

# Online Analysers for Heavy Metal Measurements in Water. SEIBOLD – COMPOSER Analysers Series. Continuous Measurements for Mission Critical Applications.



In the modern industrial development the analysis of industrial waste water has received considerable attention due to increased pollution by heavy metals. Therefore, it is very important and urgent to deploy reliable, fast and sensitive methods to determine and control the concentration of heavy metals in outlet samples.

## The Task:

The main task is the continuous on line measurement of heavy metal concentrations in waste water. Today the most reliable method for continuous measurement is the colorimetric method using complexometric chemical reactions. Heavy metal ions have very similar chemical behaviour and appear together in complex samples hindering measurement of heavy metal of interest. Measurement becomes even more complex when the sample composition changes in production processes.

For such purpose the COMPOSER for Heavy Metals Measurements has been developed by SEIBOLD-Messtechnik. Measurement is based on photometric determination of the intensity of the coloured complex formed by the heavy metal ions and the reagents.

The analyser itself and the operation and the measurements have to be done at reasonable costs measured by our TCO-model<sup>1</sup>.

## The Customisation (Optimisation) Process:

The customisation is always chemical optimisation governed by customer needs. Exact water waste composition and the measurement range of interest (e.g., very low range starting from 3 ppb and high range up to 3-5 ppm), lead chemistry and reagent development.

The first reagent does pre-treatment of the waste water for the measurement. The second reagent is the high sensitive photometric dye that reacts with heavy metal ion forming coloured complex. The major problem in measurements is the interference of other ions in waste water. In order to decrease their influence, special masking agents are used.

## The Analyser Quality:

Most important for analyser quality are reliable measurement results and reliable operations. Reliable measurement results are presented by two numbers, the accuracy and the precision.

Precision is the difference between measured and real concentration. Accuracy or reproducibility is the error of multiple measurements to each other. While an automated unit is very good in doing high precision measurements, the accuracy is far more difficult. The key to good accuracy is the calibration process.

## The Complexity:

Mechanical parts are in most cases responsible for failures and downtimes. In order to avoid these problems, the use of very simple mechanical parts, robust pumps and tubes, and no valves is mandatory. The situation in chemistry is very different and challenging. Because of the sophisticated task to get best measurement results in complex waste water compositions there is no simple answer and no simple chemistry.

To calculate the respective concentration multiple mathematical methods have to be used. The more information and data we have about the reaction the more sophisticated the mathematical methods become.

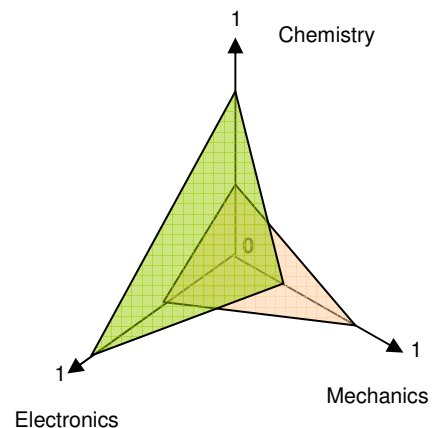


Fig. 1: The green triangle shows our Complexity-Strategy.

## <sup>1</sup>TCO-Model:

TOTAL COST OF OWNERSHIP.

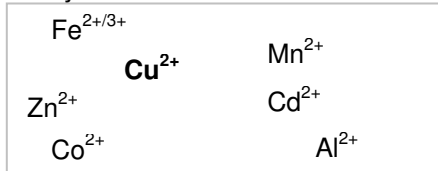
The TCO model calculates the total expenditure for running measurements in 5 years. This includes investment costs, set up and installation costs as well as cost for running the system as reagent consumption and spare parts and internal and external costs of maintenance.

A typical TCO for heavy metals measurement is EUR 2.70 per measurement (based on 5 years of operation and European salaries and measurements hourly). The share is 50% for maintenance, 25% investment and installation and 25% consumption and spare parts and waste disposal. SEIBOLD offers consulting for calculating your TCO for heavy metals measurement.

# Online Analysers for Heavy Metal Measurements in Water.

The development process starts with chemistry.

