



METALS

ANDRITZ PYROMARS

FROM WASTE TO PROFIT

ANDRITZ

ENGINEERED SUCCESS

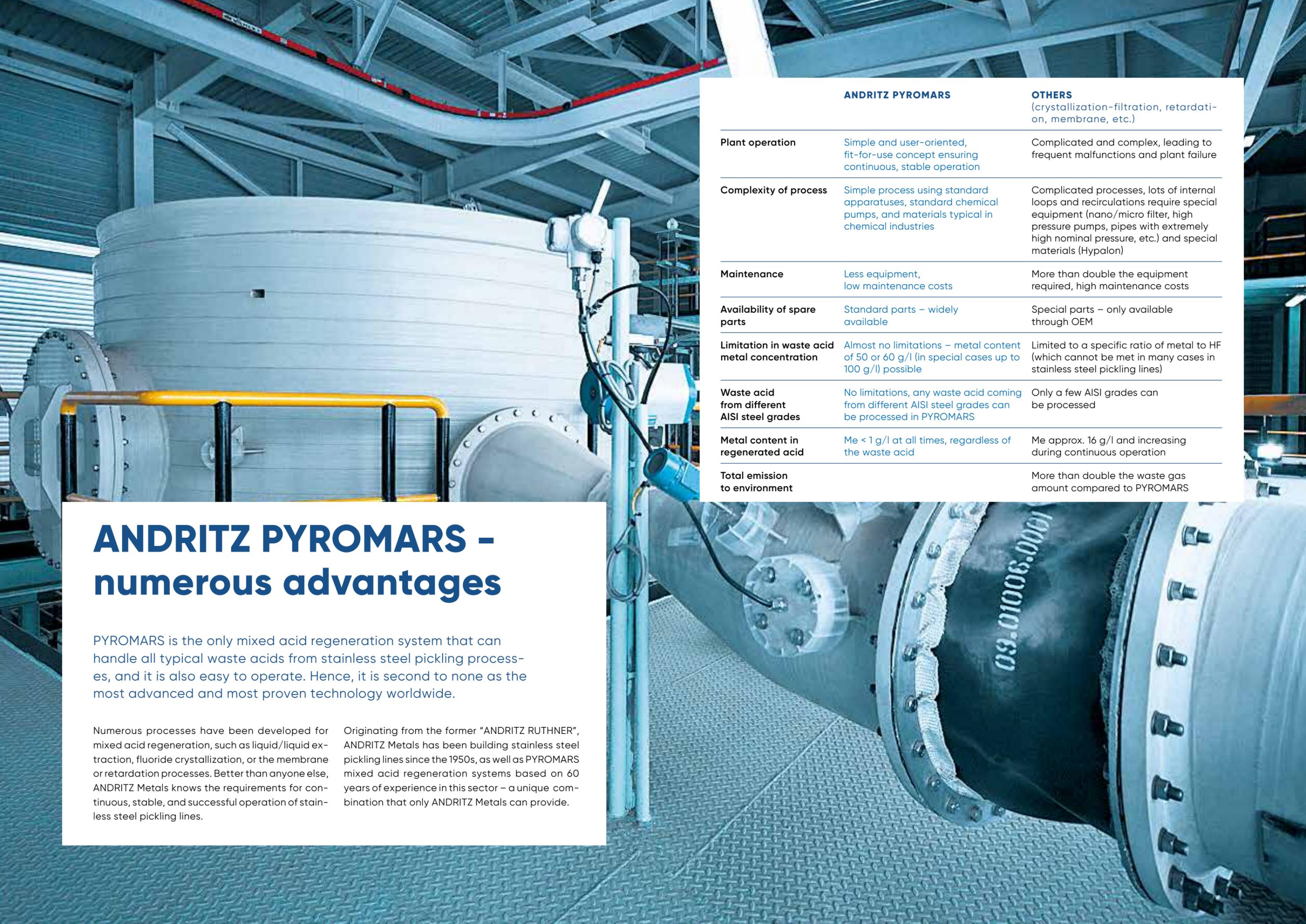
ANDRITZ PYROMARS - numerous advantages

PYROMARS is the only mixed acid regeneration system that can handle all typical waste acids from stainless steel pickling processes, and it is also easy to operate. Hence, it is second to none as the most advanced and most proven technology worldwide.

