

# Märker® Alloy 59

## FIELDS OF APPLICATION



## Shutoff and Fluid Control devices, Feed Pumps and Agitators in Inorganic and Organic Chemistry Plants well as in the Pharmaceutical Industry

These plants mainly process aqueous solutions because they are easy to transport and to measure out. In the majority of cases, aqueous solutions of inorganic substances are solutions of salts that contain chloride or sulphite/sulphate and those of organic substances are solutions based on acetic or formic acid as well as sulphonic acid.

High-select super alloy materials such as “Märker Alloy 59” are employed in these plants whenever there is the challenge of high concentrations of these substances or high temperature ranges, i.e. where standard or high-grade stainless steel does not provide adequate resistance.

In pharmaceutical plants, rather than the substances actually processed, it is the solutions used to clean the plants at mostly increased temperatures that are aggressive.

The same applies to so-called “multi-purpose plants” where different chemicals are processed at alternatively because it would not pay to construct individual plants for each substance involved.

For process equipment and pipe work systems, semi-finished products made of Alloy 59 (2.4605) shaped as plates, rods or seamless and/or longitudinally welded tubes are available from the product range of ThyssenKrupp VDM GmbH.

As a matter of fact, to produce the components of pumps and valves that come into contact with the aggressive medium, from forgings is mostly impossible or, if at all, would involve a lot of time, work and money.

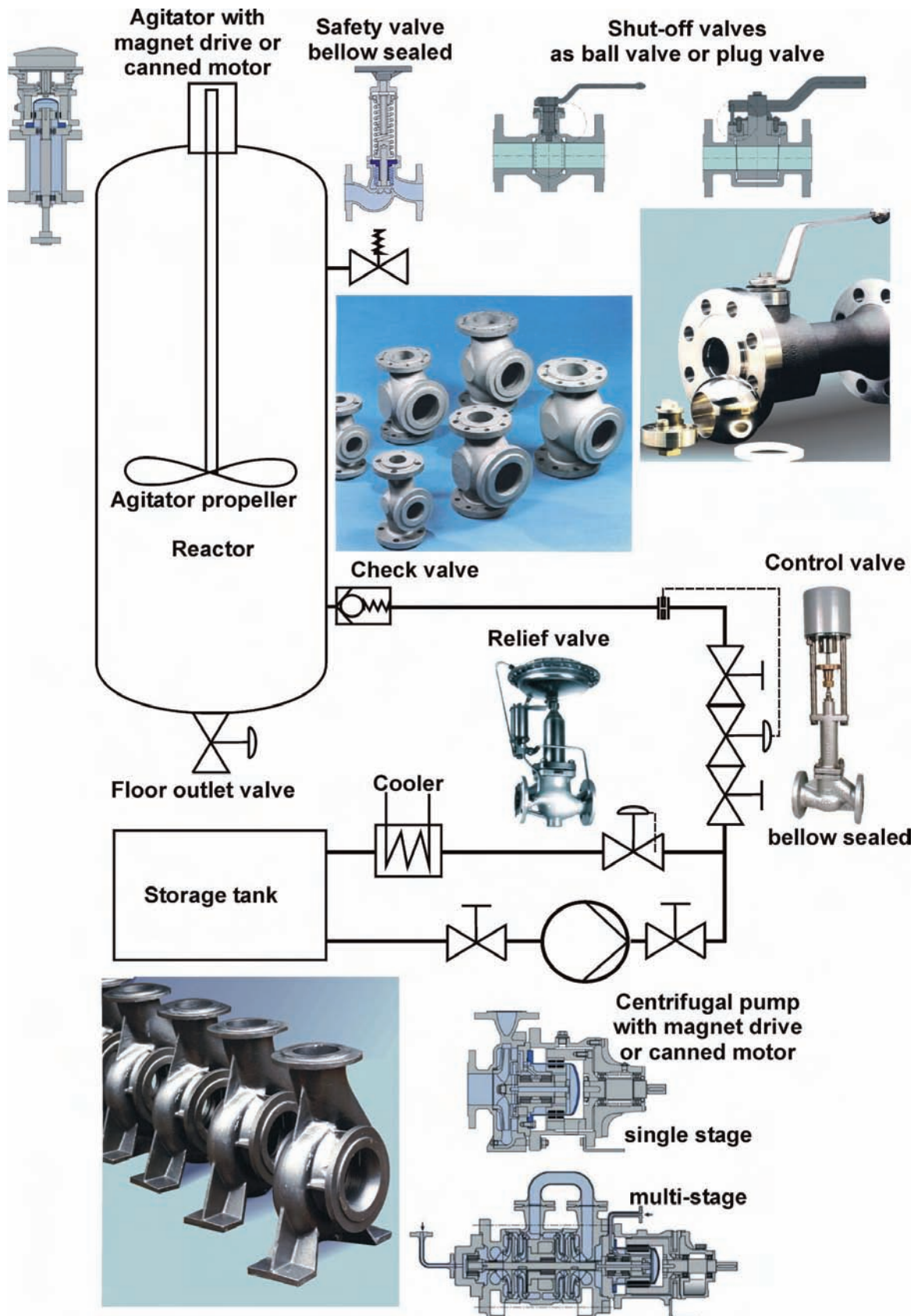
Schmidt + Clemens have therefore acquired the licence to manufacture mould casting components made from this alloy. S+C are able to supply individual components as well as volume production parts by the sand, investment or precision casting technique either as rough or part-finished castings in accordance with the delivery instructions of the components manufacturers.