**The Task (the nightmare):** Measurement of Copper in a heavy loaded composition of heavy metals.



The big challenge:

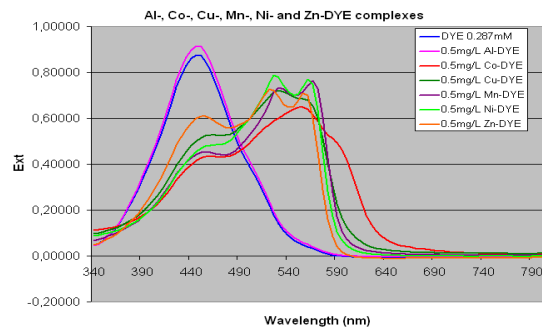
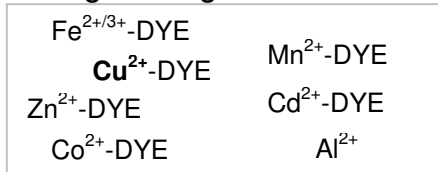
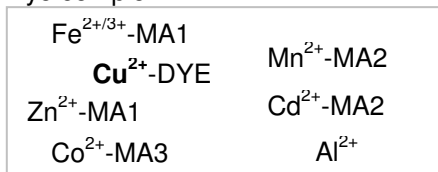


Fig. 2: Reaction heavy metals present in waste water with the same dye.

**The Strategy:**

Masking agents (MA) are used to sort out the interfering ions in order to measure only Cu-Dye complex.



(MA1...MA3 Masking Agents)

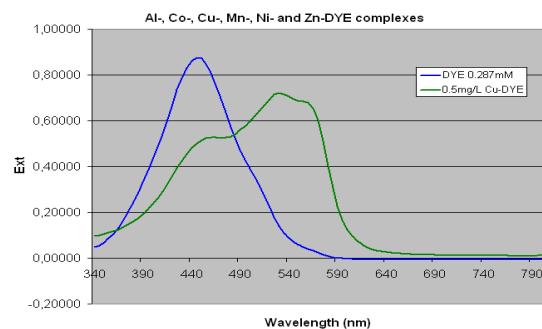


Fig. 3: Reaction between Cu and Dye while all other heavy metals are masked and therefore not detected.

The development process continues with electronics.

**The Task:** Data and process interpretation to get best measurement results and plausible data.

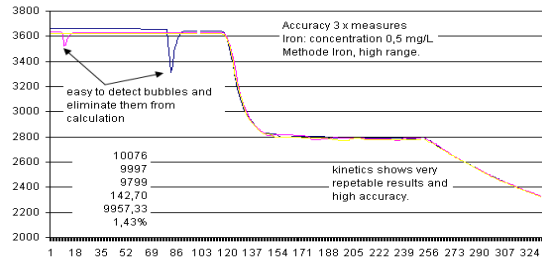


Fig. 4: Continuous data flow allows continuous control of measurement cycle and complex building.

**The Software:**

The software must support three main tasks.

1. Turning pumps on the specified time at specified speed.
2. Monitor and control the measurement cycle and test the cycle on plausibility.
3. Calculate the concentration of the specific element.
4. Communication and Control functions.

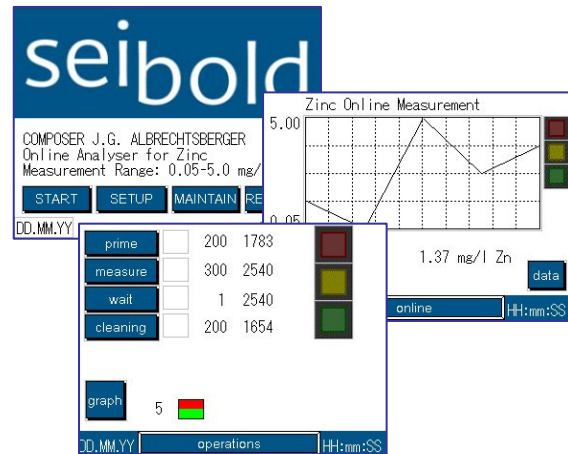


Fig. 5: Sample screens of colourful touch sensitive display.

The system is built as a flow through system due to continuous operation of SEIBOLD-COMPOSER. This also allows a real continuous mode of operation.

The speed of the pumps can be adjusted in order to obtain a specific mixture of sample, buffer solution and reagent. By adding the water pump the sample can be – for higher concentration ranges – diluted up to a factor of 10.

Because software development never ends, the software can be updated easily by engineers using a serial interface or USB.

### The Hardware:

The hardware design is robust and follows clear function principles.

1. Continuous flow means continuous measurements. The flow through the cell is directed by hoses pumps.
2. One hose principle. One diameter is used for all hoses and tubes.
3. Industrial design cabinet and functional rack for instrumentation assembly.
4. Easy maintenance tasks. The used Teflon hoses and the rack construction support the up-time and low maintenance.



Fig. 6: Installation in Shenzhen/China.