Numerous processes have been developed for mixed acid regeneration, such as liquid/liquid extraction, fluoride crystallization, or the membrane or retardation processes. Better than anyone else, ANDRITZ Metals knows the requirements for continuous, stable, and successful operation of stainless steel pickling lines.

Originating from the former "ANDRITZ RUTHNER", ANDRITZ Metals has been building stainless steel pickling lines since the 1950s, as well as PYROMARS mixed acid regeneration systems based on 60 years of experience in this sector – a unique combination that only ANDRITZ Metals can provide.

	ANDRITZ PYROMARS	OTHERS (crystallization-filtration, retardation, membrane, etc.)
Plant operation	Simple and user-oriented, fit-for-use concept ensuring continuous, stable operation	Complicated and complex, leading to frequent malfunctions and plant failure
Complexity of process	Simple process using standard apparatuses, standard chemical pumps, and materials typical in chemical industries	Complicated processes, lots of internal loops and recirculations require special equipment (nano/micro filter, high pressure pumps, pipes with extremely high nominal pressure, etc.) and special materials (Hypalon)
Maintenance	Less equipment, low maintenance costs	More than double the equipment required, high maintenance costs
Availability of spare parts	Standard parts – widely available	Special parts – only available through OEM
Limitation in waste acid metal concentration	Almost no limitations – metal content of 50 or 60 g/l (in special cases up to 100 g/l) possible	Limited to a specific ratio of metal to HF (which cannot be met in many cases in stainless steel pickling lines)
Waste acid from different AISI steel grades	No limitations, any waste acid coming from different AISI steel grades can be processed in PYROMARS	Only a few AISI grades can be processed
Metal content in regenerated acid	Me < 1 g/l at all times, regardless of the waste acid	Me approx. 16 g/l and increasing during continuous operation
Total emission to environment		More than double the waste gas amount compared to PYROMARS

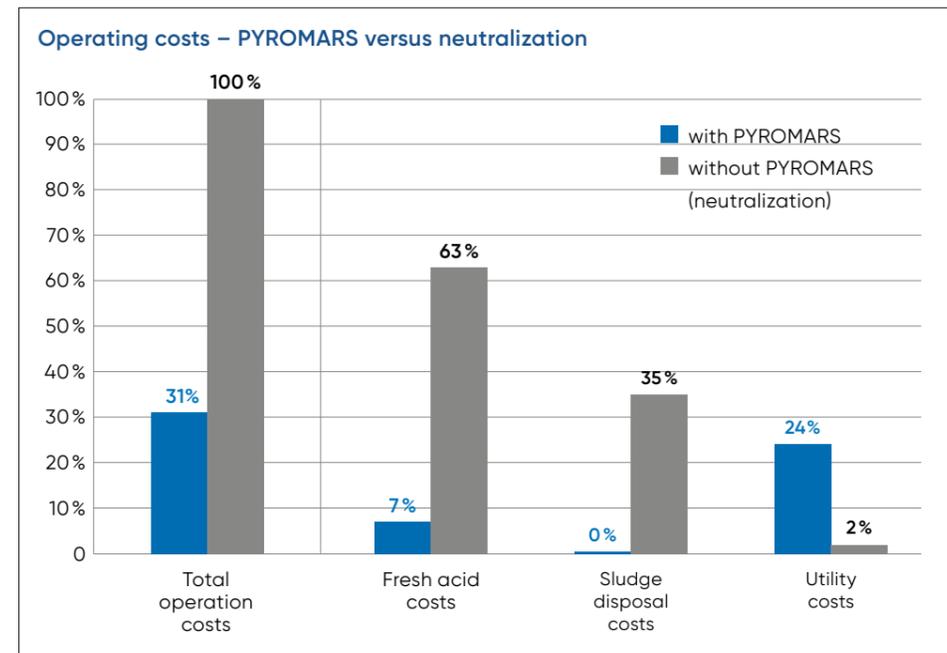


Cut your operating costs and keep the environment clean

ANDRITZ Metals' PYROMARS generates profit for its customers by regenerating waste mixed acid. High recovery rates for the hydrofluoric and nitric acids greatly reduce costs for fresh acid demand and, consequently, also reduce pickling costs.

