# Process Monitoring: What Really Matters

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## ABSTRACT

**This paper focuses on an increasingly important topic: problems with bidding procedures for process monitoring instrumentation. The recent calls for bids are exclusively focussed on prices and do not take into account the kind of application and the specific requirements with respect to instrument maintenance and quality assurance. As a rule, the cheapest instrument selected does not in the majority of cases represent the best solution, in particular for cycle chemistry monitoring in power plants.**


## INTRODUCTION

Analytical instruments for process monitoring have evolved considerably over the last decades. The focus on electronic stability and sensor accuracy has shifted to an emphasis on cost of ownership and quality assurance. The log files of the support department of an instrument manufacturer clearly indicate that the practical problems lie in sampling, in the choice of a suitable analytical technology and in maintenance. The following discussion focuses on on-line analytical instruments in thermal power plants. A few examples will illustrate the issue.

## THE SAMPLING PROBLEM

When going through the records of the support department it becomes obvious that steady and sufficient sample flow is one of the most frequent problems in steam and condensate monitoring. As long as sample flow is not measured and recorded, it is very difficult for a remote support technician to detect the sampling problem.

### Sample Flow Monitoring

We have, therefore, started to include sample flow monitoring as part of each and every on-line instrument. It should not happen that an operator feels perfectly safe with condensate conductivity while in reality the sensor is sitting in a stagnant sample. *Figure 1* shows a flow cell for two conductivity sensors with cation column, needle valve and flow meter. Resin exhaustion is calculated from the sample flow and the differential conductivity.

### Sample Temperature

It is amazing to see how much money designers designate to tight temperature control with numerous coolers. Modern instruments, however, can compensate for changes in sample temperature in a wide range. With the use of solution temperature compensation it is sufficient to maintain a sample temperature below 45 °C. Money spent on coolers would be better invested in securing steady sample flow.

## GOOD INSTRUMENT CHOICE

Technical specifications in bidding documents often do not include the measuring point and the nature of the sample. Internet bidding for several power plants was recently conducted for 150 conductivity meters, 30 pH meters and 8 dissolved oxygen meters without further details. The operator might get a good price, but the instrument might be more suitable for potable water than for steam and condensate. Everyone has the instruments he deserves.


*Figure 1: Flow cell for two conductivity sensors (specific conductivity and cation conductivity) with cation column, needle valve and flow meter.*

### Cost Effective Selection

It is well known that pH in high purity water requires a lot of attention. Clever operators calculate pH from differential conductivity and save on maintenance. However, the chemical treatment of the feedwater must be known. Purchasing departments without the necessary background will ignore this possibility and close the way to savings for many operators.

### Sample Specific Selection

Monitoring disinfectants in cooling water discharge is now required for most cooling towers. In many cases, this can be done by an amperometric device at low cost and with high reliability. Chemicals such as corrosion inhibitors or the use of chloramination call for a colorimetric device at higher cost and more maintenance. Again, if purchasing ignores these facts, the cheaper instrument is chosen and will have to be replaced later at high cost.

### Same Parameter – Different Instruments

Operators are often seduced by technical features. Automatic calibration and low detection limits are amongst the features many instrument manufacturers are proud of. However, the question is: "What do you really need?" And even more important: "What can you reasonably maintain?"

A simple sodium monitor has no moving parts and requires manual calibration. Sample flow and reagent levels are controlled. The instrument is easy to understand and everyone can service it (*Figure 2a*). A system for sodium measurement in low pH samples is a bit more complex and requires some maintenance (*Figure 2b*). If you really have to see very low sodium levels, e.g., in the $ng \cdot kg^{-1}$ (ppt) range, in your condenser leakage detection, you absolutely need automatic calibration because low level standard solutions cannot be prepared in the laboratory. However, there are pumps and valves that need maintenance (*Figure 2c*).


*Figure 2a:*

*Standard sodium analyzer.*


*Figure 2b:*

*Sodium analyzer with active reagent addition for sodium measurement in low pH samples.*


*Figure 2c:*

*Sophisticated sodium analyzer featuring automatic calibration with standard dilution. This instrument is capable of measuring sodium in the $ng \cdot kg^{-1}$ (ppt) range.*

The choice of the instrument depends on the plant and how it is operated. It is, therefore, very important to tell the vendor what one plans to do with an analyzer. It is not enough to compare data sheets and select the fanciest specifications.

## MAINTENANCE

Whenever an R&D engineer is asked for precise instructions on maintenance he always tells us: "It depends…." There is no general rule for analyzers because sample quality varies from one plant to the other and even from one sampling point to the other. Maintenance schedules have to be established accordingly. In our records, we have seen rather too much than not enough maintenance. Most instruments give pretty stable results when left undisturbed.

### Calibration

Do not try to calibrate when standards are difficult to prepare or when there is a lack of trained personnel. A reliable trend has more value than an insecure accuracy. It is good practice to not calibrate too often but check values from time to time with a standard or with a portable instrument.

Sometimes operators want to calibrate electronics and signal outputs. Modern instruments, however, have no potentiometers. Calibration data is stored in the EEPROM and the system remains stable for years.

### Accuracy

In many process applications the term "accuracy" has limited meaning because there is no valid reference value. How would you test the 5 $\mu g \cdot kg^{-1}$ (ppb) reading of a dissolved oxygen meter? Sometimes samples are sent around the globe to test for traces of sodium. With disastrous results, obviously.

From experience we know that calibration data is a good indicator. If this data is within certain limits, the probability of an accurate reading is high (*Figure 3*). Therefore, you should always have a calibration history. It has much more value for quality assurance than any test with depleted standards or unsuitable methods.

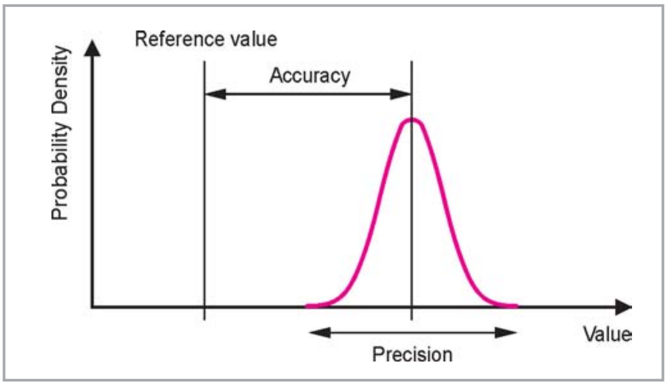


*Figure 3: Accuracy and precision.*

## WHAT REALLY MATTERS

It is not the data sheet, nor the fancy features! Reliable operation of process monitors starts with right or wrong choices. Operators should have a word in making these choices because they have to live with what they get. What is important:

– to control sample parameters, especially flow,
– to select the right instrument for a given task, and
– to define a suitable quality control program.

There is a lot of modern technology that will help to control essential instrument and sample parameters from a remote location such as a central laboratory. The key, however, is not the transmission technology but the data that is transmitted. There are already a few happy station chemists who can tell from their home if a cation column in the plant is exhausted or if a silica analyzer requires servicing.

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## THE AUTHOR

**Ruedi Germann** worked for 20 years as an independent business consultant before joining the management of a Swiss-based international instrumentation company. He started SWAN Analytical Instruments in a management buy-out in 1991 and has served as managing director ever since. The company has realized several information technology projects that integrate analytical instruments with modern software tools for quality assurance applications in thermal power plants.

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