For reasons outlined above it is also difficult to produce mechanical seals or glands that will resist this type of corrosion. Consequently, these plants commonly employ glandless pumps (canned motor pumps) and bellows valves.

In pharmaceutical plants, the surface of the castings is required to meet even more severe requirements. It is, therefore, common to apply the precision casting technique with its rather inherent high surface finish (to be electro-polished, if necessary) which does not provide any problems during sterilisation.

The following schematic diagram of a chemical plant is intended to illustrate which pumps or valves S+C can supply components for that comply with the requirements specified above.

## Shutoff and Fluid Control devices, Feed Pumps and Agitators in Inorganic and Organic Chemistry Plants well as in the Pharmaceutical Industry (Examples)



## Flue Gas Cleaning Plants for Coal-fired Power Stations and Waste Incineration Plants: Shutoff and Control Devices, Agitator Propellers, Fan Blades

In flue gas cleaning plants, after the gases have cooled down, corrosive constituents are washed out with fluids that bind these constituents, thereby enabling their discharge as slurry, dissolved salts or acids.

As a general rule, sulfur compounds (sulfates) are bound to gypsum by means of lime milk and, in special cases, brought to oxidize into  $\text{SO}_3$  and dissolved in water as diluted sulfuric acid.

Likewise, chlorides are bound by means of alkaline solutions (CaOH or NaOH) and discharged as salts.

Where metallic materials are used in the scrubbers, their permanent resistance to pitting and crevice corrosion as well as to stress corrosion cracking is a decisive factor for selecting the appropriate material. These types of corrosion are potentially hazardous not only in the high temperature range but also at low temperatures that fall below the dew point of the flue gases, thus creating higher chloride concentrations.

As a matter of fact, flue gas cleaning plants are chemical facilities with special feedstock and, therefore, require materials for fans, valves and agitator propellers that are designed to be resistant to the contact medium.

