

CLOSING THE ACID LOOP – WHILE CUTTING OPERATING COSTS

Regeneration systems for hydrochloric waste pickling solutions

ANDRITZ

The leading acid regeneration technology

THE PROCESS

The dissolved iron is extracted either as iron oxide powder (spray roasting technology) or as sintered iron oxide (fluidized bed technology). Spray roasting is also used to produce other metal oxides from chloride solutions, for example aluminium, cobalt, magnesium, nickel and titanium oxides, rare earth, and various mixed oxides.

When steel is pickled with hydrochloric acid, an iron chloride solution is produced:

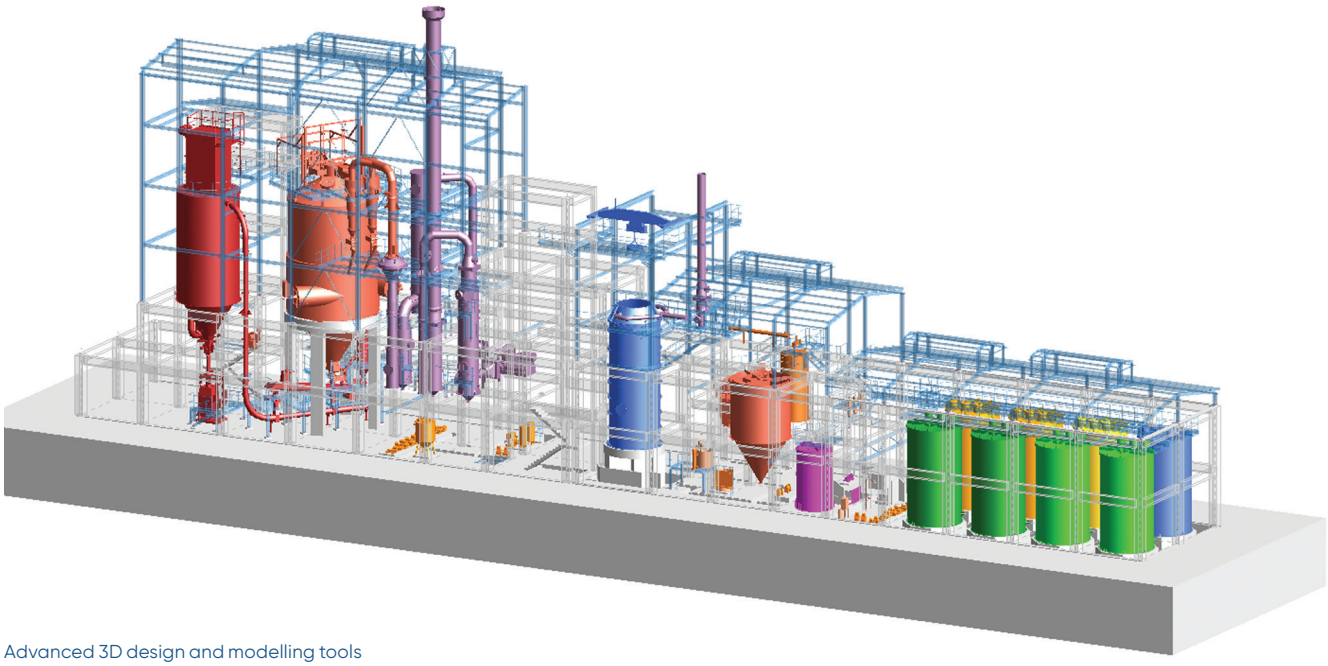
- $FeO + 2HCl = FeCl_2 + H_2O$.

In the regeneration system, the iron chloride ($FeCl_2$) is converted into hydrochloric acid and iron oxide by hydrolytic decomposition.

- $2\,FeCl_2 + 2H_2O + \frac{1}{2}O_2 = Fe_2O_3 + 4HCl$

This reaction takes place in the reactor at temperatures ranging from 600° C to 800° C.

The ANDRITZ spray roasting and fluid bed processes recycle hydrochloric acid with an efficiency of 99.5% for reuse in your pickling line.



Advanced 3D design and modelling tools

Our technologies provide high savings

The iron chloride containing waste pickling acid from the pickling system is conveyed to the pre-evaporator, where it comes into direct contact with the hot off gases from the reactor and is concentrated. This concentrated iron chloride solution is sprayed into the spray roasting reactor or fed to the bed of a fluidized bed reactor.

