GF Piping Systems

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Butterfly Valve 565

Ensuring the safe and reliable flow of fluids

How plastic butterfly valves reduce the climate impact of piping systems

Abstract

From water treatment to industrial plants, butterfly valves ensure a safe and reliable flow of fluids. In addition, digital interfaces allow them to be seamlessly integrated into modern automated processes in a wide range of applications. But what is the optimal material for butterfly valves – metal or plastic? GF Piping Systems set out to answer this question by conducting a comparative life cycle assessment of the plastic Butterfly Valve 565 and a metal alternative in accordance with ISO 14040/44. The results show that the 565 produces 75 % fewer greenhouse gas emissions throughout its entire lifecycle of 23 years, 33 % fewer greenhouse gas emissions during its production, and has a 21 % lower water footprint. As a result, the Butterfly Valve 565 is an ideal replacement for metal valves. Apart from being more sustainable, it is also 60 % lighter, more cost-effective thanks to longer maintenance intervals, and offers extensive digital functionality. Furthermore, the Butterfly Valve 565 is the first industrial butterfly valve with an Environmental Product Declaration (EPD) in accordance with EN 15804: 2012+A2:2019.

Introduction

The challenges of modern water treatment across industries

Water is becoming a more and more valuable resource. On the one hand, the demand for potable water is increasing as a result of rising population numbers and the threat of climate change. At the same time, modern industries equally rely on process water to produce electronics, pharmaceuticals, or food. Because of these trends, it is estimated that water demand will continue to rise by 20-30 % until the year 2050 (UNESCO, 2019). Furthermore, countries around the world are increasing their use of carbon pricing, either through taxes or emissions trading, in an effort to cut greenhouse gas emissions (OECD, 2022). For every stakeholder in the water industries this means that high quality and sustainable water treatment is turning into a priority as it helps them to not only fulfill environmental sustainability goals but also to save operational costs.

However, in an effort to close water circuits, reduce leakages, and optimize water usage, operators need modern piping systems that are up to the task of ensuring the safe and reliable transport of water and other mediums – while also offering operators future-proof digital functionality that allows them to monitor, control and analyze the system. Furthermore, the sustainability of individual components and raw material, as well as the impact of manufacturing and logistics are also important factors that must be considered. Here, industrial companies require detailed and trustworthy information that helps them make the right decision. Life Cycle Assessments (LCA) are an effective method as they evaluate the environmental impacts of a product throughout the stages of its lifecycle. It is therefore the aim of this paper to demonstrate the advantages of plastic as a long-lasting, environmentally sustainable, and cost-effective material for industrial butterfly valves.

A recent LCA study conducted on GF Piping Systems' plastic Butterfly Valve 565, the first industrial butterfly valve with an EPD (Environmental Product Declaration), will serve as a basis.

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Focusing on the environment

The first industrial butterfly valve with an Environmental Product Declaration

Butterfly valves are essential for safely and reliably controlling the flow of fluids in many different applications, from water treatment to industrial plants. Their construction is simple: A valve housing encloses a disc that that can be rotated within the cross-section of the pipe and reduces flow as needed. Butterfly valves are either controlled manually or with an actuator. In addition, their installation length is compact, and they do not require large investments.

Which type of valve is more sustainable – metal or plastic? GF Piping Systems set out to answer this question and commissioned a study of its Butterfly Valve 565 by an independent institute. The Swiss Climate AG analyzed the environmental impact as part of a Life Cycle Assessment (LCA) that served two main purposes:

The first purpose of the LCA was to achieve an EPD in accordance with EN 15804:2012+A2:2019. The Environmental Product Declaration (EPD) is a Type III environmental declaration that uses scientifically quantified data from the Life Cycle Assessment for the estimation of environmental impacts and comparisons between similar products. The Butterfly Valve 565 is the first industrial butterfly valve to obtain this certification and therefore enables customers to make an informed decision based on an analysis from a trusted and independent source.

