Mathcad®, PTC's Design Calculation Software, Improves the Whole Lifecycle at SICK Maihak GmbH

SICK Maihak GmbH, Reute, Germany

The Situation

SICK Maihak's major focus is offering "measuring technology from one source" for numerous tasks in different industries. SICK AG, a worldwide leading manufacturer of sensors and sensor solutions for factory and logistics automation located in Waldkirch, has combined its products and services for process automation under this brand. At four locations in Germany various subsidiaries develop and produce components and system solutions for gas analysis, dust measurement, and flow-through measurement as well as water and liquid analysis.

The Challenges

- Develop a broad pallet of measuring instruments
- Ever more-complex products, as environmental regulations become stricter
- Necessity of assessing, early on, the feasibility of devices

The Solution

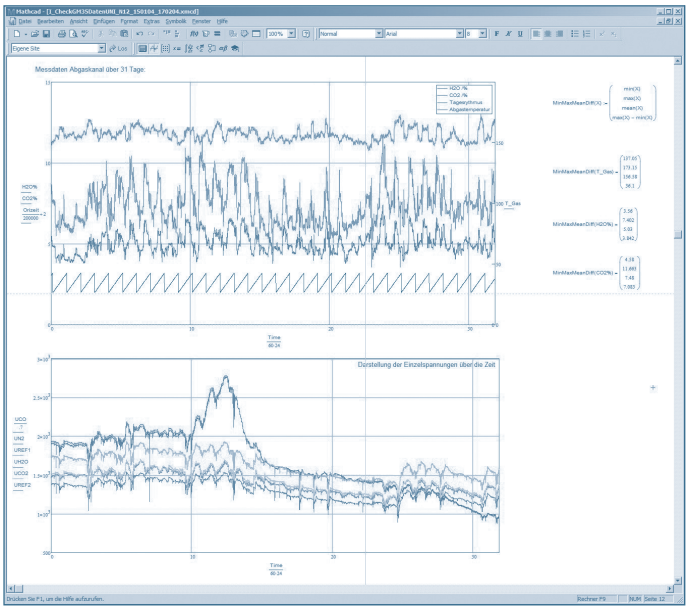
- Simulate the optical-electronic system structure with PTC's Mathcad
- Design measuring instruments in 3D with PTC's CAD solution, CoCreate® Modeling
- Use calculation data for calibration and service

The Results

- Accelerate product development through timely simulation
- Shorten the production of sample parts by using 3D data
- Improve quality by considering more influential variables

Cleanly Calculated Process Measuring Technology

SICK Maihak GmbH is a pioneer and world market leader in the area of in-situ measurement technology, which is used primarily for measuring emissions. The devices are located right at the waste gas flue and illuminate by means of a measuring lance, which projects the hot gas flow several meters into the channel, without the gas having to be extracted and treated. "This has the advantage that a person can supervise the concentration constantly, and also precisely measure substances whose concentration varies over the duct's cross-section," explains Rolf Disch, employee in the Research & Development Applied Physics Department at Sick Maihak GmbH in Reute.



Mathcad calculation software from PTC is used during running operation in order to analyze the causes of possible disturbances based on analysis of the measurement data. (Photo: SICK AG)

In-situ measuring instruments – like all other SICK products – are developed with the 3D CAD software, CoCreate Modeling, from PTC, which is used throughout the company. New products have been modeled in 3D for five years, which has accelerated the development process. In particular, the process of making samples has become shorter since employees in the testing workshop have been using 3D data directly for producing operating models, according to Jürgen Kaufmann, Manager of the Process Automation Development Group.

Devices Measure Light Absorption

With the exception of volume flow measurement, which is based on ultrasonic technology, almost all process automation devices measure with light waves. The challenge with spectrometry consists of finding the measuring range in which the substance(s) to be measured absorb(s) as much light as possible, and the disturbing elements in the gas mixture which emit no light. That is not easy, because water appears nearly everywhere as a variable disturbance. At high temperatures, gases expand and exhibit fewer molecules, which reduces the signal strength over the section measured. High pressures diffuse the spectral lines to be measured and increase the danger of intersecting with other substances.