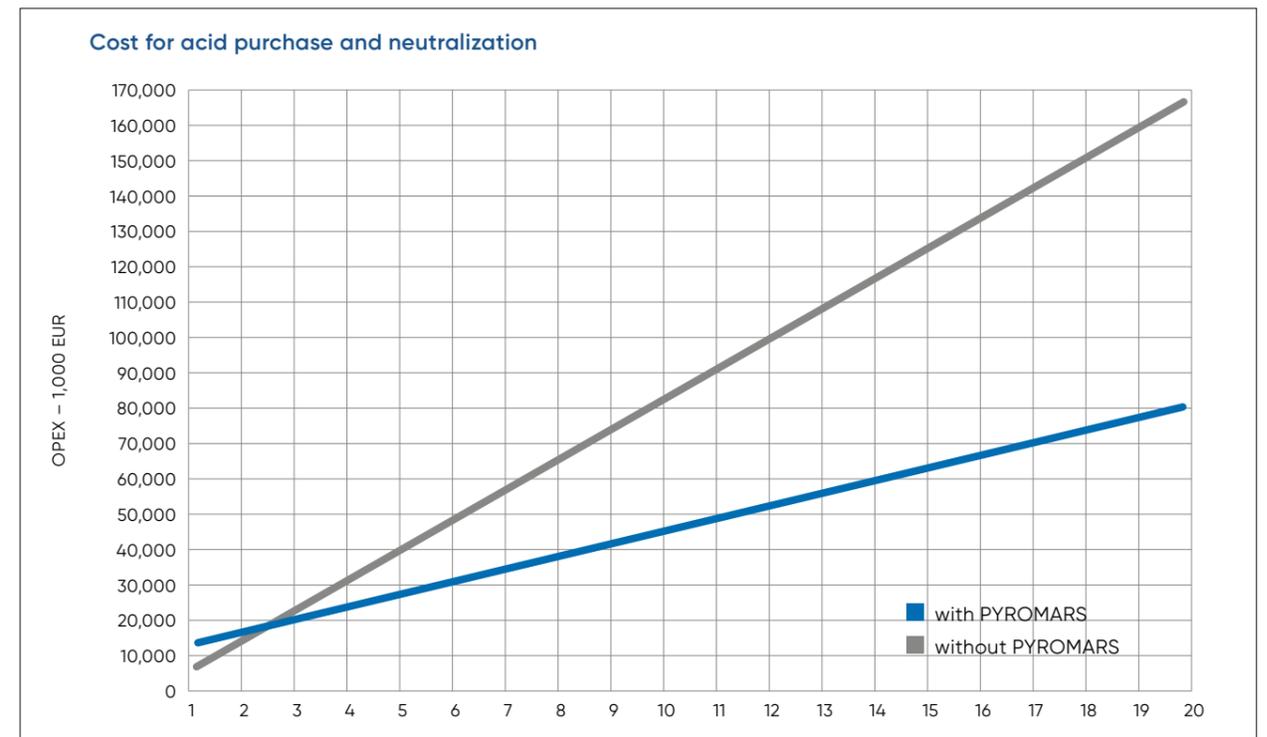


PYROMARS reactor acid spray system, Malaysia



NO NITRATES, NO SLUDGE, MINIMIZED COSTS

- Recovery of nitric acid up to 80%
- Recovery of hydrofluoric acid up to 99%
- No expenses for neutralization of spent pickling acid and for disposal of neutralization slurry
- Nitrates (HNO_3) introduced to the PYROMARS process are either recovered as acid (up to 80%) or reduced to nitrogen (N_2) by SCR (selective catalytic reduction)
- This makes the nitrate reduction efficiency of PYROMARS almost 100%.