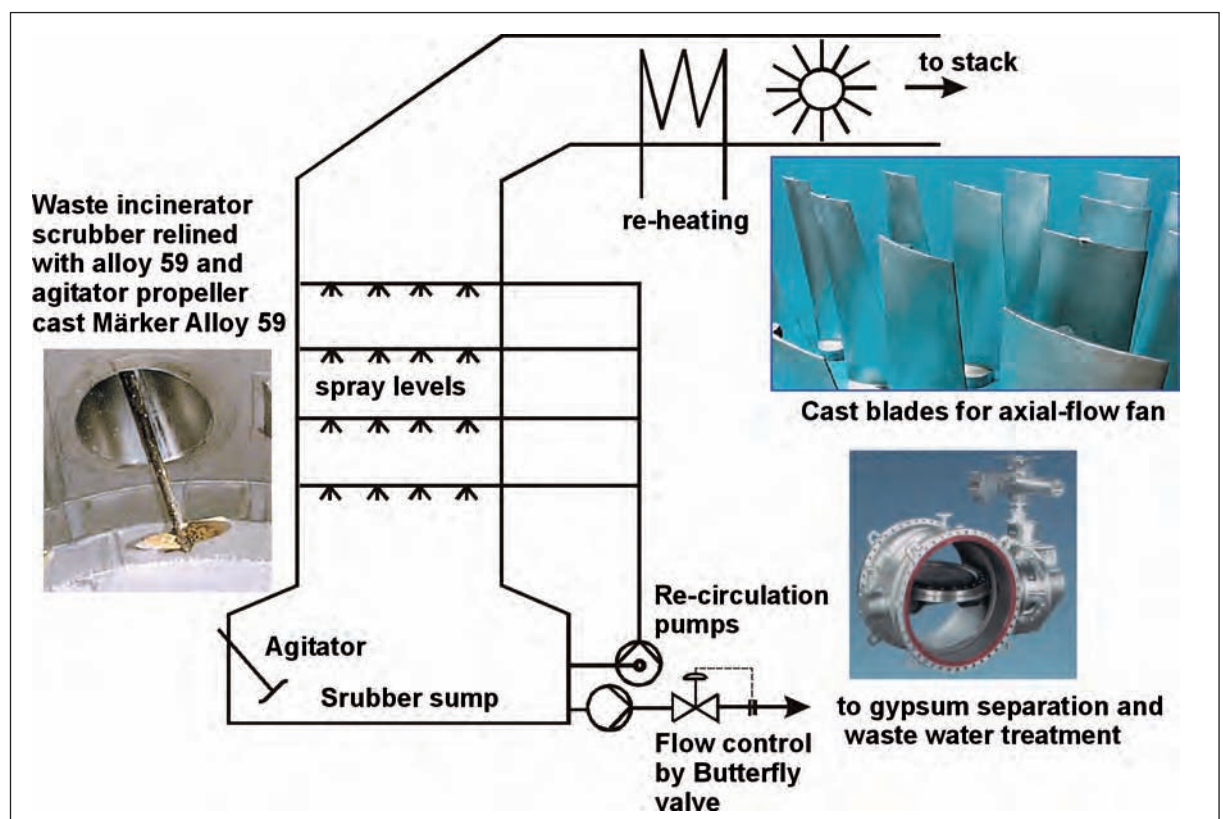
In view of their size, these components must be manufactured as castings.

The Nickel-based alloy Märker Alloy 59 proved to be particularly effective in facilities downstream of lignite power stations because this fuel shows high salt contents, i.e. apart from sulfur, contains major quantities of chlorides.

The same applies to flue gases in special waste incineration plants where chlorinated plastic material and industrial wastes, e.g. from hospitals, are disposed of.

The gypsum generated as part of the procedure is separated from the effluents coming from the scrubber in the waste water treatment plant. The residual water containing dissolved chlorides and other hazardous matter is chemically treated before evaporation.

The high temperatures and chloride concentrations generated in this process also require the use of Nickel-based alloys such as Märker Alloy 59 in pumps and valves.





## Organic Acids and Media

### Citric Acid

To recover citric acid from bio cultures, it is first converted to calcium citrate, filtered and brought into contact with highly concentrated sulphuric acid. In this mixture of 95 to 99 % sulphuric acid, Märker Alloy 59 can be employed whilst it would not be resistant to pure sulphuric acid at such high concentrations.

