CaseStudy

SIMONA

G&H KUNSTSTOFFTECHNIK

Electropolishing facility for European XFEL accelerator

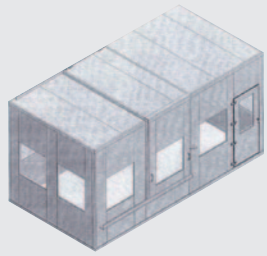
Lab room of the electropolishing facility, made from SIMONA® PP-DWU AlphaPlus® Twin-Wall Sheets.

The German Electron Synchrotron DESY is one of the world's leading research centers for investigating physical matter. In order to realise the international X-ray laser system, European XFEL, a new electropolishing facility was required for the purpose of producing the resonators (linear accelerators) with the necessary surface quality. A wide range of SIMONA® Products were used for the construction of this facility.

The project at a glance

Project
Construction of an electropolishing facility for the particle acceleration units (resonators) of the European XFEL

Dimensions of the electropolishing facility
- 17.5 x 2.1 x 2.5 m



Client
RI-Research GmbH, Bergisch-Gladbach

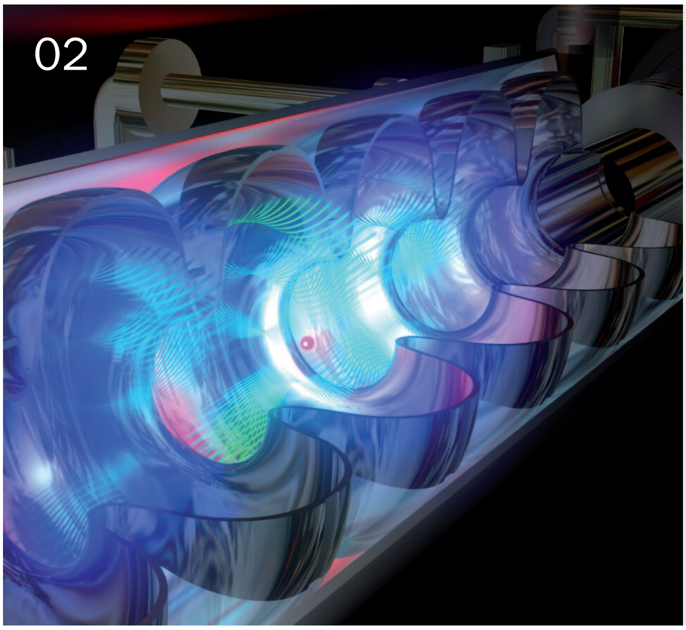
Contractor
G & H Kunststofftechnik GmbH & Co. KG, Sprockhövel
www.gh-kunststofftechnik.de

Technical support
SIMONA AG, Technical Service Center

Products used
- SIMONA® PP-DWU AlphaPlus®
- SIMONA® PP-DWU AlphaPlus® Twin-Wall Sheets
- SIMONA® PPs
- SIMONA® PVC-CAW
- SIMONA® PVC-GLAS
- SIMONA® PVDF
- SIMONA® PP-H AlphaPlus®

Time of project
Completion of facility: 2010
Estimated completion of the European XFEL project: 2014

Project description



The DESY research center (German Electron Synchrotron) in Hamburg is part of an installation – 3.4 km in length – that stretches to a research site in Schenefeld, Schleswig-Holstein, mainly underground. DESY develops, constructs and operates particle accelerators and detectors for particle physics and for research using the special light that is generated in these accelerators. A very powerful X-ray laser system is due to commence operations in 2014: the European XFEL (X = X-rays, FEL = Free Electron Laser). This installation generates ultra-short laser flashes in the X-ray range; the length of each flash is less than 100 quadrillionths of a second and their luminous intensity is sufficient for snapshots. This makes it possible to film ultra-fast processes such as molecule formation or chemical reactions. Using this method, scientists will be able to determine the structure of biomolecules and depict the nano world three-dimensionally. As opposed to the existing FLASH installation at DESY, in which the electrons are accelerated to an energy level of 1.25 GeV, the figure for the European XFEL will be 17.5 GeV. A bright laser beam will be generated in the wavelength range of 0.1 to 6 nanometres, which makes it possible to image test samples with atomic resolution.

