



Continuous monitoring of the acid and metal concentration of pickling baths used in the steel industry

Relevant for:

Steel industry, plant manufacturers, surface coaters, ...



1 Process

Pickling in the steel industry is the process which chemically removes the scale or corrosion layers from the surface of metals using acids or bases.

Scale is produced during hot rolling. It is a metal oxide layer on the surface of the metal which is produced at high temperatures under the influence of oxygen.

Pickling baths for steel are typically filled with sulfuric acid or hydrochloric acid. Phosphoric acid, nitric acid, hydrofluoric acid and other acid mixtures are used in special cases, such as for pickling stainless steel or aluminum. Over time the metal ion concentration of the pickling bath increases and the acid concentration decreases. This can be corrected to a certain extent by adding fresh acid to the bath. The acid concentration of the pickling bath is a decisive factor for achieving a clean surface without attacking the basic material. This attack on the metal is called 'etching': hydrogen is released which can cause the steel to become brittle.

2 Measuring method

The fluid consists of water, acid and metallic salts, whereby the acid and salts are dissociated in the pickling bath. To determine the acid concentration requires measurement of at least two different physical properties. In practice, an optimal solution is provided by measurement of the density in combination with measurement of the conductivity.

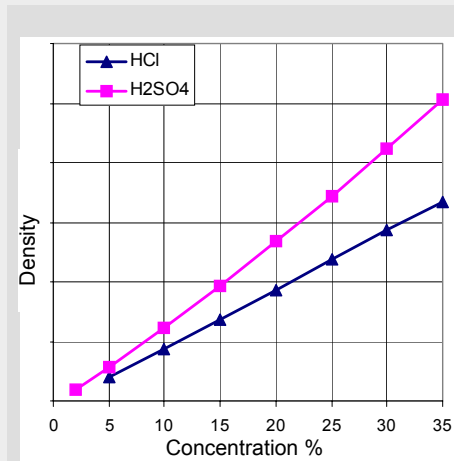


Fig. 1 Density as a function of the concentration

Accuracy

Anton Paar's process system achieves a measuring accuracy of $\pm 0.3\%$, depending on the acid, temperature range, measuring range and contamination.

3 Configuration of the system

- DPRn 427 tantalum density sensor
- Conductivity sensor
- mPDS 2000V3 evaluation unit

Typical installation

Measurement is carried out in the supply pipe to the pickling bath, in the return pipe from the pickling bath and in the pipe for adding regenerated acid.

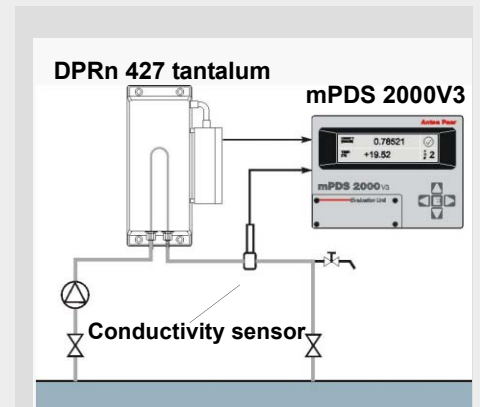


Fig. 2 Example of an installation



Fig. 3 Connection of the DPRn 427 tantalum

4 Applications

- Hydrochloric acid: 5 – 20 %, 25 – 90 °C
- Sulfuric acid: 5 – 30 %, 40 – 103 °C
- Phosphoric acid: 2– 20 %, 70 – 90 °C

5 Customer benefits

- Reduced acid consumption by optimizing the acid concentration.
- Decreased risk of overpickling (etching the basic material).
- Optimized pickling quality and duration.
- Less water needed for rinsing.
- Rapid and continuous process monitoring.
- High accuracy over a wide range.
- Robust and maintenance-free method.

6 Alternative methods

Laboratory:

- Titration: During titration a reagent is added to the sample, drop by drop, until the indicator contained in the sample changes color. The concentration can be calculated from the amount of reagent needed.

Disadvantages: discontinuous method, requires trained personnel and consumables.

Online:

- Online titration: Automated titration. Disadvantages: Requires consumables, high acquisition costs (ratio approx. 1:3).
- Sound velocity with conductivity. Disadvantages: Does not cover the whole application range, near the turning points the measuring accuracy decreases.

7 Customers

- Cold rolling mills
- Coating companies
- Electroplating companies
- Anodization companies
- Chemical industry
- Plant manufacturers

8 Literature

- Jürgen N.M. Unruh; Lehrbuch für Galvaniseure und Verfahrensmechaniker für Beschichtungstechnik (Lernstufe 1)
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