PYROMARS - Serving best stainless steel pickling

The ANDRITZ Metals PYROMARS process is unique in the stainless steel market for "total regeneration of mixed acid" used in pickling baths for stainless steel production. Outstanding performance in metal removal from waste pickle liquor from all AISI steel grades provides the pickling line with maximum possible free acid at high concentration.

Total regeneration refers to the recovery of free and bound nitric acid and hydrofluoric acid, but also of dissolved metals.

One of the more popular technologies for partial regeneration (free acid only) is retardation. It is probably the most widespread technology in this area. A resin sorption process is used to remove dissolved metals

from the pickling acid and return the unused acid (free acid only) to the pickling process. It is a simple method based on ion exchange in resins, however, nitric acid influences the stability of the resin and this has raised concerns about the lifetime of the units.

Another regeneration method using micro and nano filtration techni-

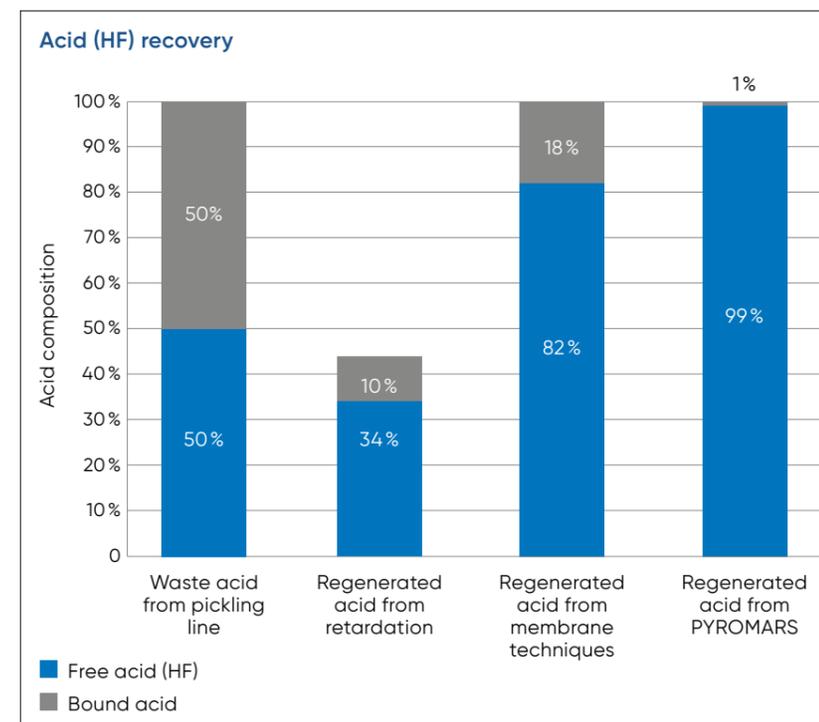
ques was also developed and put into operation in the past two decades. Despite promising, high recovery rates and low operation costs, success has been modest due to very high complexity during operation, short lifetime of membranes, and limitations on waste acid composition.

THE MOST ACCEPTED SOLUTION IN THE MARKET

The pyrohydrolytic total regeneration process for waste mixed acid was developed from the "Ruthner Spray Roasting Process" originally applied in the regeneration of hydrochloric acid. Since the first PYROMARS plant was built in 1995, this process has today become the most accepted solution for the total recovery of metals and mixed acid.

COST EFFICIENT WITH A FAST RETURN ON INVESTMENT

The various technologies on the market have many advantages and disadvantages. However, when weighed up against these other processes, the PYROMARS spray-roasting technology is the most attractive option for customers looking for a cost-efficient and environmentally friendly technology for the total recovery of mixed acid.



PYROMARS solves the pollution problem because it closes all loops (hydrofluoric acid, nitric acid, metal, and sludge loops).

PYROMARS systems are characterized by their high economy of operation and short payback period for the related investment costs.

