

TURNING WASTE ACID INTO MEASURABLE OPERATING VALUE

ANDRITZ PYROMARS

ANDRITZ

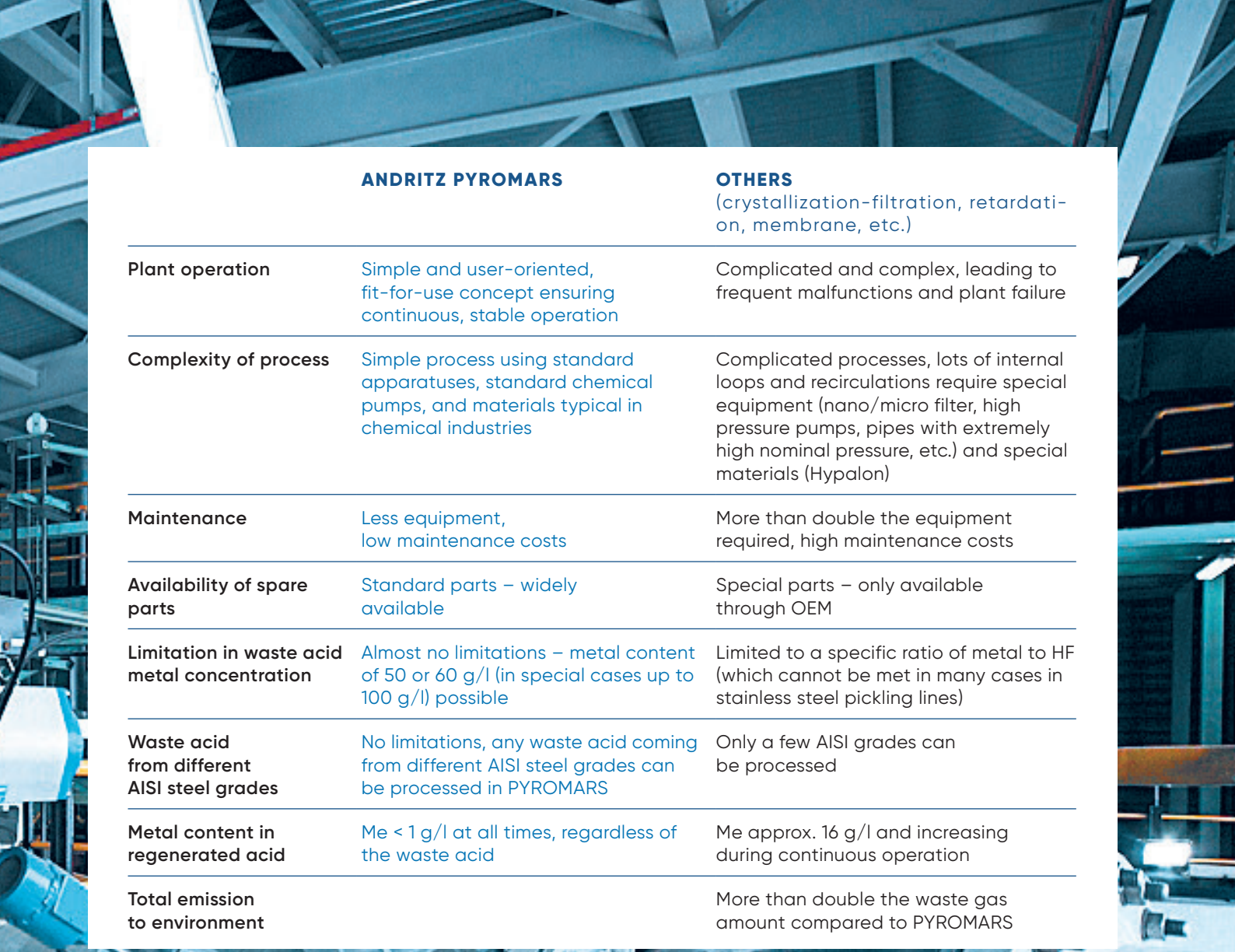


ANDRITZ PYROMARS – numerous advantages

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 more than 70 years of experience in this sector – a unique combination that only ANDRITZ Metals can provide.