The second purpose of the study was to conduct an analysis of the environmental impacts of the Butterfly Valve 565 and a metal alternative as part of a comparative LCA study in accordance with ISO 14040/44.

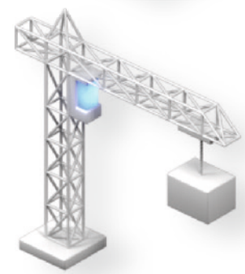
Life Cycle Assessment (LCA)

Study design

The system boundaries, as well as the quality and scope of the Life Cycle Assessment of the Butterfly Valve 565 and the metal alternative are made in accordance with the Product Category Rule (PCR) 2019:14 (EPD, 2022a). PCRs provide the rules, requirements, and guidelines for developing an EPD for a specific product category. They ensure that functionally similar products are assessed in the same way when conducting the LCA and for product comparison. This includes defining which processes and stages of the product's life cycle need to be considered, or the amount, weight and service life of the product being assessed, for example (EPD, 2022b). The life cycle phases and processes considered in this analysis are:

Production stage

Raw material supply, transport, manufacturing



Construction stage

Transport and installation

End-of-Life stage

Deconstruction, disposal, waste processing

Beyond the system boundaries

Reuse-, Recovery-, or Recycling Potential

Figure 1: The four lifecycle phases considered in the LCA study.

Plastic beats metal

In order to put the results into context, the Butterfly Valve 565 DN100 was compared to an equivalent metal valve in the configuration DN100. Figure 2 shows the material composition of both valves.

The comparison of the carbon footprints of the Butterfly Valve 565 and the metal alternative shows that the raw material supply is the most emission intensive phase in the life cycles of both valves. Both the provision of fibre reinforced polyamide (55 % of the Butterfly Valve 565's mass and ferrous metals (86 % of the metal alternative's mass) lead to significant environmental impacts. With regard to manufacturing, the production of the Butterfly Valve 565 results in fewer emissions[1]. When doing a comparison of the valves considering their respective service lives, the plastic Butterfly Valve 565 emits 26 % less carbon emissions than the metal alternative[1].

Compared to the foreseen 23-year service life of the Butterfly Valve 565, the metal alternative must be replaced every 7.8 years in a piping system. The reduced service life is caused by factors such as corrosion, abrasion, as well as inferior chemical resistance. Therefore, when considering that the metal alternative has to be replaced every 7.8 years, the Butterfly Valve 565 outperforms the metal valve in a number of key areas:

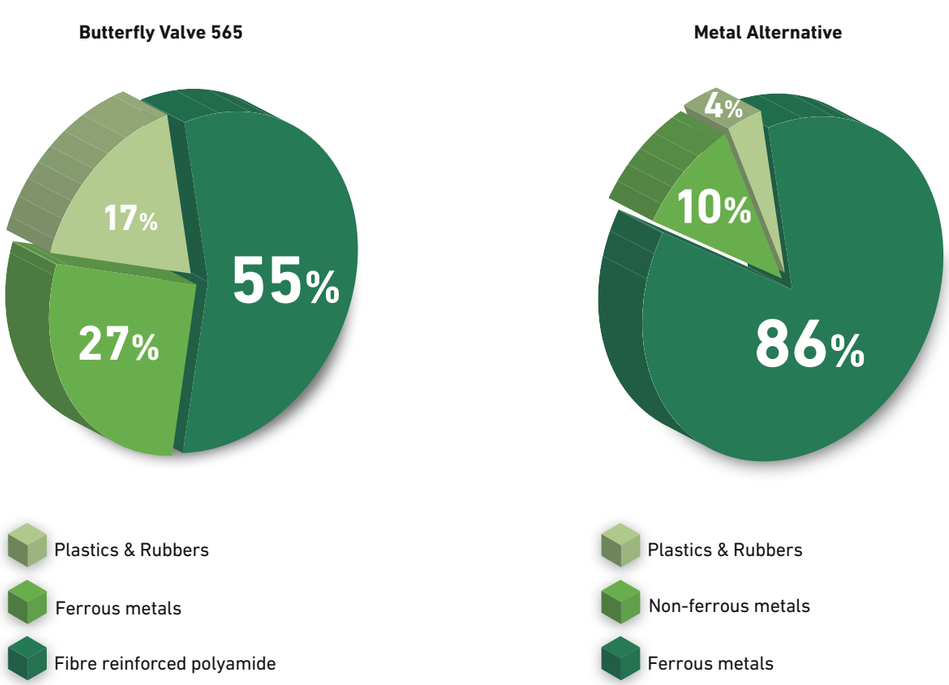


Figure 2: The material composition of the two tested valves (disregarding packaging).

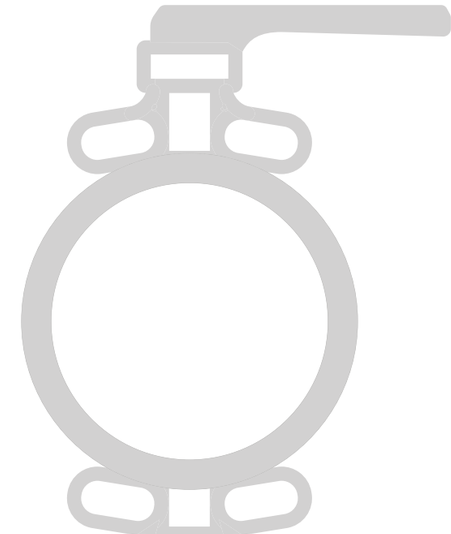
1 It must be noted that to model the production process of the metal alternative, the analysis relies more heavily on assumptions and generic data compared to the Butterfly Valve 565 where system specific data was available.

75%

lower greenhouse gas emissions throughout the entire lifecycle of foreseen 23 years, from the production phase all the way to the end-of-life phase[2].

33%

lower greenhouse gas emissions during the production phase.



21%

lower water footprint throughout the entire lifecycle.

Converted into water use the plastic valve needs less water than the metal valve.

Having a detailed look on the manufacturing phase the impact on the climate change is much lower for the plastic valve than the metal one.

2 The replacement of the metal alternative every 7.8 years is included.

The Butterfly Valve 565

Why is plastic the optimal material for butterfly valves?

Traditionally, many butterfly valves are made of metal. Despite this material's robustness, it has a number of drawbacks. It is susceptible to corrosion which can not only lead to damage within the piping system – resulting in the loss of precious water and a potential environmental risk – but also increases maintenance requirements. The result: High operating costs. At the same time, metal valves are heavy, which increases the logistical costs as well as the physical strain during installation and maintenance. In order to unlock the full potential of butterfly valves, an alternative material is necessary.

Over the past decades, plastics have established themselves as a new standard for modern piping systems. High performance thermoplastics are particularly capable of withstanding stresses such as water shocks and protect the valve against abrasion as well as corrosion. For plant operators this means a longer service life and reduced costs for maintenance or overhauls.

What sets the Butterfly Valve 565 apart?

First presented as the newest generation of plastic valves in 2021, the Butterfly Valve 565 by GF Piping Systems has been on the market for over a year now. The wafer-style valve was developed for water and water treatment applications (e.g. swimming pools & aqua parks, industrial and municipal wastewater, marine applications, or decentralized water treatment), and it is available in dimensions ranging from DN 50 to DN 300. It meets metric, ANSI, BS, and JIS flange standards and is suitable for piping systems made of ABS, PVC-U, and PVC-C, as well as the ecoFIT, COOL-FIT and PROGEF product ranges by GF Piping Systems. The 565 features a very high pressure and temperature resistance (PN16 at 80°C). Its housing is mostly made of fiber reinforced polyamide, while the outer valve disc is made of polyvinylidene difluoride. Due to its construction, the 565 has a number of important benefits compared to metal:

Figure 3: The low weight of the 565 results from a housing made of fiber reinforced polyamide and a polyvinylidene difluoride valve disc.