### Acetic acid

In a number of procedures, organic compounds are used as acetic acid ester to facilitate subsequent processing. In the majority of cases, industrial acetic acids contain traces of formic acid, sulphuric acid, chlorides such as  $\text{FeCl}_3$  that have an oxidizing effect, or atmospheric oxygen.

These additives considerably increase the susceptibility to corrosion, thus requiring materials superior to the 6 % Mo special stainless steels.

The same applies to minor percentages of acetic acid anhydride in chemical reactions.

### Oil and Gas Production – Cooling Circuits

On offshore platforms and frequently also in onshore facilities, seawater is the medium of choice for cooling. The cooling water is chlorinated to prevent algae growth in the system. However, this significantly increases the risk of pitting and crevice corrosion mainly in welded and flanged connections.

Particularly in the sealing faces of flanges, the most severe crevice corrosion conditions appear.

Besides the choice of the appropriate metallic material, the correct selection of sealing materials influences the corrosion resistance.

For safety reasons and independent of the chloride concentrations, the US marine prescribes the use of Alloy 59.

Accordingly, all components that come into contact with the medium, such as pumps and valves, but also all connecting flanges, must be made from equivalent material.

## Inorganic Acids

### Sulphuric, Hydrochloric Acid, Phosphoric Acid

The diagrams shown on page 6 of the material data sheet demonstrate that the Märker Alloy 59 material is ideal for use throughout various ranges of temperature and concentration.

These acids are commonly used in chemical processes and primarily employed to dissolve minerals and as reactants for intermediate products.

On account of the fact that these acids are frequently left over once the processes are terminated they are recovered in evaporator plants where increasing concentrations are pumped through evaporators.

For many of these pumps and valves, castings made from Märker Alloy 59 have proved to be the optimum solution.

### Aluminium Reprocessing

Melting aluminium waste leaves a layer of sodium and potassium salts to protect the molten metal against oxidation.

To recover the aluminium contained in the salts they are dissolved in water by means of ammonium chloride and re-crystallized.

The process solution contains 20 to 25 % NaCl, 6 to 8 % KCl, and 5 to 8 %  $\text{NH}_4\text{Cl}$ , pH value 4.5 to 6 at 170 °C.

After 3,800 hours of exposure, Märker Alloy 59 proved to be the only material that did not show any corrosion.

### Copper melting Furnace

Sulphur dioxide-enriched exhaust gases are cleaned in 55 sulphuric acid at 45 to 60 °C.

The acid later-on has a concentration of 50 to 55 % at 75 °C with up to 7,000 ppm chlorides and fluorides. Märker Alloy 59 is ideal for use in the exhaust gas fan.

## Pulp and Paper Production

Paper is made from pulp and water. Pulp is mainly made from wood or recycled paper.

Wood consists of cellulose, hemi-cellulose and lignin. Cellulose and hemi-cellulose form the fibers which are glued together by the lignin. Two different commercial-scale pulping procedures are applied: digestion with either  $\text{Na}_2\text{S}$  and  $\text{NaOH}$  (sulfate procedure) or with  $\text{Mg}(\text{HSO}_3)_2$  (sulfite procedure). [4,5] Exceptionally the organosolv procedure is applied in which the digestion happens with acetic acid.

Paper gets white only by bleaching, otherwise it is more or less a brown color from the lignin. Bleaching of cellulose acts to destroy the remaining lignin. In Europe bleaching is made environmentally acceptable by oxygen or hydrogen-peroxide and ozone (TCF=Total Chlorine Free). Outside Europe however, still today bleaching with elemental chlorine or chlorine-dioxide (ECF=Elemental Chlorine Free) is applied.

Elemental chlorine causes the most corrosive conditions and the harshest environmental load. Chlorine-dioxide is somewhat environmentally friendlier.

