

PFAUDLER

— Glass-Lined Technology

Standard Glass

WWG – Reliable
and Versatile



GMM
— Pfaudler —

PFAUDLER

— Glass-Lined Technology

For over 130 years, Pfaudler is the leader in developing new technologies to meet the highly specific chemical processing needs of its clients. One reason why our glass-lined equipment is trusted by over 90% of the world's top chemical companies is the sheer reliability of our reaction technologies and comprehensiveness of our glass-lined accessories. These technologies are critical to the safe containment of corrosive contents, maintaining the vessel pressure and ensuring the final batch quality.

In short, our glass-lined technologies are absolutely integral to an effective process.

PRODUCTS & EQUIPMENT

Glass Lined Reactors

Glass Lined Mixing Systems

Baffling Technologies

Storage Tanks & Receivers

Glass Lined Columns

Accessories

Glass Lined Instrumentation

**Glass Lined Heat &
Mass Transfer**

50/5/50t

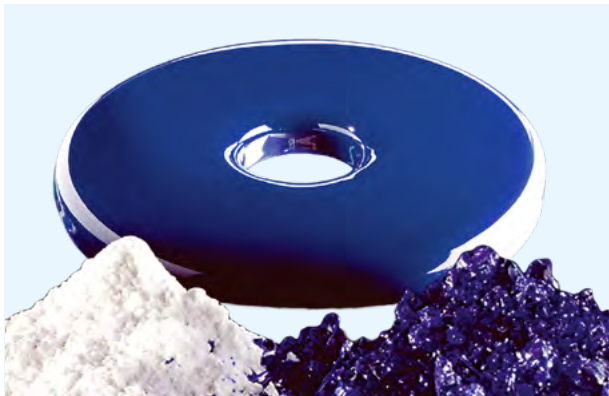


Pfautler World Wide Glass

WWG - the universally applicable classic

Extreme corrosion resistance smoothly linked with extraordinary mechanical stability: these are only two of many properties that distinguish our standard enamelling. Pfautler has taken advantage of knowledge gained in the field of high-technology ceramics in order to improve physical properties and chemical stability. The result is **Pfautler World Wide Glass WWG**, an enamel displaying maximum resistance to acids, water and bases. This provides operators of enamelled devices with a material that protects both the equipment and the product as never before.

Pfautler World Wide Glass WWG is available in cobalt blue, and also white if desired. The high degree of light reflection of the white enamel creates a bright reactive environment and facilitates quick recognition of any colour shift in the current process.



Overview of advantages of Pfautler blue and white World Wide Glass

WWG blue

- Extraordinary corrosion resistance
- Very high resistance against mechanical strain
- Good durability regarding thermal shock
- Homogeneous current enamelling
- Anti-adhesive surface

Additional advantages of white WWG

- Product residues optimally detectable
- Greater contrast to product
- High degree of light reflection