60% lighter

In a DN 100 configuration, the valve weighs 2,6 kg which is around 60% lighter than metal alternatives. Its low weight simplifies the installation.

Direct replacement

The 565 is available in the same installation lengths as valves made of metal. This means that it can be retrofitted without having to modify the piping system which in turn simplifies the planning and installation phase.

Reduced costs

The purchasing costs are now similar to metal solutions. Due to a longer service life and lower maintenance requirements, the plastic Butterfly Valve is more cost-effective.

How can butterfly valves be integrated into automated processes?

Figure 4: In addition to manual operation, the Butterfly Valve 565 can be fitted with pneumatic and smart electric actuators.

The Butterfly Valve 565 can be manually operated with a lockable lever or a hand wheel. Here, the effort required to fully open and close it can be reduced with the help of a gear box. In addition, it can be operated with a pneumatic actuator that is ideal for plants with a high number of actuated valves, and an electric or smart actuator. But above all, the Butterfly Valve 565 features digital interfaces for state-of-the-art process automation.

Electric Actuator

With a simple set-up and operation, the Electric Actuator is highly reliable. At the same time, the newest generation of actuators features a wide range of intelligent functionality. This includes modular equipment such as different fieldbus options (e.g. Profibus), electric interfaces, integrated battery-powered fail-safe-units or visual system feedback.

Intelligent operation via an app

With the Smart Actuator, plants can be easily digitalized. An app allows the operator to access system data and to monitor and control the 565.

A double sensor for maximum control

Operators can use the optional LED position feedback to monitor the current position of the valve – in combination with manual operation or automation. The compact sensor is suitable for tight spaces and has an IP67 rating.

A full overview thanks to the Data-Matrix-Code

The Data-Matrix-Code can be used to record all technical information about the individual valve. This leads to transparency and traceability, and also simplifies the installation, maintenance, or repair.

Reference Case

The Butterfly Valve 565 in action at De Halve Maan brewery

De Halve Maan is a brewery located in the heart of the Belgian city of Bruges, where it has passed on the art of beer brewing from generation to generation since 1856. Today, the family business has one goal: to brew superior quality beers with respect for tradition. However, De Halve Maan achieves this goal with the environment in mind. As part of a major sustainability project in 2022, the brewery decided to install a water treatment plant at its bottling facility. Belgian company Veolia Water Technologies, a market leader in water treatment, was commissioned to design and install the plant.

For this project, Veolia required compact and easy to install components that do not sacrifice quality or durability, as the available space at the company site was very limited. Therefore, Veolia turned to the Butterfly Valve 565 by GF Piping Systems. The company was convinced by its lightweight and efficient construction which was perfectly suited for the compact plant design and tight spaces at De Halve Maan.

The Butterfly Valve 565 offers the brewery a number of significant benefits. As plastic does not oxidize, there is no risk of corrosion, which makes the new plant future-proof. At the same time, pressure and temperature resistance are an important requirement, as some of the butterfly valves are needed for a heated water system, while others are installed in a ten-meter-high tank with relatively high operating temperatures. Thanks to its material properties and the fiberglass-reinforced housing of the 565, these conditions are not an issue.

The De Halve Maan brewery is very pleased with the result of the new water treatment plant.

"As a brewery, we are big fans of stainless steel, but it is clear that the added value of plastic in this application is enormous. The plastic butterfly valves from GF Piping Systems are a new feat of innovation that will contribute to the longevity of our water treatment plant and the sustainability of our delicious beer through their robustness and lightness."

Karsten Pauwels, Process Manager at De Halve Maan.

Figure 5: Ease of use meets durability:
The Butterfly Valve 565 at De Halve Maan brewery.

Solutions across industries

What do plastic butterfly valves offer the marine industry?