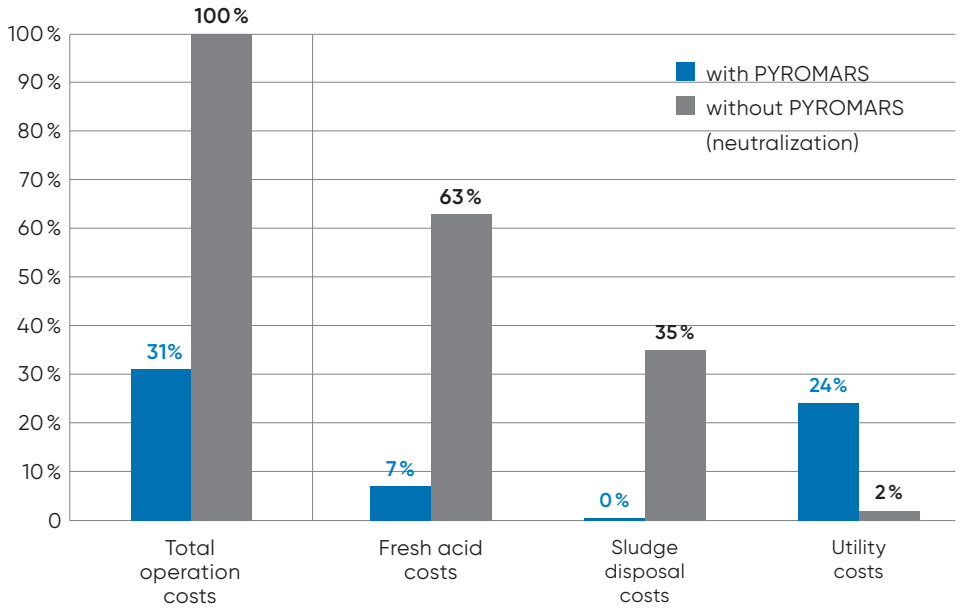
	ANDRITZ PYROMARS	OTHERS (crystallization-filtration, retardation, membrane, etc.)
Plant operation	Simple and user-oriented, fit-for-use concept ensuring continuous, stable operation	Complicated and complex, leading to frequent malfunctions and plant failure
Complexity of process	Simple process using 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 generats 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.