**ACID
CONCENTRATION
 H_2SO_4 | HNO_3**

**ION SENSITIVE
pH Value 2.0**

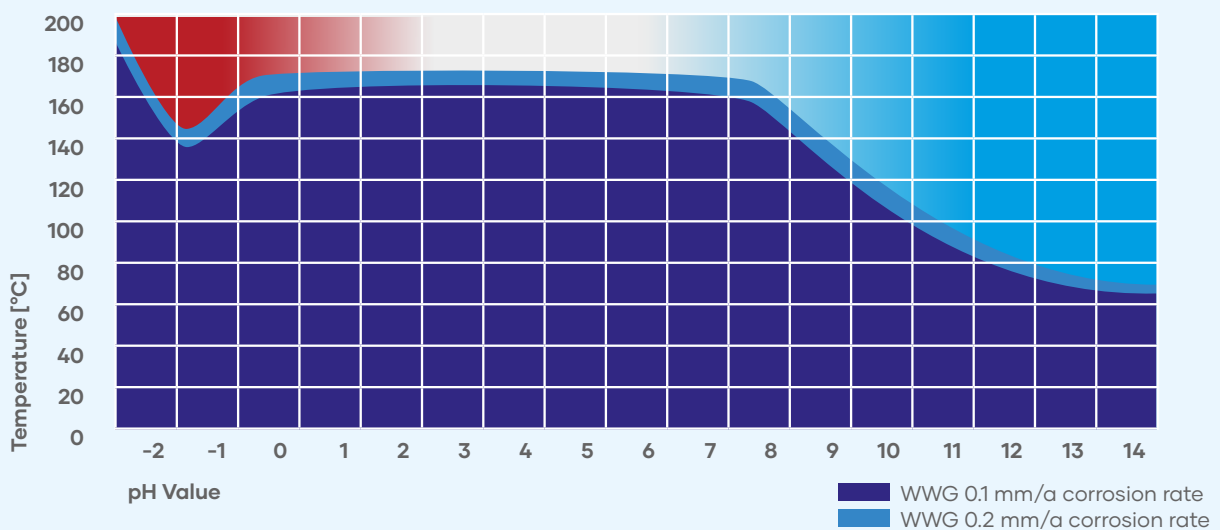
Properties

There are many good reasons for using enamelled steel: Increased productivity, equipment and product protection, process and plant safety.



WWG CORROSION CURVE

pH value measured at room temperature



PHYSICAL PROPERTIES		SPECIFICATION	
Corrosion in HCl (20 % HCl 108 °C)	(DIN EN ISO 28721-2)	0.039 mm/a	108 °C
Corrosion in water		< 0.01 mm/a	100 °C
Corrosion in 0,1 N NaOH	(DIN EN ISO 28721-2)	0.29 mm/a	80 °C
Impact resistance		33 Nm	
Resistance to disruptive discharge		> 30 kV/mm	
Specific electrical resistivity		> 10 ¹³ Ω cm at RT	
Adhesive strength		> 100 N/mm ²	
Abrasion resistance		2.4 mg cm ² h	
Thermal shock resistance	(DIN EN ISO 28721-2)	230 K*	

* Applies to sample plates in laboratory conditions



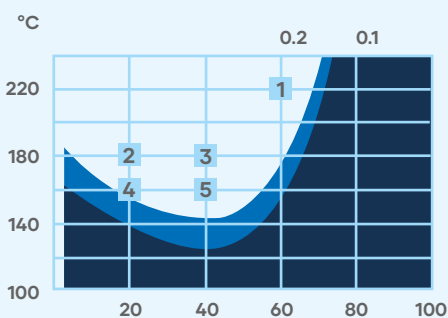
Chemical Behaviour

In respect of alkalis and acids

The iso-corrosion curves reflect the ratio of product or acid volume to the enamelled surface in large stirring containers and yield experimental data according to DIN EN 14483-2 and 5.

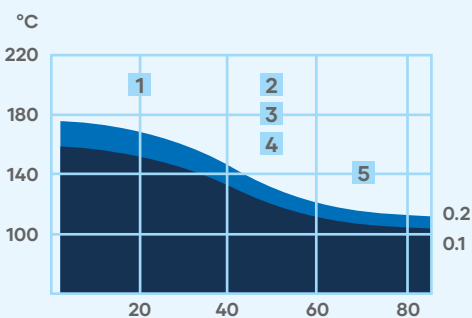
Using the silica effect, Pfaudler World Wide Glass WVG can take much more chemical stress than the usual limits without any risk. The diagrams thus also show typical concentrations with added silicon dioxide as corrosion protection.

FIG. 2 SULPHURIC ACID wt % H_2SO_4



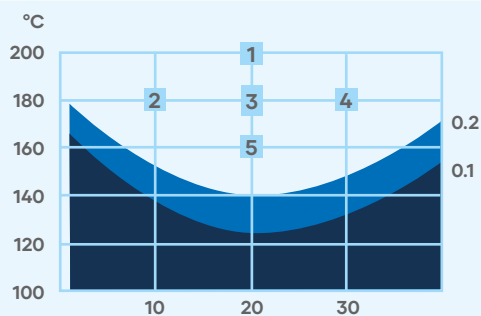
- | | | | | |
|---|-----|----------------------|------|------|
| 1 | 50 | ppm SiO ₂ | 0.05 | mm/a |
| 2 | 600 | ppm SiO ₂ | 0.02 | mm/a |
| 3 | 250 | ppm SiO ₂ | 0.02 | mm/a |
| 4 | 250 | ppm SiO ₂ | 0.04 | mm/a |
| 5 | 60 | ppm SiO ₂ | 0.1 | mm/a |