KEY FEATURES

- Fresh acid demand for pickling line: reduction from 100% → 20-25%
- Nitrate and sludge discharge: reduction from 100% → 10-20%
- Return on investment ROI: approx. 2-3 years

COMPOSITION
—
NO LIMITATIONS ON WASTE ACID COMPOSITION FROM DIFFERENT AISI STEEL GRADES

RECOVERY
—
MAXIMUM POSSIBLE RECOVERY OF FREE AND BOUND ACID

SEPARATION
—
HIGHEST POSSIBLE METAL SEPARATION

PYROMARS reactor and DeNOx, Germany



Generating profit - regenerating waste mixed acid

PYROlytical **Mixed Acid Recovery System** - During processing, stainless steels are subject to a pickling process in which mixtures of nitric and hydrofluoric acid are used as pickling agents.

The waste acid contains metals that are similar to the stainless steel composition. When certain metal concentrations are reached, these metals have to be removed from the pickle liquor.

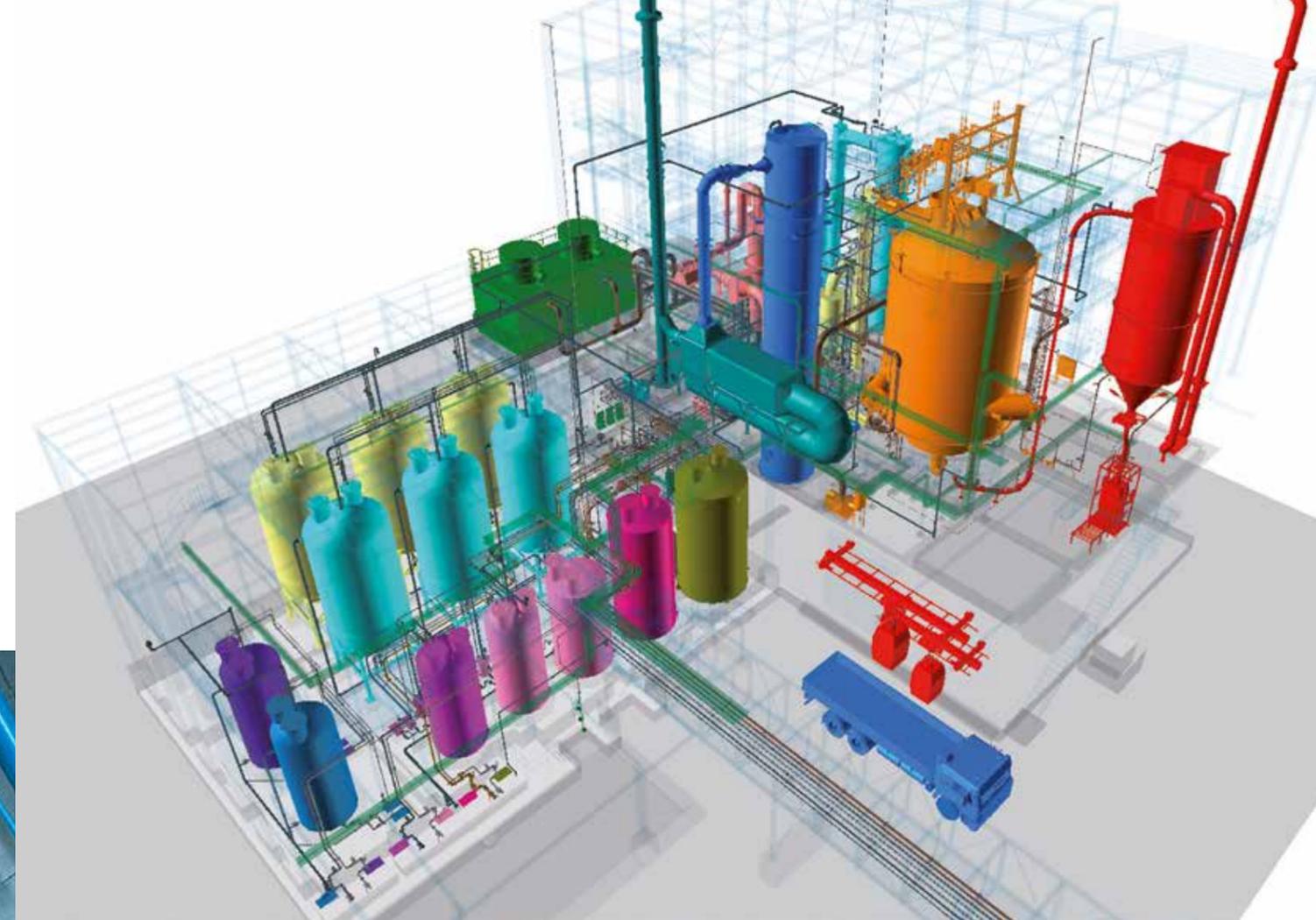
THE TRANSFORMATION INTO PROFIT

This waste acid can either be discharged and neutralized, which incurs high costs for neutralization and a supply of fresh acid, or it can be transformed from pure waste into profit using the ANDRITZ Metals PYROMARS technology. The process recovers valuable chemical agents from the waste acids, which

Inside a PYROMARS reactor



Base of a PYROMARS reactor



PYROMARS process 3D model