The Butterfly Valve 565 has seen use in swimming pools, potable water treatment and production, hot and cold-water plants, as well as refrigeration and HVAC installations. However, butterfly valves also play an important role in the maritime sector, as ships rely on extensive piping systems for everything from potable water and wastewater to ballast water treatment. Now, the experts of the leading certification societies in the maritime sector, DNV, Bureau Veritas, ABS, Lloyds Register and RINA, have confirmed that the Butterfly Valve 565 with its materials and components in nine sizes has been tested for the safe operation onboard ships. Therefore, the five classification societies have approved the plastic valve for maritime applications. In an industry where weight savings are crucial to lower fuel consumption and CO_2 emissions, this means that the low weight of the Butterfly Valve 565 can now unlock previously untapped potential – for instance, replacing 600 metal butterfly valves saves up to ten tons in weight.

Just like every other industry, the maritime sector is currently facing the challenge of becoming more sustainable. Here, the International Maritime Organization (IMO) is responsible for creating guidelines regarding climate protection. The IMO's current greenhouse gas strategy is designed to reduce the carbon intensity of international shipping by at least 40% by 2030, and 70% by 2050, compared to 2008 (IMO, 2018). For shipbuilders and owners this means that drastic changes to the ways ships are built and operated are necessary. Lightweight and long-lasting piping systems and components such as the Butterfly Valve 565 can be an important part of a larger strategy to make shipping more sustainable.

Approvals

Conclusion

The Butterfly Valve 565 beats metal in every round

Butterfly valves are essential for various applications, from utilities and process industries to the marine sector. However, to ensure the best possible operation, the choice of the correct material is essential. Unlike metal, plastic is corrosion-free, long-lasting, and lightweight. With the Butterfly Valve 565, GF Piping Systems has introduced a new generation that is not only 60 % lighter than metal alternatives, but also makes plastic more cost-effective due to much longer maintenance intervals. At the same time, the 565 offers a wide range of options to automate processes with smart actuators, digital interfaces, and complete traceability which simplifies operation and prepares water applications for digitalization. Furthermore, identical installation lengths make it the perfect replacement for metal valves. But above all, the comparative LCA study shows that plastic is the more environmentally sustainable material throughout its service life – thanks to 26 % fewer CO_2 emissions per unit than metal. When taking the replacement of the metal alternative during the for seen service life of 565 (23 years) into account, the CO_2 emissions are 75 % lower. This combination of a long lifespan, lower environmental impact, and automation make the Butterfly Valve 565 by GF Piping Systems a modern and future-proof solution.

