Introduction
Sodium chlorate is an inorganic compound with the chemical formula NaClO$_3$. It is a white crystalline powder that is readily soluble in water. It is hygroscopic. It decomposes above 300 °C to release oxygen and leave sodium chloride. Several hundred million tons are produced annually, mainly for applications in bleaching paper.

Application Overview
Industrially, sodium chlorate is produced by the electrolysis of a hot sodium chloride solution:

$$\text{NaCl} + 3 \text{H}_2\text{O} \rightarrow \text{NaClO}_3 + 3 \text{H}_2$$

In chemistry and manufacturing, **electrolysis** is a method of using a direct electric current (DC) to drive an otherwise non-spontaneous chemical reaction. Electrolysis is commercially highly important as a stage in the separation of elements from naturally occurring sources such as ores using an electrolytic cell. The voltage that is needed for electrolysis to occur is called the decomposition potential.

This reaction progresses in heat (at least 70 degrees Celsius), and controlled pH. In lower temperature or with high pH another reaction progresses:

$$2 \text{NaCl} + \text{H}_2\text{O} \rightarrow \text{NaClO} + \text{NaCl} + \text{H}_2$$

The Chloralkali process is an industrial process for the electrolytic production of sodium chlorate. It can also be synthesized by passing chlorine gas through a solution of sodium hydroxide. It is then purified by crystallization.

Typical process details

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Strong Chlorate (Composition :NaCl 8%,NaClO$_3$ 36%,Na$_2$Cr$_2$O$_7$ 0.3%,Water Balance. NaOCl 2 to 5 gpl, pH 5 to 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press Nor/Max</td>
<td>1.1 / 1.8 kg/cm$^2$ (g)</td>
</tr>
<tr>
<td>Temp Nor/Max/Min</td>
<td>85 / 90 / 25 deg.C</td>
</tr>
<tr>
<td>Design Parameters:</td>
<td>Pressure - FV/6.11 kg/cm$^2$ (g) &amp; Design temperature- 117 deg.C</td>
</tr>
<tr>
<td>Density</td>
<td>1330 kg/m$^3$ @ N.O.C</td>
</tr>
<tr>
<td>pH Nor/Max/Min</td>
<td>(5.8-6.2) / 6.8 / 4.5</td>
</tr>
<tr>
<td>Installation</td>
<td>Insertion type</td>
</tr>
<tr>
<td>Insertion Length</td>
<td>Minimum 60 mm</td>
</tr>
</tbody>
</table>
Typical problems
Frequent cleaning

Remedies
Use of differential sensor

Product Recommendation
Measurement System

Process Liquid Analyzer:
- 2-wire FLEXA pH/ORP Analyzer
- 4-wire PH450G pH/ORP Analyzer

Features
Dual sensor measurement on 2-wire type analyser
Indication of sensor wellness

Features
Easy touchscreen operation
Trending display up to 2 weeks
Advanced Process Temperature Compensation

Sensor Selection:
FU20-FTS sensor from Yokogawa is the perfect sensor for this application. Cleaning is probably not necessary for FU20-FTS sensor because of its design. pH electronics is required with two high impedance inputs like FLEXA series or PH450 series.

FU20-FTS is possible if the salt content is stable during the pH control step.

Features:
The FU20-FTS is a differential pH sensor. This means that the reference is not a (liquid) junction but a glass sensor which does not respond to pH changes (within the applicable range of the sensor). Therefore the sensor is truly maintenance free and the output voltage of the sensor depends only on the salt concentration of the process.

The sensor responds to pH changes rather than analyzes the accurate pH value. In that sense it is best to describe the sensor as pH control sensor rather than pH measuring sensor.

A rule of thumb is that a change in salt concentration of +/- 25% has an effect of less than 0.1pH on the pH reading.

Tangible benefit
Save down time in cleaning, repeated calibration, improve end product quality.

Note: For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department