FIG. 4 PHOSPHORIC ACID wt % H_3PO_4



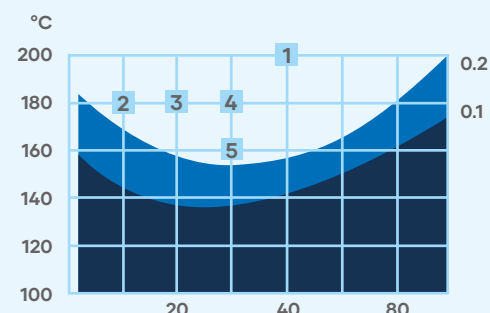
- | | | | | |
|---|-----|----------------------|------|------|
| 1 | 400 | ppm SiO ₂ | 0.05 | mm/a |
| 2 | 600 | ppm SiO ₂ | 0.03 | mm/a |
| 3 | 600 | ppm SiO ₂ | 0.02 | mm/a |
| 4 | 350 | ppm SiO ₂ | 0.02 | mm/a |
| 5 | 200 | ppm SiO ₂ | 0.1 | mm/a |

FIG. 1 HYDROCHLORIC ACID wt % HCl



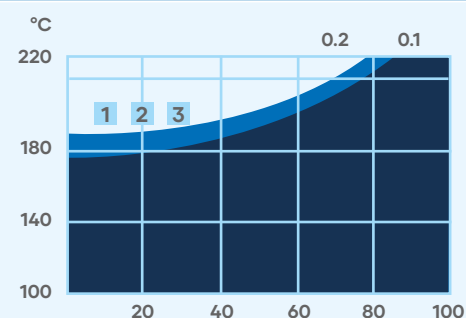
- | | | | | |
|---|-----|----------------------|-------|------|
| 1 | 250 | ppm SiO ₂ | 0.1 | mm/a |
| 2 | 600 | ppm SiO ₂ | 0.004 | mm/a |
| 3 | 250 | ppm SiO ₂ | 0.01 | mm/a |
| 4 | 100 | ppm SiO ₂ | 0.01 | mm/a |
| 5 | 100 | ppm SiO ₂ | 0.03 | mm/a |

FIG. 3 NITRIC ACID wt % HNO_3



- | | | | | |
|---|-----|----------------------|------|------|
| 1 | 250 | ppm SiO ₂ | 0.05 | mm/a |
| 2 | 600 | ppm SiO ₂ | 0.03 | mm/a |
| 3 | 600 | ppm SiO ₂ | 0.02 | mm/a |
| 4 | 250 | ppm SiO ₂ | 0.02 | mm/a |
| 5 | 100 | ppm SiO ₂ | 0.1 | mm/a |

FIG. 5 ACETIC ACID wt % CH_3COOH



- | | | | | |
|---|-----|----------------------|------|------|
| 1 | 300 | ppm SiO ₂ | 0.07 | mm/a |
| 2 | 100 | ppm SiO ₂ | 0.08 | mm/a |
| 3 | 50 | ppm SiO ₂ | 0.07 | mm/a |

The iso-corrosion diagrams illustrate factors relevant to the corrosion rate. These include, for example, the volume/surface ratio, the base concentration and the temperature. All information in the diagrams refer to a technically pure base. The curves reflect experimental data according to DIN EN 14483-2 and 5.

The two upper diagrams are predominantly applicable to aqueous solutions containing alkali-hydroxide. The application temperature is restricted to 50 °C at higher concentrations.

Dark-blue curve: chemical effect of acids on Pfaudler WWG does not exceed 0.1 mm/a thickness loss.

Light-blue curve: represents the 0.2 mm/a curve and shows the resistance capacity of Pfaudler WWG with regard to increases in temperature.

Cian squares: indicate the increasing enamel durability with regard to non-inhibited acids.

