

Essential work

Analytik Jena supports the fight against the coronavirus pandemic

The coronavirus crisis has presented people with unprecedented challenges. The same applies to companies that are in particularly high demand during a pandemic, such as manufacturers of laboratory and analysis technology whose devices and components automate and support virus detection workflows. The experts at Analytik Jena were in demand almost from the very beginning.

The situation is unprecedented: A crisis that affects every country, company, and almost everyone across the globe. A pandemic triggered by the previously unknown SARS-CoV-2 coronavirus last December has since claimed many thousands of lives. In order to slow down the spread of infection as much as possible, authorities across the globe reacted with unprecedented restrictions on movement in addition to encouraging hygiene and distancing measures, leading to a lockdown of almost all of society. Meanwhile, virologists repeatedly emphasized the importance of a third significant measure to slow down the rate of infection and protect those at risk: widespread testing.

There are various approaches to testing for the new virus. The real-time PCR testing procedure is seen as the standard method alongside enzyme-linked immunosorbent assays or other approaches for detecting antibodies. PCR stands for polymerase chain reaction and is used to examine the molecular microstructure of genetic material. It makes no difference whether the material comes from a plant, animal, human or even a virus, as all these materials contain nucleic acid. And no matter the reason or purpose for which the DNA or RNA is examined, the PCR process is always the same: The nucleic acid is isolated from the initial material and is duplicated and made visible with the help of real-time PCR. Even the smallest traces of the genetic material of a pathogen lead to a reliable positive result within a matter of hours. PCR is therefore also used to detect countless infectious diseases, including

- bacterial infections such as tuberculosis or syphilis,
- viral infections such as hepatitis B and HIV and
- parasitic infections such as malaria.

Automation to achieve critical output

The advantages of real-time PCR include its high sensitivity and the fast availability of test results. But the steps required to carry out this method are relatively elaborate when done manually for multiple tests, which is why devices and instruments were established years ago to enable automated processes for the associated laboratory tasks. Analytik Jena AG, part of the Endress+Hauser Group, is a manufacturer of high-performance analysis instruments with production sites in Jena, Göttingen and Berlin. The company supplies products for water analysis, environmental monitoring, research sector studies and quality control analyses. The demand for life science products has also drastically increased

since early 2020. These include platforms for nucleic acid extraction, pipetting systems, thermal cyclers and extraction kits in addition to enzymes required to carry out real-time PCR.

Coordinated measures in China

Employees at the Chinese sales unit were the first in the Group to be confronted with coronavirus queries at the start of the crisis. The city of Wuhan, the epicenter of the outbreak in Hubei province, emphasized the rapid tracing of infected people to curb the epidemic in addition to hygiene regulations and curfews. As early as the Chinese New Year holiday, Analytik Jena's employees in China implemented a strategy to be able to respond to requests to increase testing capacity. To begin with, the compatibility between external suppliers' detection kits specific to the SARS-CoV-2 virus and Analytik Jena's real-time thermal cycler had to be determined. The respective suppliers were offered proof-of-principle support. The human error rate, which had risen significantly due to the tremendous increase in the number of tests, was reduced to a minimum thanks to a combination of the InnuPure C16 *touch* and CyBio FeliX pipetting systems.

Shortly thereafter, the Chinese Analytik Jena colleagues provided details on detecting the RNA virus to approximately 1,000 participants via webinars. They simultaneously stepped up online training sessions as well as instrument delivery and installation. This enabled them to install ten thermal cyclers in hospitals heavily affected by CoVID-19, including the Wuhan Huoshen Mountain Hospital. The field hospital attracted global attention after having been constructed over the course of just ten days. Other crucial device users included the public health center in Shanghai Jinshan, which was another hospital hotspot that treated CoVID-19 patients in Shanghai and other parts of the country.

German production in a state of emergency

While it was mostly service technicians, sales and application employees and distributors who were in demand in China at the start of the pandemic, the demand for PCR instruments exploded worldwide towards the end of February. Analytik Jena now had another objective in addition to the challenges manufacturing firms were facing since the outbreak of the coronavirus pandemic: to increase instrument production in Jena and Göttingen as well as kit production in Berlin as much as possible without compromising on quality or defined standards.

As a result of these efforts, production had increased tremendously by early April, with the output of certain instruments having tripled. Nevertheless, customers across the globe had to continue to be patient. To put things into perspective, the lead time on the thermal cycler, which would normally be between one and two weeks within Europe, increased to the current lead time of between seven and eight weeks. The buffer stocks put in place under normal circumstances have long since been depleted. But there are also silver linings. Analytik Jena has felt the major advantages of being part of a large corporate network under the current circumstances. While there have not been any gaps in the supply chain for manufacturing hardware thus far, thanks to long-term delivery agreements and flexible suppliers, bottlenecks soon arose in the supply of salts and solvents such as alcohol for the production of nucleic acid purification kits. But these challenges were overcome with the help of the

Endress+Hauser network. Colleagues from the Group soon organized new suppliers to allow production to continue in Berlin, demonstrating that this pandemic can only be overcome through joint efforts.

Background information on coronavirus

The coronavirus disease (CoVID-19) is an infectious disease caused by a new type of virus called SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2). Coronaviruses are part of the RNA family of viruses. The chemical structure of its genetic material is not as stable as that of DNA viruses, which is why there are often changes to the genetic material. This does not, however, affect the proliferation and spread of the viruses.