The case is a lockable steel case with a 19 inch rack for holding the parts. Every part is mounted on a single plate, so changing parts is a simple task.



Fig. 7: SEIBOLD-COMPOSER for Iron Control Panel

The picture above shows the control panel with the colour touch screen and the control lamps and the hose pumps for sample, water, buffer, reagent.

The fittings and tubes are made of Teflon to guarantee maximum life time.

The red indication lamp is for failure display as reagent empty.



Fig. 8: SEIBOLD-COMPOSER testing in our laboratory.

### SEIBOLD-COMPOSER on applications:

The two main applications are industrial waste water and drinking water.

In drinking water we measure i.e. iron and manganese and cadmium. In industrial waste water testing for heavy metal producers or semiconductor companies Copper, Zink, Iron, Nickel and Cadmium are the most required heavy metals.

The measurements are used for monitoring tasks and control purposes as for dosing of chemicals for waste water treatment.

### SEIBOLD-COMPOSER at a glance

- Robust design.
- Minimal maintenance.
- Easy handling.
- Highest accuracy of measurement and high precision.
- For mission critical applications.
- Automated cleaning and calibration.
- Can perform complex control tasks via analogue and digital communication

## **ABOUT SEIBOLD-Messtechnik:**

- 75 years in business starting with pH measurements for laboratories.
- European based company in the middle of Europe.
- Focused on research and development, more than 20% of the turnover is invested in R&D.
- Focused on heavy metals online measurements and on mission critical applications.
- Supports installation virtual one with our partnerships worldwide.
- Does engineering and consulting in the field of automatisisation by online measurements.

### **The heavy metals:**

Cd <sup>2+</sup>	Cadmium-Carl Zeller
Cu <sup>2+</sup>	Copper-Johann H. Schmelzer
Fe <sup>2+/3+</sup>	Iron-Joseph von Eybler
Mn <sup>2+</sup>	Manganese-Georg C.A. Wagenseil
Ni <sup>2+</sup>	Nickel-Johann J. Fux
Pb <sup>2+</sup>	Lead-Carl Czerny
Zn <sup>2+</sup>	Zinc-Johann G. Albrechtsberger

Please ask for other heavy metals measurements.

### **SEIBOLD-COMPOSER**

All analysers are named after Viennese Composers. The main task of the Composer is to combine different musical instruments to a wonderful sound. The same counts for analysers. Perfect analysers combine and adjust chemistry, electronics and mechanics to get the best in class measurements as well as low maintenance and over all a low TCO. (...and we dislike strange number and letter combinations for great instruments ...)

### **The measurement ranges:**

SEIBOLD COMPOSER for Heavy Metals can be adjusted to three different measurement ranges.

The very low measurement range starts with 3 ppb and goes up to 50 ppb and is used for clear water applications.

The low measurement range starts with 50 ppb and goes up to 2000 ppb (2 ppm).

The high range starts with 0.1 ppm and goes up to 5 ppm. By installing a dilution unit measurement range increases up to 20 ppm, which decreases accuracy of measurement results.

### **The installation process:**

For best measurement results the rule counts „the more we know about sample composition the better the measurement results are“.

### **The Pre Installation Phase:**

Collect information about the sample and the purpose of measurement.

1. Purpose of measurement.
2. Composition of Sample. Sample analysis on heavy metals and other chemical and physical parameters..
3. Industry and know measurement problems.
4. Measurement range (typical, minimum, maximum, control value).

Based on this data the decision of masking agent is made. There are industry type masking agents sets and customised masking agents' sets available. For measurements in the ppb range the customised masking agents have to be prepared.

### **The Installation Phase:**

Because of the demand of an automated operation the sample inlet and the waste outlet as well as de-ionised water supply have to be prepared.

1. Measurement cycle (real continuous up to one hour, may be switched during operation).
2. Connection to inlets and outlet.
3. Connection to control systems via analogue output (4...20 mA) and digital communication via RS232-C interface. And of course connection to power supply.

### **The Operation Phase:**

The maintenance tasks are critical to up-time and quality of measurements. Calibration is needed when changing reagents and is supported automatically.

1. Weekly tasks. Refill reagents. Calibration. Inspect the inlets and outlet.
2. Quarterly tasks. Cleaning tasks.
3. Tasks every half year. Change the hose pump hoses. Full test of Analyser.

For all these tasks inspection sheets are available.

Please get in contact with our local partnerships, call us +43 2243 20787 and look for more information, and downloads on [www.seibold-wasser.at](http://www.seibold-wasser.at)

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