In the reactor, the concentrated iron chloride solution is atomized and contacted with hot combustion gases from burners located at the bottom of the roaster. The solution is evaporated and the iron chloride is thermally decomposed to iron oxide and gaseous hydrogen chloride. After passing through the cyclon separator, the hydrogen chloride gas, water vapor and combustion gases enter the pre-evaporator and the absorption column, where the HCl gas is absorbed adiabatically using rinse water from the pickling plant.

The resulting hydrochloric acid (18% by weight) is recycled to the pickling process.

The gas from the absorber is cleaned in a scrubber stage to comply with emission limits in and then discharged to the atmosphere.

A fan keeps the system under negative pressure, preventing the HCl gas and dust from leaking into the plant. Iron oxide powder or sintered iron oxide is discharged from the roaster bottom to storage bins and prepared for transportation.

LOW ACID CONSUMPTION

Acid consumption in pickling plants is substantially reduced when a regeneration system is used.

The following are guideline values for a pickling plant for low-carbon strip, based on 32% percent by weight of hydrochloric acid:

- Acid consumption with regeneration system: 0.5-1 kg/t material to be pickled
- Acid consumption without regeneration system: 18-30 kg/t material to be pickled

Tank farm



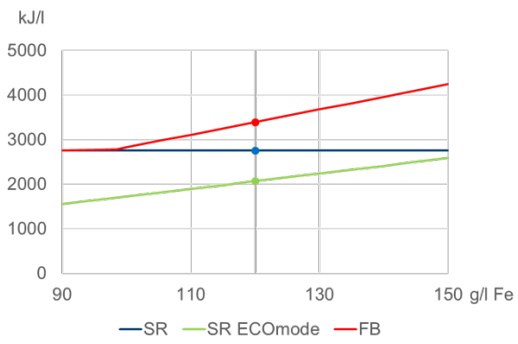
Reactor, venturi, absorbion column



FUEL CONSUMPTION

While the heat consumption for spray roasting reactors remains constant regardless of iron concentration in the waste acid, fluidized bed reactors consume more fuel at higher iron concentrations. The ECO*mode* allows for considerable savings in fuel consumption and a corresponding reduction in emissions in spray roasting reactors.

Energy consumption per liter of waste acid over iron concentration



High-quality oxides with WAPUR – Waste Acid PURification

WAPUR is the optimum process for cleaning spent pickling acid. Improved, sustainable oxide quality is achieved with effective and innovative acid regeneration technology.

In a conventional spray roasting process, the metal chlorides contained in the pickling acid are converted to metal oxides by thermal decomposition. The metal oxide composition then mirrors that of the pickled base material. With the WAPUR process introduced upstream of the spray roasting plant, much of the unwanted contamination can be removed from the pickling acid. Iron oxide, once a by-product, is thus turned into a valuable material that meets the stringent requirements of the electronics industry.

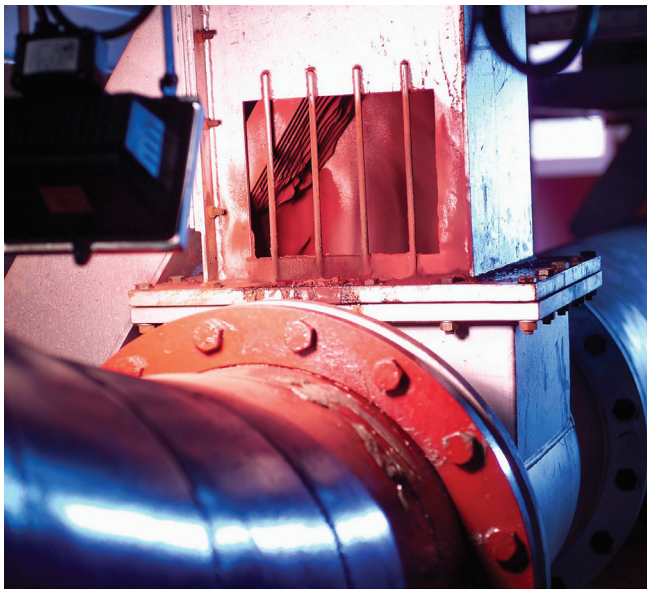
WAPUR PROCESS

The untreated acid is pumped continuously from the waste acid storage tank to a leaching column in the WAPUR system, where it is enriched with iron using scrap from the trimming shears of the pickling line. In the leaching column, the residual free hydrochloric acid in the untreated pickling liquor is bound to the iron. The overflow from the leaching column flows into the reaction tank.

