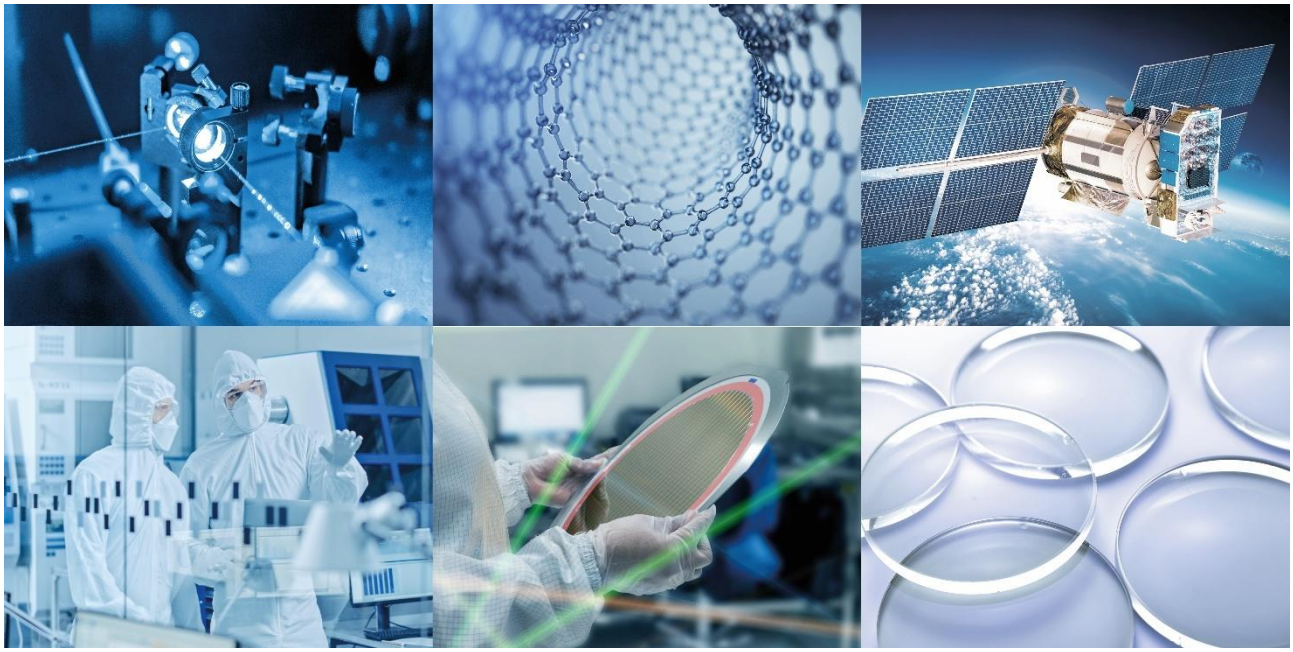
Technical Article

Ecoclean: Ultra-fine and high-purity cleaning
Maximum cleanliness – not just a cleaning process

To secure a future-proof and competitive position in the market, numerous companies are restructuring their product ranges. The trend is towards sophisticated solutions for high-tech industries. This not only means higher demands on the precision of components, but also extremely strict specifications regarding particulate and film cleanliness, which must be achieved in a process-reliable, economical and sustainable manner. This requires a different approach to cleaning, a critical look at the entire production chain and manufacturing environment, and an experienced partner.



The extremely high demands placed on manufacturing precision in high-tech industries include the cleanliness of components. These sometimes extremely strict requirements call for appropriately designed cleaning processes and systems as well as a suitable manufacturing environment.

During industrial transformation, more and more companies are focusing on the manufacture of high-quality products and components with good margins. The focus is on high-tech industries that promise stable demand through growth in the future. The extremely high demands on manufacturing precision in these industrial sectors, such as the semiconductor supply industry, electronics manufacturing, e-mobility, the optical and optoelectronic industry, sensor technology, photonics, thin-film technology, vacuum, laser and analysis technology, and aerospace, include the cleanliness of components. This applies regardless of whether the components are barely visible electronic parts, millimeter-small connecting elements, precision

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optics or meter-sized structural components, and regardless of the materials from which they are manufactured.

Defining cleanliness according to requirements

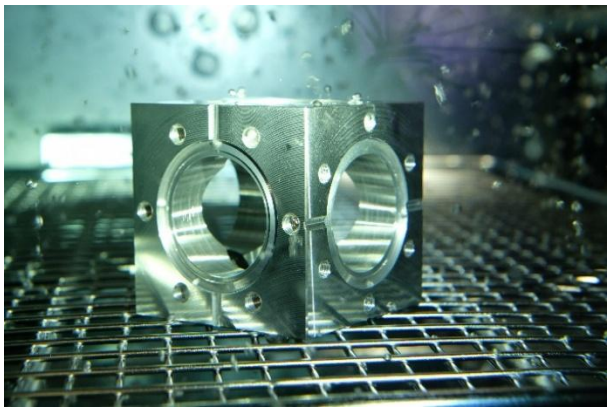
This trend poses challenging tasks for parts cleaning. Unlike conventional component cleaning, which usually involves removing large quantities of manufacturing residues such as chips and processing media, ultra-fine and high-purity cleaning is all about removing minimal residual contamination. The specifications for particulate cleanliness extend into the sub micrometer range. Depending on the industry, component and its application, film-like residual contamination, such as organic and inorganic residues, ionic residues and microorganism residues, must be removed in a process-reliable and reproducible manner down to nanometer levels. In high-purity applications, such as the manufacture of components for EUV lithography, so-called hydrogen-induced outgassing (HIO) substances must also be considered.