■ Completely resistant $V_L \leq 0.1 \text{ mm/a}$

■ Limited resistance when subject to brief chemical stress $V_L = 0.1 \dots 0.2 \text{ mm/a}$

FIG. 1 SODIUM HYDROXIDE wt % NaOH

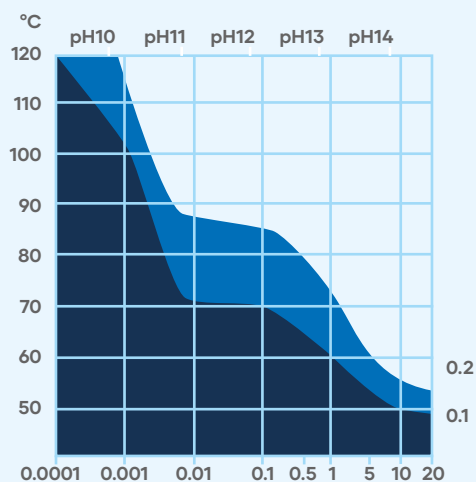


FIG. 2 POTASSIUM HYDROXIDE wt % KOH

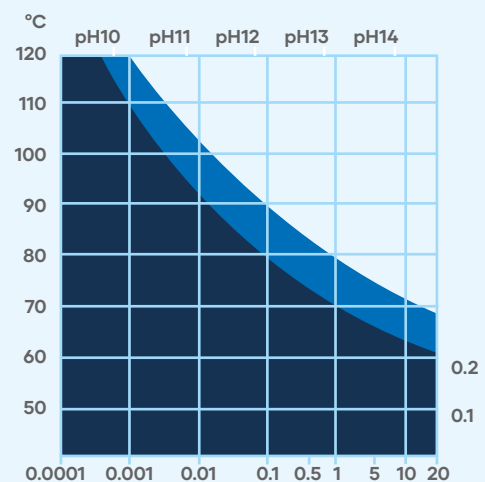


FIG. 3 SODIUM CARBONATE wt % Na_2CO_3

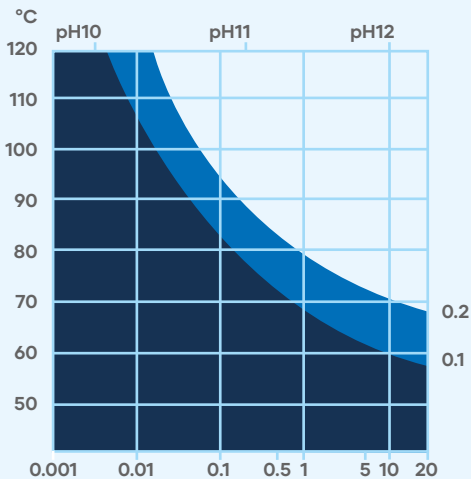
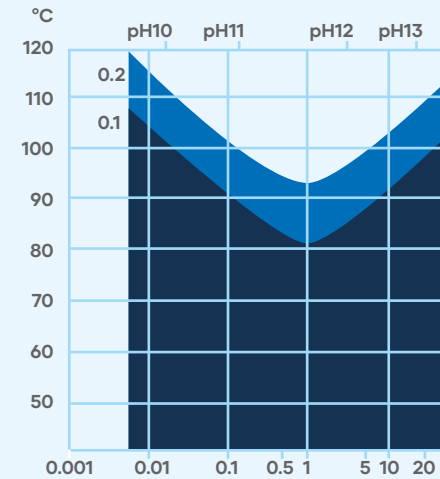


FIG. 4 AMMONIA wt % NH_3



Worldwide Presence



GMM Pfaudler is a global leader in corrosion-resistant technologies, systems, and services for the chemical, pharmaceutical, food and energy industry.

Our Branded Product Lines that include PFAUDLER, NORMAG, MAVAG, MIXION, INTERSEAL, EQUILLOY, EDLON and HYDROAIR showcase our strength as a group, our capabilities, and our pursuit for constant innovation. With an end-to-end solutions-oriented approach, a global footprint, and a perfectly integrated offering system we are able to meet complex industry demands worldwide.

GMM Pfaudler is driven by 1800+ individuals across 4 continents and 16 global manufacturing facilities around the world. The Group's targeted investments in strategic markets, innovation and competitiveness paves the way forward for GMM Pfaudler's continued legacy.

80+
Countries

1800+
Employees

04
Continents

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