THE PROCESS



are hydrofluoric and nitric acid in the form of re-usable mixed acid, and high-value metals in the form of metal oxides.

Acid management in this form is especially important in mills incorporating several pickling plants which

are linked to only one regeneration system. This makes it easy for the operator to recognize trends in pickling plants and also ensures transparency of operating conditions – a tool allowing a quick and efficient reaction to actual pickling conditions.

Zero-Effluent Mixed Acid Pickling PYROMARS meets ZEMAP

ANDRITZ METALS' newly developed ZEMAP technology transforms stainless steel mixed acid pickling into a zero-effluent process.

TOTAL NITRATE REDUCTION IN WASTE WATER – A MORE AND MORE PRESSING NEED FOR STAINLESS STEEL PRODUCERS

All nitrates (HNO_3) introduced to the PYROMARS process are either recovered as nitric acid (70%-80%) or treated in a DeNOx/SCR (Selective Catalytic Reduction) system in which NOx gases are reduced to nitrogen and subsequently released into the atmosphere.

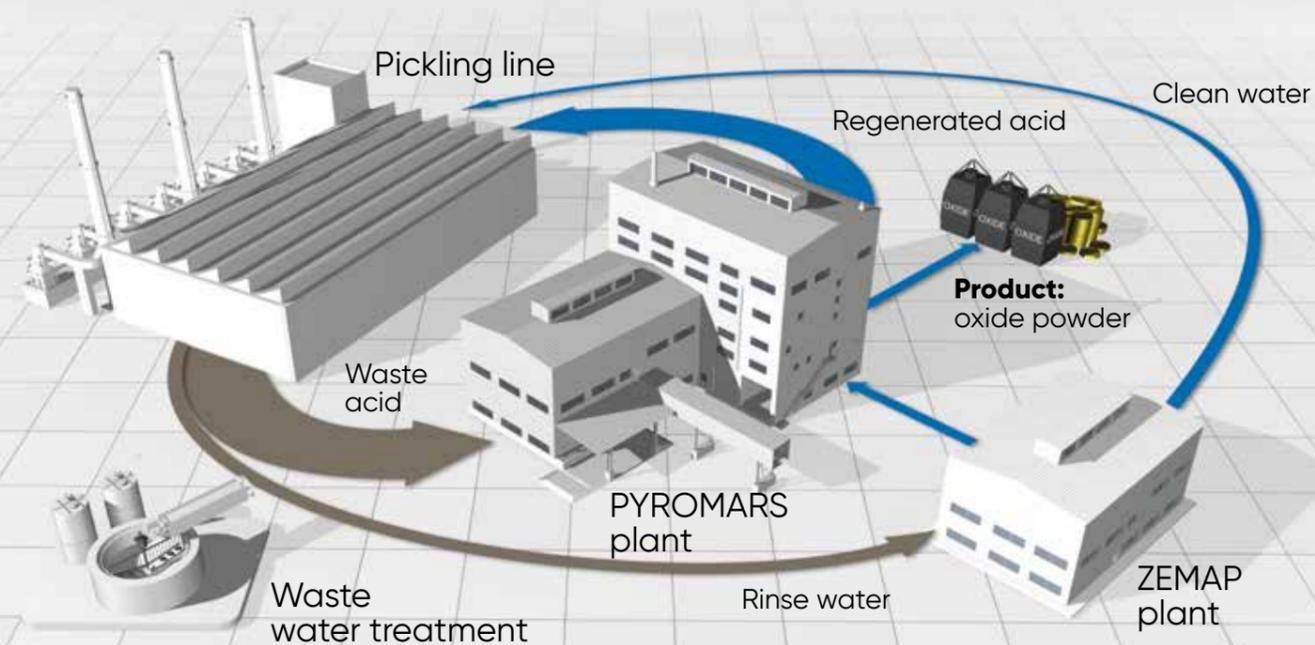
Although the efficiency of PYROMARS is almost 100% in terms of nitrate reduction, there is still mixed acid contamination in the rinse water used in the pickling line, which so far had to be treated separately in a waste water treatment plant.