Particularly in Canada, USA and Indonesia, the large cellulose productions still use the chlorine route.

Commercial grades of stainless steels fail in these very sour solutions at 70°C due to pitting, crevice corrosion or stress corrosion cracking.

## Viscose Fibers, Rayon

Viscose fibers are basically cellulose produced industrially by the viscose process.

The cellulose from the viscose production contains less remaining parts of lignin and hemi-cellulose and therefore has a higher reactivity with caustic ( $\text{NaOH}$ ) and carbon bi-sulfite ( $\text{CS}_2$ ).

The reaction with these two chemicals produces a "viscous" pulp which is ejected through fine nozzles into a spinning bath composed from diluted sulfuric acid ( $\text{H}_2\text{SO}_4$ ) with sodium sulfate ( $\text{Na}_2\text{SO}_4$ ) and zinc sulfate ( $\text{ZnSO}_4$ ).

The resulting products, apart from the viscose fibers, are again caustic soda and carbon bi-sulfite but also sodium sulfate and sulfur hydride ( $\text{H}_2\text{S}$ ). The viscose fibers (Rayon) are subsequently washed and bleached.

The spinning bath for the production of the fibers is very corrosive and therefore very demanding on the materials used.

Alloy 59 is an ideal candidate for all type of pulping and bleaching processes in the paper and Rayon production.

## Separating Technology

During the production of fine chemicals, centrifuges are needed to separate media with little difference in density. Due to its resistance against sour, oxidizing as well as reducing media, alloy 59 is universally usable.

Schmidt+ Clemens produces cylindrical and conical parts of shells for centrifuges in horizontal and vertical spinning processes. The parts are entirely machined and welded together as complete shells for decanters, ready for assembly.

## Valves for Tank-Trucks

The transport of so much different media like acids, basic liquids, contaminated and salt loaded solutions or waste liquids very often is made with tank trucks. Their tanks and piping systems therefore have to be resistant against a great variety of media to avoid the need of special tank trucks for each and every of them. Valves and flanges out of stainless steels are limited in their application as crevices and cavities, causes the hazardous media to increase in concentration, causing pitting and crevice corrosion.

In order to prevention damage, many manufacturers and users install parts out of alloy 59 whose exceptional resistance against such corrosion attacks promises long life and high reliability.



*Separating Technology: Decanter Shells weld assembly from horizontal and vertical centrifugal castings*

## Literature sources used

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## Production sites

Schmidt + Clemens GmbH + Co. KG,  
Germany

S+C ALFANAMETAL s.r.o.  
Czech Republic

S+C MÄRKER GmbH,  
Germany

S+C Bowers & Jones Ltd.  
Great Britain

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#### Contact

schleuderguss@schmidt-clemens.de  
Telephone: +49 (0) 2266-92-258  
Fax: +49 (0) 2266-92-369

### CASTING

#### Industries

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#### Contact

gusstechnik@schmidt-clemens.de  
Telephone: +49 (0) 2266-92-413  
Fax: +49 (0) 2266-92-538

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#### Contact

maerker@schmidt-clemens.de  
Telephone: +49 (0) 2266-92-211  
Fax: +49 (0) 2266-92-363

## Schmidt + Clemens

Schmidt + Clemens GmbH + Co. KG  
High Performance Steel

51789 Lindlar, Germany  
Phone: +49 22 66 92 0 - Fax: +49 22 66 92 538  
Internet: [www.schmidt-clemens.de](http://www.schmidt-clemens.de)  
P.O. Box 1140, 51779 Lindlar, Germany

S+C ALFANAMETAL s.r.o., koncern

CZ-78357 Tršice c. 126, Czech Republic  
Phone: +420 58 59 57 428  
Fax: +420 58 59 57 430  
E-Mail: [alfa@alfanametall.cz](mailto:alfa@alfanametall.cz)