The requirements for particulate cleanliness to be met during cleaning are specified by the corresponding surface cleanliness class (ORK) according to EN ISO 14644-9 (SCP – surface cleanliness by particle concentration) or the corresponding VDI guideline 2083, sheet 9.1. Film-chemical, organic and inorganic surface cleanliness is usually defined by individual specifications or factory standards. In addition, outgassing rates may be evaluated using mass spectrometers.

These demanding tasks require a partner who, on the one hand, has comprehensive technological expertise and knowledge of applications and physical relationships. On the other hand, experience in this field of cleaning and appropriate test facilities for cleaning trials under production-related conditions should be available. As an experienced full-service provider of future-oriented and globally available solutions for ultra-fine and high-purity cleaning, Ecoclean meets these requirements.

Selecting the right cleaning process and system technology

In order to meet these very strict cleanliness specifications in a process-reliable, reproducible and sustainable manner, several cleaning steps are usually required along the " " manufacturing chain. The following questions play a role in selecting the optimal solution for the respective cleaning process: What material is the part made of? What is the geometry, dimensions and weight of the component? What contaminants need to be removed? What cleanliness requirements must be met? Which cleaning process and which chemicals are suitable for this? On this basis, it is possible to determine which and how many cleaning steps are required, using which medium and which process technologies. Other aspects to be considered include the required quality of the rinsing medium and the appropriate drying technology, as well as clean part handling and the ambient conditions, for example connection or integration into a clean room or clean environment.



The specifications for particulate cleanliness extend into the sub micrometer range, and in the case of film-like contamination, even nanolayers of organic and inorganic residues, for example, must be removed in a process-reliable and reproducible manner.

Cleaning along the production chain

The basis for ultra-fine or high-purity cleaning is "oil- and grease-free" parts. To achieve and maintain this level of cleanliness, a cleaning process is carried out after the various processing steps, such as machining, forming, grinding or polishing. The effect of the cleaning medium used is enhanced by various process technologies that can be combined in almost any combination, such as steam degreasing, spray, high-pressure, immersion, ultrasonic and mega sonic cleaning, as well as plasma cleaning, injection flood washing, pulsed pressure cleaning (PPC) and ultrasonic plus. These process options ensure that the required cleanliness is consistently achieved, even for geometrically complex workpieces.

For intermediate cleaning processes or parts with less stringent cleanliness specifications, modular single- or multi-chamber systems operating under full vacuum, such as EcoCstretch or EcoCvela, are typically used. Depending on the processing medium used, these systems can be operated with an environmentally friendly solvent, e.g. hydrocarbons or modified alcohol, or a specially selected water-based cleaner. The design, system engineering, media flow and treatment of these systems are specially tailored to ultra-fine cleaning and high-purity applications. Thanks to the process of mechanics concentrated in the working chamber, e.g. injection flood washing, ultrasound and PPC, this type of system also offers advantages when cleaning large and complex workpieces.

In chamber systems, such as this two-chamber cleaning system for water-based processes, the design, system technology, media flow and treatment are specially adapted to the specific requirements of ultra-fine and high-purity cleaning.

Ultrasonic multi-bath immersion systems are the optimal solution for parts with a wide variety of materials, high throughput requirements and/or strict cleanliness specifications. In addition to individually designed cleaning systems for high-end applications, the plant manufacturer offers an efficient solution with the UCMSmartLine and UCMPerformanceLine series of systems consisting of standardized modules. Electrical and control technology is integrated into the respective modules for the process steps of cleaning, rinsing, drying, loading and unloading, as well as for the transport system. This, together with the provision of process mechanics tailored to requirements, such as PPC, allows the systems to be optimally adapted to the respective tasks. The option of upgrading the cleaning system later ensures future proof in the event of increased requirements.

Whether you need to handle a wide variety of materials, meet high throughput requirements and/or strict cleanliness specifications, modular ultrasonic multi-bath immersion systems can be efficiently adapted to the task at hand – even for integration into or connection to a cleanroom.

Test Center for process design or contract cleaning

Ecoclean determines the right system concept for the application and the optimal cleaning process in its own High Purity Test Centre. It has a Class 7 clean room with Class 6 zones and various measurement and analysis methods (e.g. microscopy, residual gas analysis, UV light and fluorescence measurement). In addition to the product-specific development of cleaning processes and parameters, the plant manufacturer also uses the Test Centre to carry out contract cleaning orders. A packaging station for cleaned parts ensures that the high level of cleanliness achieved is also delivered to the customer.

A High Purity Test Center with a cleanroom and various measuring and analysis methods is available for process design and definition of process parameters under production-related conditions. Contract cleaning orders are also carried out here.

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