APPLICATION STUDY

FOCUS-ON

A SAMSON & KROHNE COMPANY

OPTIMIZATION OF ALKALINE ELECTROLYSERS WITH FOCUS-1

HIGHLIGHTS

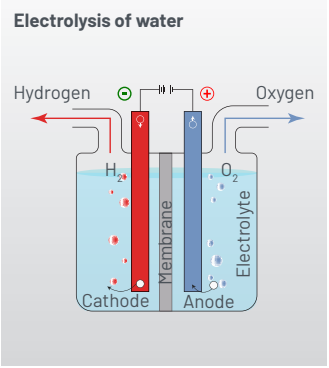
- Cost savings resulting from integration of flow measurement, analytic measurement and control in one single device
- Installing only one single device saves on space, installation cost and drives out complexity
- Unique fast and accurate KOH concentration measurement integrated
- Optimum control performance and reliability through high measurement frequency and digital twin

1. BACKGROUND

Within the frame work of the energy transition from fossil based fuels to renewable sources hydrogen will play a significant role. Generation of hydrogen can be done via different routes, but the one through electrolysis and in particular the alkaline electrolyser is the focus here. The market for alkaline electrolysers is growing rapidly as these installations are often being used in combination with large PV solar fields and wind turbines, with the goal to relieve the electrical power grid. In combination with their growing use, there is also a continuous search for optimisation in electrolyser operation and performance. This application study relates to the use of a smart meter valve in alkaline electrolysers and is based on proven experience with one of the biggest hydrogen electrolyser producers in the world. This project proves that the smart meter valve's added functionality creates an ideal set up in alkaline electrolysers reducing cost and improving functionality and system performance.

2. CONTROL REQUIREMENTS

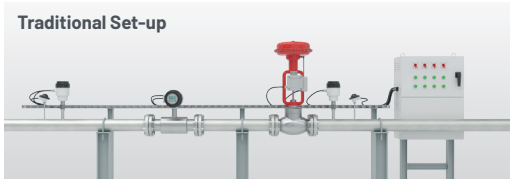
In an alkaline electrolyser hydrogen is generated by splitting water (H_2O) molecules in its two base molecules being oxygen (O_2) and hydrogen (H_2). This can be done by applying an electrical voltage on 2 electrodes inserted in a water filled basin. The water in the basin needs to be electrically conductive, so the electrons, necessary for the reaction, can flow from one electrode to the other. The required and optimum conductivity is achieved by mixing KOH in the demineralized water in the basin.



As the (water splitting) reaction takes place, demineralized water needs to be added (in the right amount) in order to maintain the optimum KOH concentration. As the reaction itself is exotherm the water in the basin needs to be circulated (pumped round) in order to maintain a homogenous temperature distribution and to keep the temperature within limits.

Currently the KOH concentration is measured by (off-line) concentration sensors, or deduced by Coriolis mass flowmeters. In both cases their output values go to a PLC, which then operates a valve that controls the inflow of demineralized water in the electrolyser. As the circulation flow of the water/ KOH mixture needs to be monitored as well, additionally a flowmeter and a temperature sensor will be installed. Of course in the case of the Coriolis mass flowmeter the flowmeter would not be strictly necessary.

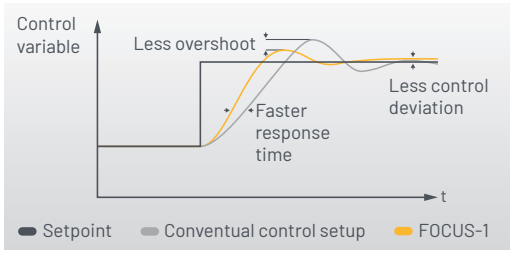
Reviewing this control set-up there is a concentration sensor, a flowmeter, a temperature sensor, a control valve and a PLC with corresponding software installed. Requiring all these individual sensors has consequences for the mechanical and electrical construction, installation labor, hardware and software integration in the PLC and likely the dynamic behavior of all of these components as one system. In short, a complex system with a challenge to get the dynamic behavior to where it should be and with that open for improvement.



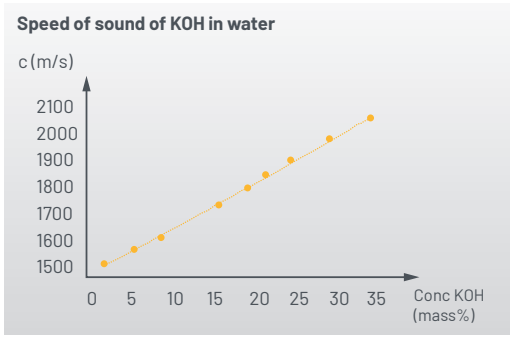
3. FOCUS-ON SOLUTION

As in the FOCUS-1, smart meter valve, an ultrasonic flowmeter, temperature and pressure sensors have been integrated with a control valve together with powerful processing, data storage and control capacity the complexity of this application goes away. Now only one single device has to be installed and performs the flow control and KOH concentration measurement.

As for the (circulation) flow control the integrated (temperature, flow, pressure) sensors are paced at 10 Hz the integrated (PID) control algorithm can drive the control valve very accurately and fast resulting in corresponding process control.



The KOH concentration measurement, necessary to control the demineralised water flow, is an integrated standard feature that is generated by smart combination of available sensor signals (sonic velocity, temperature, pressure). It as fast as the other measurements, i.e. 10 Hz, it is very accurate (<0.4% relative uncertainty) and comes as standard feature of the FOCUS-1 smart meter valve.

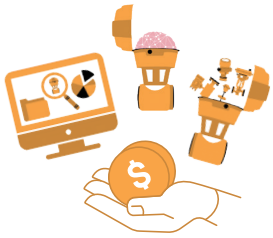


4. FOCUS-1'S USED IN ALKALINE ELECTROLYSERS

- FOCUS-1 DN 50 Smart Meter Valve for Water/KOH circulation flow
- FOCUS-1 DN 50 Smart Meter Valve for demineralized water flow
- FOCUS-1 DN 100 Smart Meter Valve for KOH crossover

5. CUSTOMER BENEFITS

- Comprehensive control and monitoring capabilities with FOCUS-1
- Improved efficiency of electrolyser operation via accurate, stable and fast flow control
- Electrolyser optimalization via direct KOH concentration measurement
- All-in-one solution significantly reduces complexity, cost and installation effort
- Additional data insights allow for high uptime of electrolyser units



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