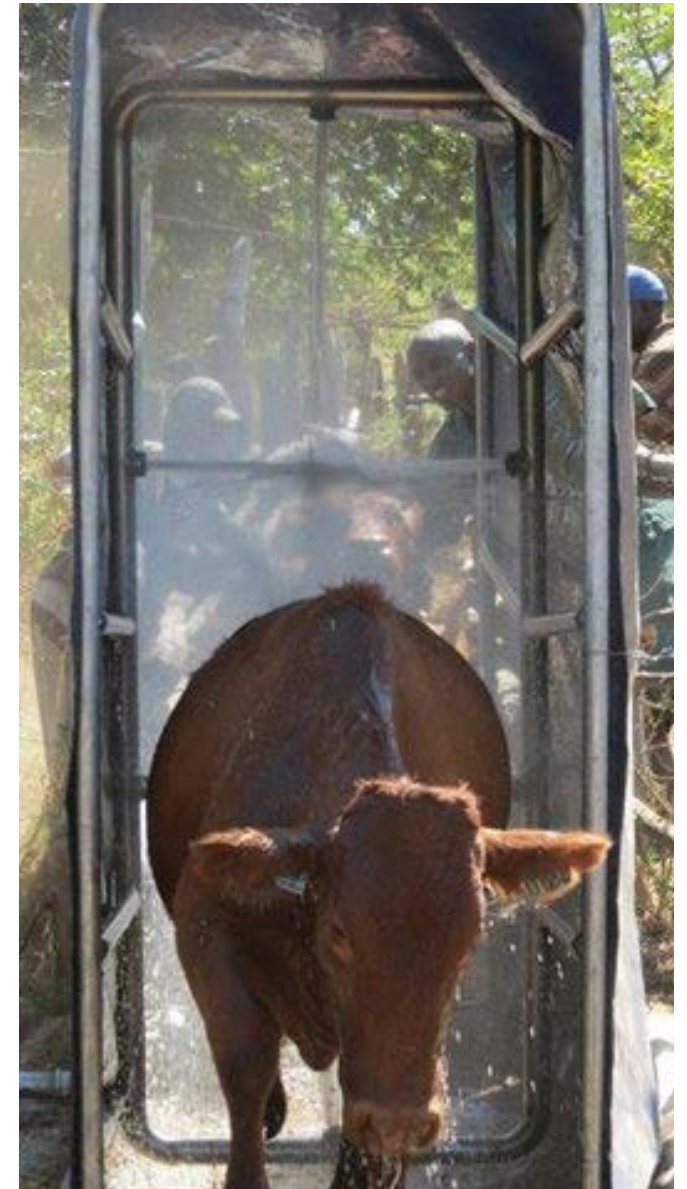


*Cow brushes allow cattle to self-clean their skin.
Photos: Agri-Service (Germany), www.agri-service.de*



In tropical humid areas and regions close to wildlife habitation, it is important to treat livestock regularly against parasites like ticks and mites. Full immersion in plunge dips is a common technique; however, the chemical solution may get over-concentrated through evaporation or unacceptably diluted by heavy rainfall. Spray applicators are an alternative. They make it possible to ensure the right concentration is used consistently. Experience shows that only about half of the chemical product is needed over the year, which means a significant cost reduction. Made from stainless steel tube, spray races are a mechanically resistant solution for many years of trouble-free operation.

In a tropical climate, stainless steel spray applicators prevent tick-borne diseases spreading.
Photos: J. Engelbrecht (RSA), www.sprayrace.co.za



7 Dairy farming

In many parts of the world, dairy farming has been among the most basic and traditional agricultural activities for centuries. Today, Asian cultures are increasingly including milk products into their diet and make this sector of the food industry grow at a spectacular speed. Milk being among the most sensitive food products, stainless steel has been part of the processing chain since the early days of its invention – including milking and the collection of the milk at farms of any size.

The time between milking and the pickup of the milk by road tankers is critical for its quality. Milk leaves the udder at about 35 °C. Milk has natural anti-bacterial properties immediately after extraction, however it should be cooled down to 4-6 °C as rapidly as possible to prevent microbial growth. Austenitic stainless steel has rather low thermal conductivity, which helps to maintain temperatures at the requested low level.

The raw milk is also agitated slightly to keep milk fat from accumulating at the top. Stainless steel is the obvious material for the moving parts.