After increasing the pH value, part of the bivalent iron is transformed into iron hydroxide and part of it is oxidized to trivalent iron. This hydroxide then adsorbs other co-precipitated elements.

The particles are agglomerated by adding a flocculant and settle in a sedimentation tank. This slurry is removed in a filter press, while the filtrate – which is very clean waste pickle liquor – is routed to the storage tanks for processing in the acid regeneration plant.

Oxide conveying system



BENEFITS OF THE WAPUR PROCESS

- No waste water
- Can be added to an existing regeneration system
- No additional personnel required
- Adapts to variations in the capacity
- Does not import any changes to the existing regeneration plant's operating procedures
- The iron oxide produced from the "waste" product creates an attractive source of revenue
- The iron scrap used in the process is transformed into high-value iron oxide
- Low utility consumption, continuous operation

Make our experience your advantage

The ANDRITZ spray roasting and fluid bed processes recycle hydrochloric acid with an efficiency of 99.5% for reuse in your pickling line.

WAPUR is the optimum process for cleaning spent pickling acid.

ECO*mode*, designed to reduce fuel consumption and emissions of HCl acid regeneration plants, represents the next big step in a series of improvements, and can not only be used for new installations, but also for existing plants.

A closed loop leaching process allows the production of high-quality oxide from metal chlorides (Fe, Ni, Co, Ti, Mg, etc.).

BENEFITS OF THE HCL REGENERATION TECHNOLOGY

- Proven and sophisticated design with more than 260 references worldwide
- Most stringent requirements regarding process technology, reliability, efficiency, and maintenance
- Recycling of hydrochloric acid with an efficiency of 99.5%
- Closed acid loop between the pickling plant and the regeneration system
- Waste pickle liquors containing unwanted elements can be treated
- Rinse water can be used as absorption water in the regeneration plant, thus reducing, or in most cases completely eliminating the requirement of neutralization capacity for the process
- Reactors can be heated with any gaseous or liquid fuels
- High-purity iron oxide as a by-product with the WAPUR process

Dust separator and injection of waste pickle at the evaporator



Proven and sophisticated design

EXTRACT FROM OUR REFERENCE LIST

Customer	Country	Capacity (t/h)
Aarti Steels (Nigeria) Ltd.	Nigeria	1,500
Abul Khair Stripprocessing Limited	Bangladesh	3,600
Acciaieria Arvedi	Italy	10,000
Al Ghurair Steel	U.A.E.	2,700
Anyang Iron & Steel	China	11,000
Arcellormittal Nippon Steel India Ltd	India	12,000
Baoshan Iron & Steel Corp.	China	2 x 7,500
Baosteel Shanghai No. 1	China	9,500
Benxi Iron & Steel	China	12,500
Essar Steel	India	5,000
Guangxi Liuzhou Iron & Steel	China	10,000
Guangzhou JFE Steel Sheet	China	9,500
Handan Iron & Steel Group	China	8,000
Inpromesa F. Sidmed S.A.	Spain	9,000
International Steels Limited	Pakistan	4,500
JSW Steel Coated Products Ltd.	India	6,000
OJSC Novolipets Steel	Russia	2,700
Rizhao Steel Holding Group Ltd.	China	2 x 20,000
Safal Steel (Pty) Ltd.	South Africa	1,500
Tian Tie Group	China	11,700
Tata Steel UK Ltd.	United Kingdom	6,000
thyssenKrupp Steel Europe AG	Germany	9,000
Union Steel	Korea	10,000
Usinas Siderúrgicas de Minas Gerais	Brazil	6,000
voestalpine Stahl	Austria	5,000

OVER 260 REFERENCES WORLDWIDE

REDUCE ECOLOGICAL FOOTPRINT

ADDITIONAL REVENUE

FROM PRODUCTION OF HIGH-VALUE IRON OXIDE



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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