Operating costs – PYROMARS versus neutralization



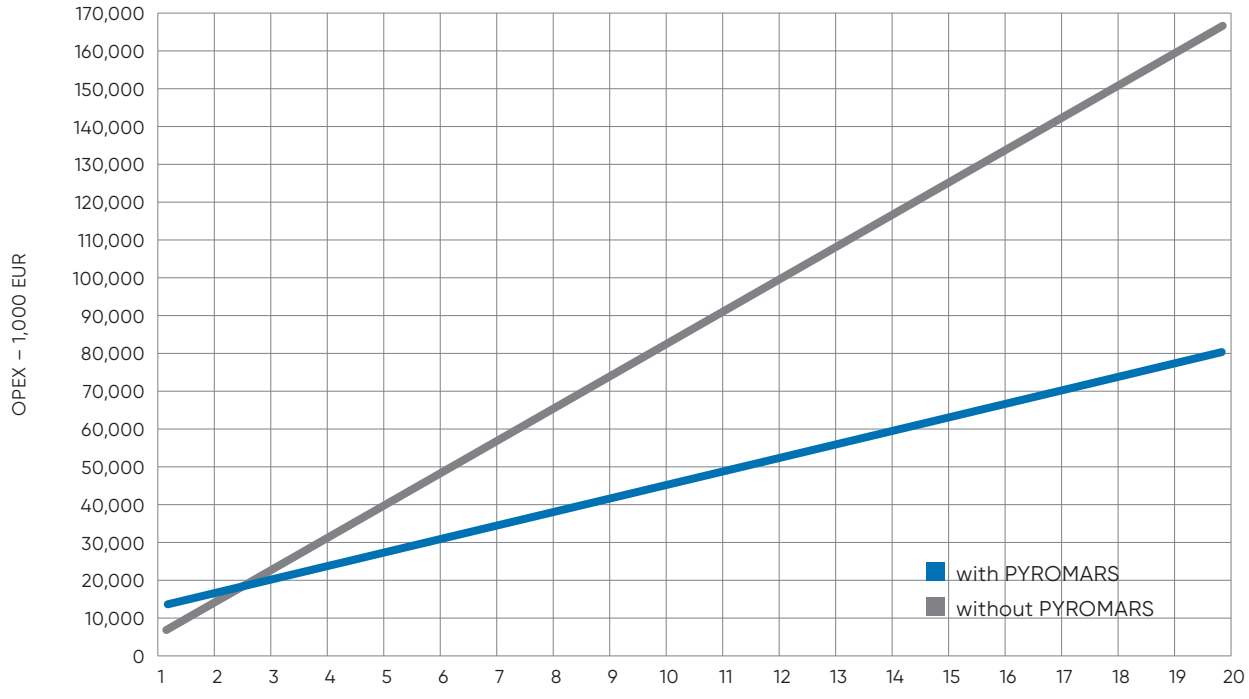
NO NITRATES, NO SLUDGE, MINIMIZED COSTS

- 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 reactor acid spray system, Malaysia

Cost for acid purchase and neutralization



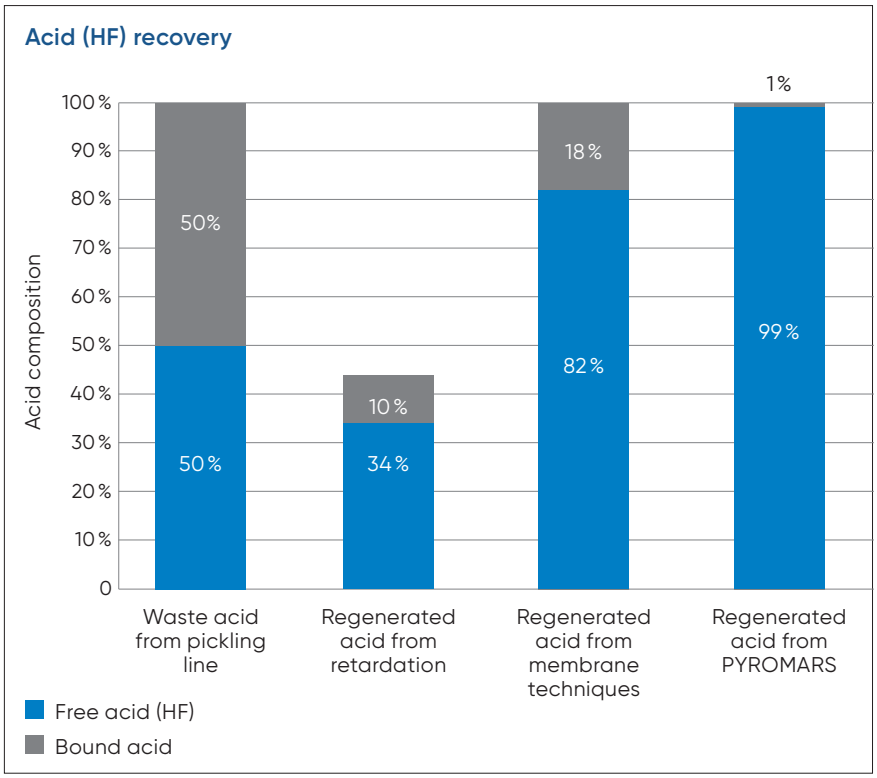
PYROMARS – Serving best stainless steel pickling

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 techniques 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 **M**ixed **A**cid **R**ecovery **S**ystem – 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