ANDRITZ METALS' ZEMAP MAKES FURTHER WASTE WATER TREATMENT UNNECESSARY.

Due to recovery of the rinse water

from the rinsing section, the effluents from the pickling line are nitrate-free, and the pickling, rinsing, and acid regeneration process becomes a closed-loop operation.

- Significant reduction in demineralized water consumption
- Hydrofluoric acid consumption reduced to almost zero
- Sludge disposal reduced to zero
- Effluents from the pickling line are nitrate-free



Rinse water:
 - ~99% nitrates reduction
 - ~99% sludge reduction



ANDRITZ METALS' ZEMAP makes further waste water treatment unnecessary. Due to recovery of the rinse water from the rinsing section, the effluents from the pickling line are nitrate-free, and the pickling, rinsing, and acid regeneration process becomes a closed-loop operation.



EXTRACT FROM OUR REFERENCE LIST

Customer	Country	Capacity l/h
Acerinox S.A.	Spain	3,000
Bahru Stainless Ltd.	Malaysia	5,500
Beihai Chengde Ferronickel & Stainless Steel Co. Ltd.	China	7,500
Columbus Stainless (PTY) Ltd.	South Africa	4,500
Fujian Fuxin Special Steel Co. Ltd.	China	7,500
Lianzhong Stainless Steel (Yieh Group), Guangzhou	China	7,500
Posco Pohang Iron & Steel Co.	Korea	4,500
Shanghai Baoshan Iron & Steel Co. Ltd.	China	4,500
Steel Authority of India Limited Salem Steel Plant	India	4,500
Taiyuan Iron and Steel (Group) Co. Ltd.	China	3 x 7,500
ThyssenKrupp Stainless USA	USA	5,500
ThyssenKrupp Nirosta GmbH	Germany	4,500
Yieh United Kaohsiung	Taiwan	4,500
Zhangjiagang Pohang Stainless Steel	China	5,500

ENGINEERED SUCCESS FOR FLAT PRODUCT PROCESSING

AUSTRIA

ANDRITZ AG

p: +43 50805 55325

stainless.regeneration@andritz.com

[ANDRITZ.COM/METALS](https://www.andritz.com/metals)

ANDRITZ

All data, information, statements, photographs and graphic illustrations in this leaflet are without any obligation and raise no liabilities to or form part of any sales contracts of ANDRITZ AG or any affiliates for equipment and/or systems referred to herein. © ANDRITZ AG 2021. All rights reserved. No part of this copyrighted work may be reproduced, modified or distributed in any form or by any means, or stored in any database or retrieval system, without the prior written permission of ANDRITZ AG or its affiliates. Any such unauthorized use for any purpose is a violation of the relevant copyright laws. ANDRITZ AG, Stattegger Strasse 18, 8045 Graz, Austria. ME-Pyromars_en_2021