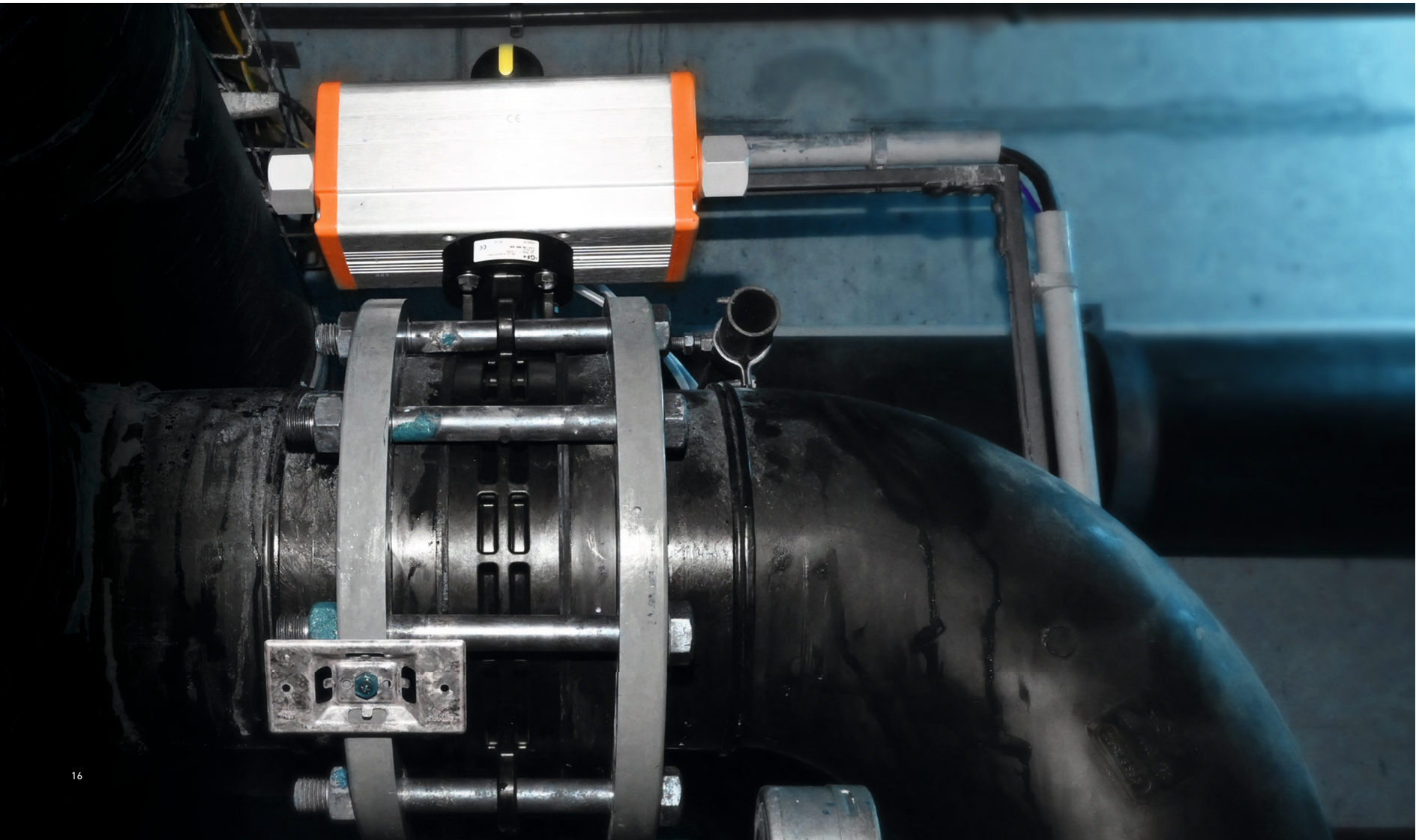


Figure 6: Due to its identical installation length, the Butterfly Valve 565 can easily replace metal valves while additional equipment like the pneumatic actuator allows it to be seamlessly integrated into an automation loop – as seen here at a German aqua park.

About GF Piping Systems

GF Piping Systems is the leading flow solutions provider worldwide, enabling the safe and sustainable transport of fluids. The company specializes in plastic piping systems and system solutions plus services in all project phases. GF Piping Systems has its own sales companies in 31 countries, which means it is always by its customers' side. Production sites in 36 locations in America, Europe, and Asia ensure sufficient availability and quick, reliable delivery. In 2022, GF Piping Systems generated sales of CHF 2,2 bn and employed 8'085 people. GF Piping Systems is a division of Georg Fischer AG, which was founded in 1802, and is headquartered in Schaffhausen, Switzerland.

How can GF Piping Systems help you?

As an expert for the safe and reliable transport of fluids, GF Piping Systems has been a proponent of plastics as a piping material for over 60 years. As a result, our products are currently being used by customers in more than 100 countries around the world. No matter whether they are applied in buildings, utilities, production facilities or on ships, we believe that plastic piping systems are superior to equivalent systems made from materials such as metal or steel: They are lightweight, corrosion-free and require little maintenance, which makes them easy to handle and cheaper to operate. In addition, our broad spectrum of products and services offers the right solution for every application, from new projects to retrofits.

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Figures

GF Piping Systems

Your Contact

Jochen Hamburger
Product Manager Valves
+41 76 424 91 29
jochen.hamburger@georgfischer.com

Georg Fischer Piping Systems Ltd
Ebnatstrasse 111
8201 Schaffhausen
Switzerland

www.gfps.com/565

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