The thermal energy contained in the milk does not need to be lost: stainless steel heat exchangers use it for the preparation of hot water. Sophisticated models can recover up to 60% of the heat and produce 0.7 litres of warm water of 50 to 55 °C per litre of milk cooled. This water can

be heated up further to 80-85 °C – the standard temperature for cleaning the milking system – or mixed with cold water for general cleaning purposes. During the year, the energy recovered from 1,000 litres of milk per day can save 13,100 kWh of electricity or 1,900 litres of oil.



*For small farms with only few cows, stainless steel bucket-top milkers are a practical solution.
Photo: BouMatic (Denmark), www.boumatic.com*



*Milk cooling with integrated heat recovery ensures optimal raw milk quality and reduces the energy consumption of the dairy farm.
Photos: DeLaval (UK), www.delaval.co.uk*

Modern dairy farming is becoming a robotized process. In the most advanced equipment, cows are milked by camera-controlled robotic arms, which are made from stainless steel. Operations are computer-controlled. Functions and even statistical and health data of the cow are displayed on a touchscreen, which, like most of the equipment, is integrated in a stainless steel cabinet.



*Automated milking stations are to a large extent made from stainless steel – like the touchscreen control panel and the robotic milking arm.
Photos: DeLaval, (UK), www.delaval.co.uk*

8 Ancillary equipment

In weighing equipment, load cells may be safely housed in stainless steel. Also for the floor plates, stainless steel is available as an option. Models with stainless steel teal plate are available for weights of up to one ton. But also smaller vet scales are often full stainless steel designs. Calving aids are often made from stainless steel because of the obvious hygienic advantages of the material.



For calving aids, stainless steel is an excellent option because of its outstanding cleanability.

Photo: Leader Products (Australia), www.leaderproducts.com.au



From crush beams (top left) and floor plate for livestock (bottom left) to vet scales (above), a wide range of weighing equipment is available in stainless steel.

Photos: Nuweigh (Australia), www.nuweigh.com.au



9 Storage tanks for slurry and waste water

Stainless steel containers are used for the collection of slurry as well as biogas fermenters. The challenge is in providing mechanical stability, liquid and gas tightness as well as minimal material use. The mechanical properties of stainless steel fulfil this required profile: the excellent formability of austenitic stainless steel makes it possible to form stiffeners. A combination of mechanical fasteners and polymer sealants provide durable and tight joints.

Erection times for stainless steel tanks are minimal. The surfaces are smooth and pore-free and there are no ageing processes as would be found in cementitious materials. The material stainless steel is chemically and biologically neutral.

Recently, duplex stainless steels have become an alternative to the established austenitic grades in this application. Because of their combination of high corrosion resistance and mechanical strength, wall thicknesses can be reduced by up to 30% compared with classic designs.



Stainless steel tanks for slurry storage and biogas fermentation are fast to erect and the useful life of the material is virtually unlimited.

Photos: Steel Tec Farm GmbH (Germany), www.steel-tec-farm.de



10 Summary

Although less visible to the general public, stainless steel is commonly found in farm environments. Two factors make agriculture an increasingly important end-use for stainless steel: the explosive growth in demand for dairy products, which is fuelled by changing nutritional patterns in Asia, and the need to improve the productivity of farming to feed a growing world population. Corrosion resistance of the bulk material, easy-to-clean surfaces and outstanding formability make stainless steel a most cost-effective solution. Work-hardening, formed stiffeners or duplex stainless steel are alternative options to minimise wall thickness.



Milk cooling with integrated heat recovery ensures optimal raw milk quality and reduces the energy consumption of the dairy farm.

Photo: DeLaval (UK), www.delaval.co.uk



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The International Stainless Steel Forum (ISSF) is a non-profit research and development organisation which was founded in 1996 and which serves as the focal point for the international stainless steel industry.

Who are the members?

ISSF has two categories of membership: company members and affiliated members. Company members are producers of stainless steel (integrated mills and rerollers). Affiliated members are national or regional stainless steel industry associations. ISSF now has 65 members in 25 countries. Collectively they produce 80% of all stainless steel.

Vision

Stainless steel provides sustainable solutions for everyday life.

More information

For more information about ISSF, please consult our website worldstainless.org.

For more information about stainless steel and sustainability, please consult the sustainablestainless.org website.

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