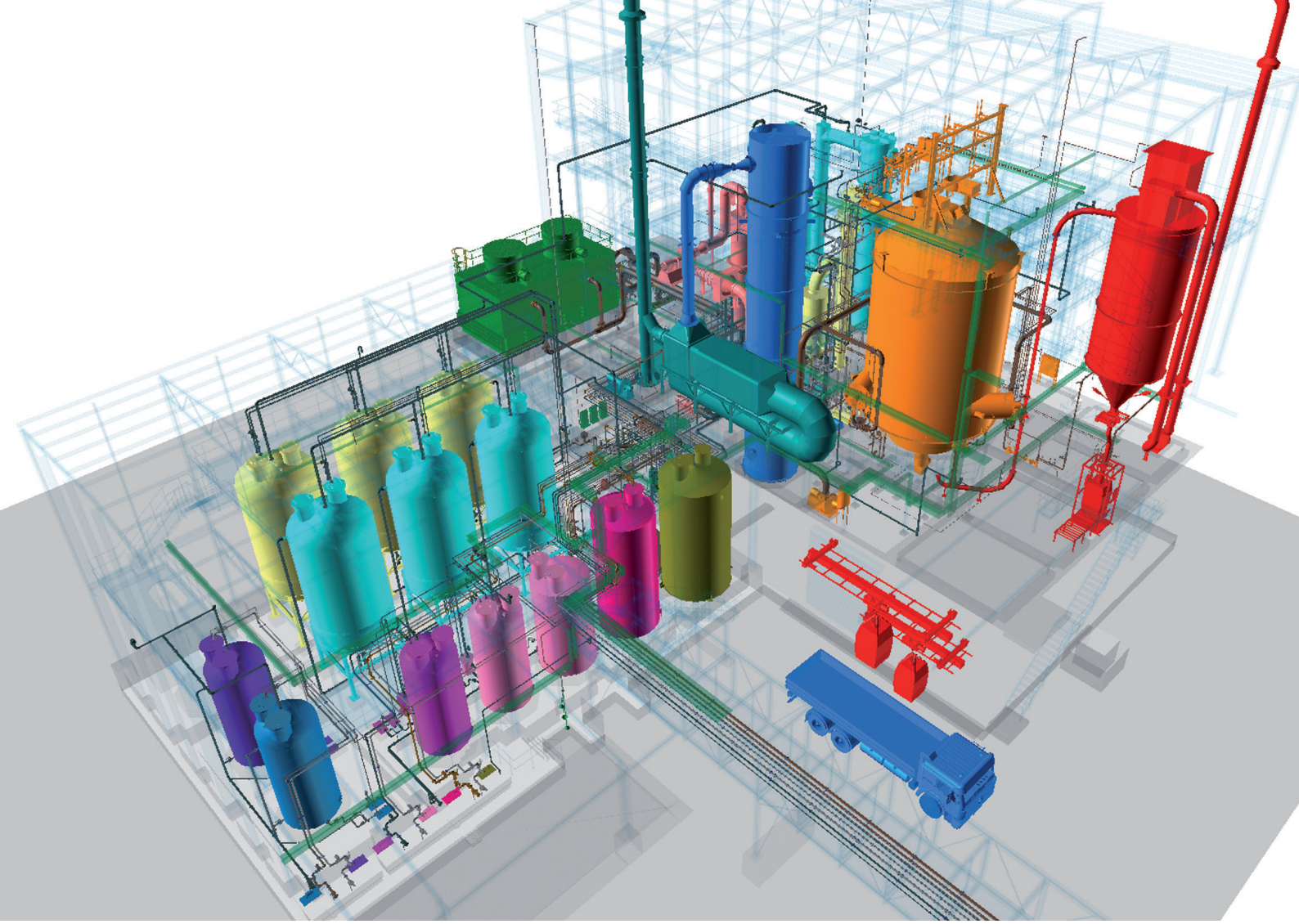
This waste acid can either be discharged and neutralized, which incurs high costs for neutralization and a supply of fresh acid, or it can be transformed from pure waste into profit using the ANDRITZ Metals PYROMARS technology. The process recovers valuable chemical agents from the waste acids, which

Inside a PYROMARS reactor





Base of a PYROMARS reactor



PYROMARS process 3D model

THE PROCESS

Selective thermal process	Adiabatic absorption	Condensation	Oxidation	DeNOx plant (SCR)	**Regenerated acid**

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' 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