In order to enable this, electrons are accelerated to almost the speed of light in a superconducting linear accelerator, in so-called resonators, at a temperature of –271 °C, and then forced onto a slalom course and induced to emit high-intensity X-ray laser flashes.

Owing to the low temperature of –271 °C, the electrical power is efficiently transferred to the accelerated particles by electromagnetic waves propagating in the resonator. Superconduction makes it possible to generate an electron beam that is extremely fine and uniform, which is a basic requirement for X-ray lasers. In addition, the output of useful light flashes is increased. In future, certain experiments will therefore only be possible at the European XFEL.

03_Tilt-and-turn frame for the particle accelerator (resonator). 02_Electrons in the resonator (photo: DESY). 03_Tanks for process chemicals, made from SIMONA® PP-DWU AlphaPlus® and SIMONA® PVDF.

Those venturing into the world of particle acceleration have to apply exacting standards when it comes to the production tolerances of the acceleration equipment. One example worth mentioning here is the resonators in the linear accelerator, the surfaces of which have to be electropolished to a high level of uniform accuracy in the installation.

In this context G & H Kunststofftechnik GmbH & Co. KG, Sprockhövel, was awarded a contract by RI-Research GmbH, Bergisch-Gladbach, to build an entire electropolishing facility, including the media processing unit and the waste air cleaning system for treating the resonators. Drawing on its experience in plant construction, G & H Kunststofftechnik GmbH & Co. KG was able to plan, make and assemble the entire installation.

The individual parts of the project were:

- Room lining (SIMONA® PP-DWU AlphaPlus®)
- GRP/steel installation level
- PP cleanroom (SIMONA® PP-DWU AlphaPlus® TWS)
- Waste air system for the HF-containing gases
- Tanks (SIMONA® PP-DWU AlphaPlus®/SIMONA® PVDF)
- Pump, heat exchanger, piping (SIMONA® PVDF) and tubing (PFA)

Other items of the project:

- Sizing and installation of the sensors (e.g. level sensor)
- Design and construction of the tilt-and-turn device, including the necessary mechanical system made of VA 1.4571 (stainless steel) for accommodating the resonator

Electropolishing is based on a reverse plating process. That is, the metal workpiece to be treated is wired up as an anode. In electroplating, direct current is used to deposit metal on a workpiece (the cathode). In electropolishing, direct current is used to erode metal from the surface of the workpiece; the surface of the workpiece is smoothed. The basic requirements for successful application of such a process are thorough preliminary cleaning and the rinsing of the

electrolyte off the workpiece after the electropolishing process. In this respect an electropolishing facility consists not only of the electropolishing tank itself but also a large number of pre-treatment and after-treatment tanks.

To be able to monitor end-to-end processes in the installation safely, some parts of the system are made of transparent SIMONA® PVC-GLAS. SIMONA® PVDF was used wherever it was not possible to apply SIMONA® PP-DWU AlphaPlus® or SIMONA® PVC-CAW because of the aggressiveness of the chemical.
The lab room of the electropolishing facility was made from SIMONA® PP-DWU AlphaPlus® Twin-Wall Sheets, and the windows were made from SIMONA® PVC-GLAS.

04_Part of the extraction system. 05_Waste air system for gases containing hydrogen fluoride, made from SIMONA® PP-H AlphaPlus®.

The lab room has a wall/ceiling element that can be opened as a sliding element in order to place the resonator in the electropolishing facility for treatment and to remove it again after the process. To be able to move the resonator into the correct position after it has been placed in the lab room for processing, a tilt-and-turn device, including its mechanical system, was developed specially by G & H Kunststofftechnik GmbH & Co. KG. The equipment for the process chemicals is accommodated in a very confined area underneath the lab room. Owing to the limited space available, the assembly of this part of the electropolishing facility proved to be very challenging.

This demanding project was completed successfully using numerous SIMONA® Products. In addition, the extensive technical consultancy provided by SIMONA at all times during the project planning and implementation stages was greatly appreciated by the contractor G & H Kunststofftechnik GmbH & Co. KG.

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