PTC's engineering calculation software, Mathcad, has been used at SICK Maihak GmbH for 17 years, in order to test ideas for new products or advancements early on for their feasibility. "Before another research model is made, I check on a mathematical model whether I can measure with justifiable efficiency and required accuracy via the existing means available to us, a certain component under specific conditions like temperature, pressure, humidity, or oxygen concentration," clarifies Disch. "Simply said, I define a formula in which I enter these values and which delivers to me the operating parameters for light source, optics, and detector, with which I can measure the desired substance and how long the measured section must be, in order to achieve the detection sensitivity."

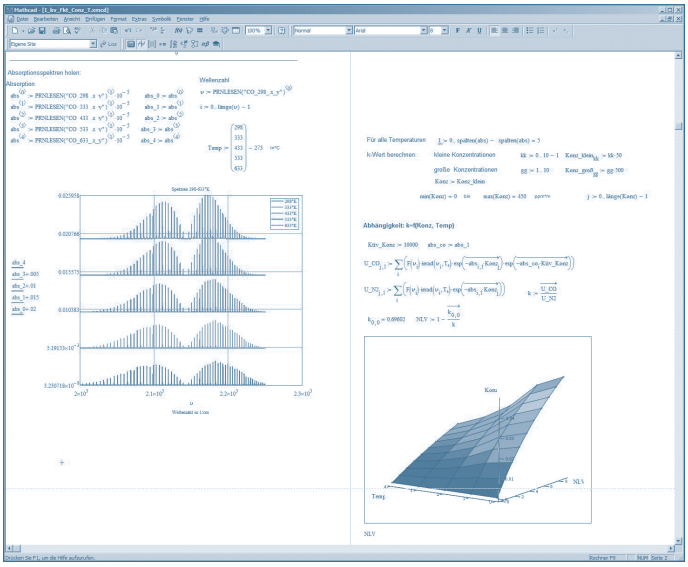
Mathcad's strength is that one can calculate nearly everything that can be computed: "The operation is absolutely intuitive: One enters the formula in the same way one would write on paper or a blackboard, and the software transfers it automatically into a line-oriented programming code," explains Disch, who programmed his formulas with Basic before the system's introduction. "Entering a formula in line-oriented language is very complex and error-prone. In addition, nobody else can read the formula on the first attempt." In this regard, Mathcad not only facilitates work for physicists, but also simplifies the documentation and the communication of results to others participating in the development disciplines.

In practice, research models follow the theoretical calculation of the optical-electronic structure. Physicists examine their calculated results at an optical bench with heatable cuvette, in which the gas mixture expected in the channel is conducted. The technical designers are already involved in this phase in order to model certain components for research structures. Their real purpose, however, is constructing the operating models, which must withstand real operating conditions.

> "Owing to PTC's Mathcad in product development, we are clearly faster and more precise, because we can estimate more influences in shorter time."
>
> – Rolf Disch, Research & Development Applied Physics
> SICK Maihak GmbH

Mathcad Visualizes the Results

Both in the model's research and operating phases, a number of measuring data are recorded, which flow back into Mathcad and are processed into graphics. The visual representation has always improved from version to version, as Disch says. Now one can represent the correlation of several parameters, for example, in the form of a 3D surface. At the same time, this is the basis for calibrating the devices. For spectrometry the concentrations of the desired substances are not directly measured, but the absorbed light and/or a voltage, which must be converted into the appropriate measurement value.



Even before creating the research models, engineers must determine the spectra and filter curves of the measuring instrument (left). With their help, the expected sensitivities are simulated. (Photo: SICK AG)

Mathcad supports the devices' calibration, as well as running operation. If, based on arbitrary fluctuations of the measurement data, service technicians assume an error, which they cannot locate immediately, they send these to Reute for analysis. Calculation specialists load these into Mathcad and compare them with the calibration data, in order to determine, based on correlations, the cause of possible error.

Even though Mathcad is used throughout the entire product lifecycle, Development profits most from the use of Mathcad calculation software: "In this way, we are clearly faster and more precise, because we can estimate more influences in a shorter amount of time," Disch says. "Without the [Mathcad] calculation tool, we would begin development with a research model and would even include the data with the danger that, after the model's research phase, it turns out that it doesn't function in the way we imagined. Now I can intercept such unsuccessful attempts in advance. The research models only serve to protect our computation results," concludes Disch.