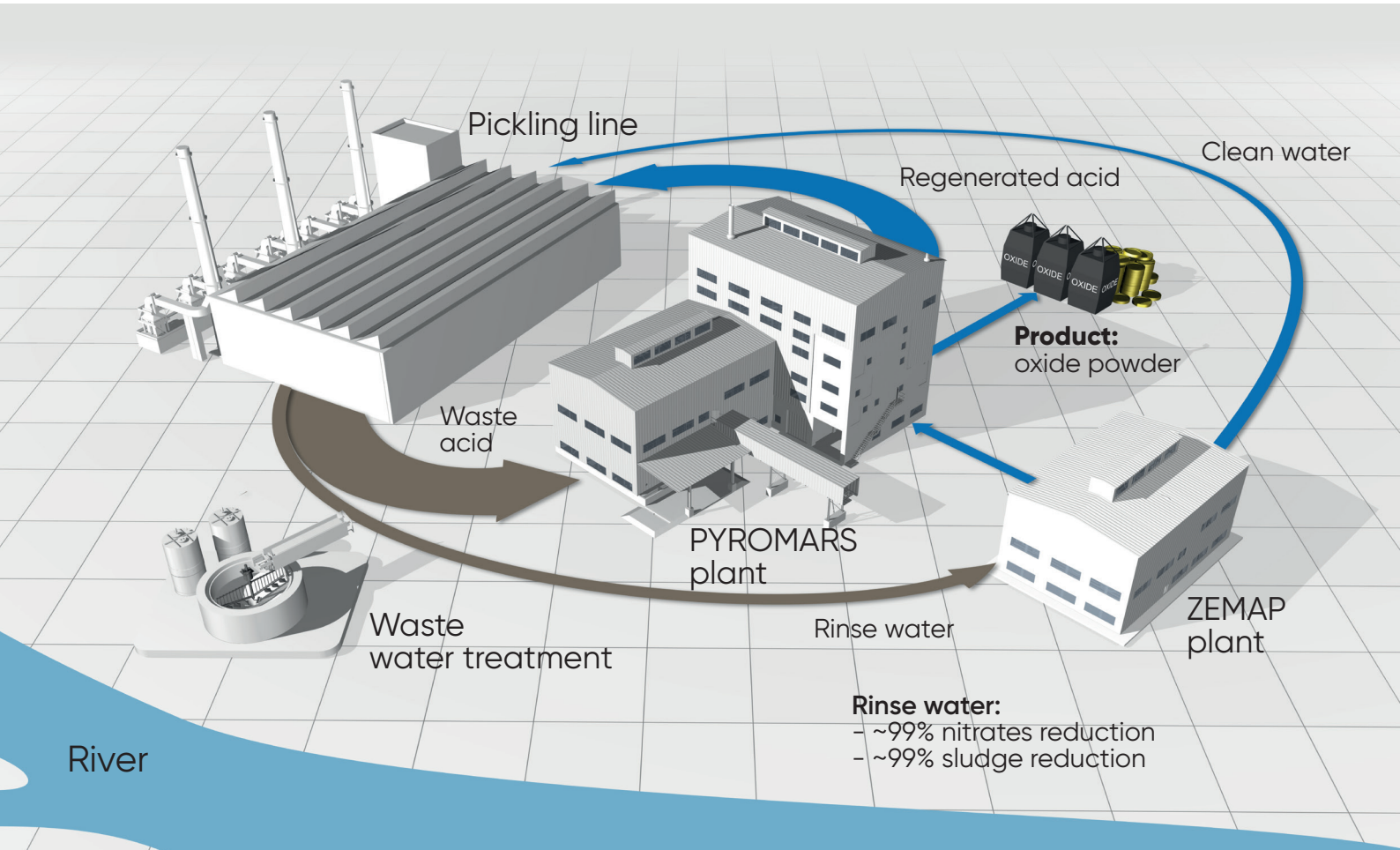
All nitrates (HNO_3) introduced to the PYROMARS process are either recovered as nitric acid (60%-80%) or treated in a DeNOx/SCR (Selective Catalytic Reduction) system in which NOx gases are reduced to nitrogen and subsequently released into the atmosphere.

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





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▲ ZEMAP system

ANDRITZ METALS

ANDRITZ Metals Processing is a global leader in providing cutting-edge solutions for the production and processing of cold-rolled strip made of carbon steel, stainless steel, aluminum, and other non-ferrous metals. Our innovative technologies and comprehensive services ensure that we support our customers at every stage of the plant life cycle, from initial setup to ongoing maintenance and optimization.

We combine our deep industry expertise with advanced automation and digitalization to help our customers achieve peak performance and sustainable growth. Our service business is dedicated to maximizing the efficiency and longevity of your equipment, ensuring you stay ahead in a competitive market.

ANDRITZ. FOR GROWTH THAT MATTERS.

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