Titanium Dioxide Manufacturing

BACKGROUND

Although titanium is a familiar construction metal in aerospace and medicine, over 90% of titanium production is used to make titanium dioxide (TiO_2) for pigment in the paint, paper, plastics, and ink industries. TiO_2 has replaced lead based additives in paint due to better environmental properties and a very high "hiding power" compared to alternative chemicals.

Two processes are used to produce TiO_2, the sulfate process and the increasingly popular chloride process. The process used depends on the form of the titanium ore available and the desired pigment properties. Bulk minerals such as ilmenite ($FeTiO_3$) that easily dissolve in sulfuric acid are most economically handled by the sulfate process. The chloride process is typically used on higher quality titanium ores.

PROCESS

Ilmenite nominally contains only 53% TiO_2, so it must be purified before further processing. Raw ilmenite or slag ore is first soaked in sulfuric acid for several hours to free up the titanium from the mineral. The titanium dissolves as titanium sulfate while many impurities do not dissolve and are removed by settling. The hydrated form of titanium dioxide is produced upon hydrolysis in alkali at elevated temperature. This precipitate is filtered and washed to remove traces of iron impurities that can affect the brightness of the pigments produced. Ions such as potassium, phosphorus, or aluminum may be added to control particle size and durability. The hydrate paste then undergoes a high temperature calcination stage that yields the solid white product.

Pigment properties are determined by the particle size distribution of the base pigment, the chemical composition, and the crystal structure of the particles. The properties of the pigment are therefore strongly affected by the conditions present during the hydrolysis and calcination stages. Temperature, pH, deposition rate, ore quality, and additives used all play a factor in determining the crystal structure. Specifically, the pH in the hydrolysis step influences the reactivity of the TiO_2 and the ease of removing the impurities.

THE PROBLEM

Measuring pH in this manufacturing process is complicated by the very properties of the liquids used. The finely dispersed ore particles tend to badly coat standard pH sensors, first causing sluggishness and eventual total failure. This problem is compounded if the process is allowed to dry on the pH sensor. Rosemount Analytical has developed powerful solutions to preserve a viable pH measurement under these circumstances.

THE SOLUTION

The first part of the solution is the high performance PERpH-X® line of pH sensors. These sensors use two layers of porous liquid junctions to separate the process chemicals from the silver reference, and allow the outer reference solution to be conveniently refilled with a preloaded syringe. The outer junction can be quickly and easily replaced to foster convenient troubleshooting. The PERpH-X reference solution can be customized for different application situations and includes a titanium solution ground for complete diagnostics of the reference and glass portions of the sensor.

Rosemount Analytical analyzers and transmitters such as the loop powered model 5081pH continuously assess the health of the PERpH-X sensor and alert the user if the glass is broken or the reference is getting coated. This allows cleaning action to be automated and preventive, which is much more effective than waiting for manual sampling to indicate a problem.

All PERpH-X sensors are available with integral cable or with the convenient VP connector and the model 3500 version is available with an internal preamplifier which is recommended for cable runs longer than 10 meters. The PERpH-X sensor is frequently all that is needed to solve the measurement problem.

The second part of the solution is the advanced PASVE Mounting and Service Valve. The rotary PASVE valve enables convenient automatic flushing and cleaning, and can also minimize exposure to the process during shutdown periods. A typical customer can thus continuously measure pH during operation while flushing the sensor with warm water every thirty minutes.

The PASVE valve is available in manual and automatic versions and is compatible with Rosemount Analytical model 389, 396, 396P, and 3300 PERpH-X sensors. There are many installation options including direct mounting on tanks or pipes, flanges, and threaded connections. For more detail see the PASVE Product Data Sheet PN 71-PASVE.

INSTRUMENTATION

Model 5081 pH/ORP Smart Two-Wire Transmitter

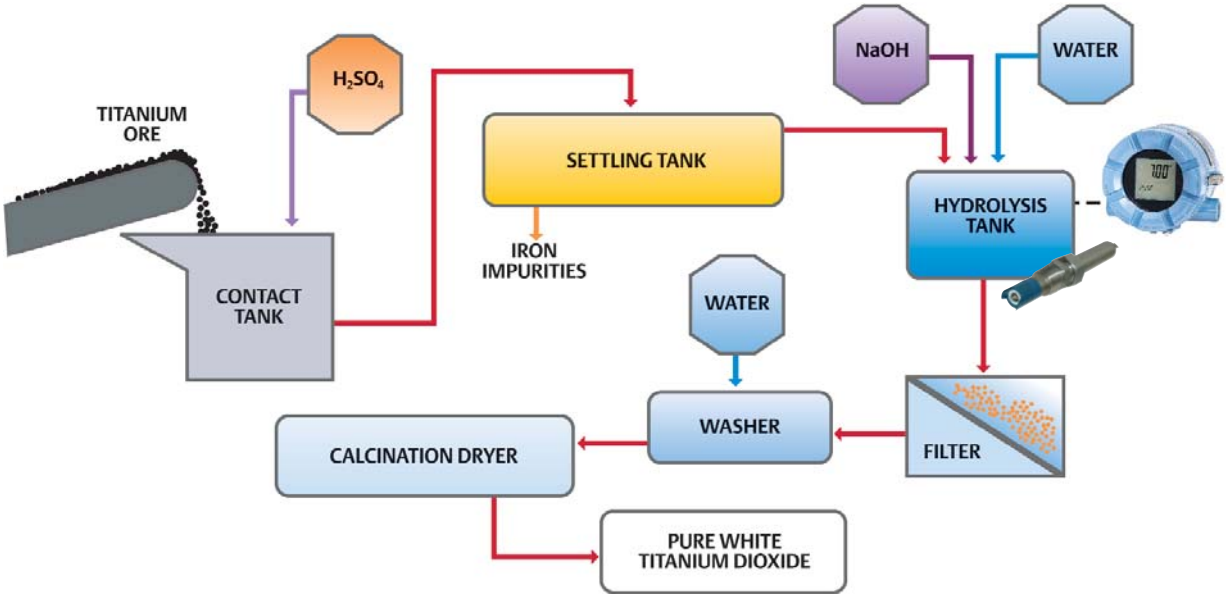
- Hand-held infrared remote control link to activate all the transmitter functions.
- NEMA 4X (IP65) weatherproof, corrosion resistant enclosure.
- Non-volatile EEPROM memory to hold data in event of power failure.

Model 3300HT High Performance pH/ORP Sensor

- Fast, accurate, & stable measurement
- Rugged, versatile design
- High temperature design increases sensor life when used in elevated temperature applications.
- Long lasting rebuildable reference
- Quick connect cable or integral cable

Model PASVE Rotary Retraction Valve

- Can be mounted on pipe lines, tanks, or directly in-line
- Safe retraction to 250 psig pressure
- Great for dirty, coating, and/or abrasive applications typically found in the Mining Industry
- Patented, Unique Rotary valve design provides cleaning and calibrating without sensor removal or process shutdown
- Manual or Automatic rotation available
- Extended sensor life: Sensor can rotate into process for critical measurement, then rotate out and flushed with water until next measurement time is needed. Especially good when used in harsh processes.



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