The PCR process

The polymerase chain reaction (PCR) is the most important laboratory method of examining the molecular microstructure of genetic material. It comprises three steps:

- Denaturation: The DNA containing the targeting sequence is heated, which causes the DNA's proteins to denature, yielding DNA in single-stranded fragments.
- Annealing (primer formation): The temperature is lowered so that the primers attach themselves to the homologous areas of the targeting sequence.
- Polymerization: The targeting sequence is synthesized and thereby doubled, starting from the left and right primer molecule.

The PCR process consists of around 20 to 50 cycles which are carried out fully automatically by the corresponding thermal cycler.

A fluorescent dye that is only activated during DNA synthesis is added to the reaction during real-time PCR. The fluorescence is measured during each cycle, which allows the amplified DNA quantity to be determined. A certain fluorescence signal threshold value is achieved sooner or later (or not at all) depending on the original number of copies. Due to this additional information, real-time PCR is also referred to as "quantitative PCR (qPCR)".

Range of life science technology

Analytik Jena offers analytical and laboratory automation solutions to users from various industries. The company pools its biotechnological competence in the life science product segment. The range of automated total and individual solutions for molecular diagnostics includes thermal cyclers, nucleic acid extra extraction machines, spectrophotometers, PCR work stations and kits, assays and reagents as well as materials for molecular biological analysis and liquid handling. The following workflow is suggested to detect SARS-CoV-2 for research purposes:

Nucleic acid extraction

- Analytik Jena produces various extraction platforms and associated kits to extract viral RNA from swabs of cell-free bodily fluids such as serum, plasma or liquid.

Amplification and detection

- Molecular assays to diagnose SARS-CoV-2 have been developed and can be accessed via the WHO website. Various commercial kits based on real-time PCR are also available. The PCR setup can be pipetted by a liquid handling platform such as CyBio FeliX. In general, all real-time PCR-based assays can be adapted to the qTOWER³ real-time thermal cycler family by Analytik Jena.

InnuPure C16 touch

The InnuPure C16 *touch* pipetting system provides reproducible procedures for easy nucleic acid extraction. The integrated dosage unit permits the final elution volume to be set from 20 to 500 µl and transferred automatically. The accompanying extraction kits reduce the risk of cross-contamination, while the aerosol filters of the pipette tips prevent contamination of dosage units and samples. A piercing tool eliminates the need for manual removal of foils from the sealed prefilled reagent plastic, preventing buffer solutions from being mixed. Non-prefilled kits are also available as an alternative.

Real-time thermal cycler

The qTOWER³ thermal cyclers help laboratory technicians achieve rapid analysis times and precise results, all at a high amount of samples. The homogeneous temperature and patented optic system guarantee homogeneous excitation and illumination of all individual samples, leading to precise measurement results of the real-time PCR workflow. The number of samples can range from 96 to 384.

Fully automatic multichannel pipetting system

CyBio FeliX is a fully automatic multichannel pipetting robot. The modular system consists of a basic unit with a two-level deck system and easy-to-change pipetting heads. These can automatically switch between different pipette tip magazines and pipetting tools such as grippers.

Quotes

“The mode of operation hasn’t changed much for laboratories that carried out flu tests, for instance. The challenge is down to the sheer number of tests. The number has increased so drastically, as has the demand for reagents and our products, causing bottlenecks along front areas of the supply chain.”

Christine Marion Gräfe, Product Manager Analytik Jena

“We usually have lead times of one to two weeks within Europe for the Thermocycler qTOWER³. We are currently at seven to eight weeks. The buffer that we have in place under normal circumstances has been depleted, despite the fact that we have drastically increased production and almost tripled our output!”

Melanie Kelm, Head of Product Management Analytik Jena

“There are major advantages to being part of a large network in the current situation. With the help of the Endress+Hauser network we were able to gain new suppliers to be able to continue production.”

Melanie Kelm, Head of Product Management Analytik Jena

“We have heard about these unpleasant aspects where suppliers have taken advantage of the demand situation to increase prices. Analytik Jena has not done this. Our prices and performance have remained as they were before the crisis. We are not compromising on quality parameters.”

Melanie Kelm, Head of Product Management Analytik Jena



EH_qTOWER384.jpg

Automation support in the laboratory: In general, all real-time PCR-based assays can be adapted to a real-time thermal cycler of Analytik Jena's qTOWER3 family. Picture: Analytik Jena



EH_CyBio_FeliX_3.jpg

A PCR setup can be pipetted from a liquid handling platform like CyBio FeliX. Picture: Analytik Jena



EH_CyBio_FeliX_1.jpg



EH_CyBio_FeliX_2.jpg

The CyBio FeliX is a fully automatic multichannel pipetting robot. The modular system consists of the basic unit with a deck system on two levels and easy-to-change pipetting heads. Picture: Analytik Jena



EH_InnuPure_C16_touch_1.jpg

The pipetting system of the InnuPure C16 touch ensures reproducible processes. With the integrated dosing unit, the elution volume can be set from 20 to 500 µl and transferred automatically. Picture: Analytik Jena



EH_InnuPure_C16_touch_2.jpg

The combination of the InnuPure C16 touch and CyBio FeliX pipetting systems reduces human error sources, which can become acute in the corona crisis, for example, due to enormously increased sample volumes. Picture: Analytik Jena

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Dr. Christine Marion Gräfe, Product Manager Analytik Jena

Melanie Kelm, Head of Product Management Analytik Jena

Melanie Kelm has worked for Analytik Jena since graduating. She has been able to get to know all areas of the company since 2003 and is now Head of Product Management. But her roots lie in life sciences, or rather molecular biology, meaning she has plenty of experience with detecting bacteria and viruses.

Contact for journalists: Maik Dirumdam, Specialist Corporate Communications Analytik Jena

External Sources:

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