Ready for New Applications

Enclosed machines are the ideal solution for the ultra-fine cleaning of parts with complex shapes because all types of liquid chemical cleaning and drying processes can be used. In addition, new technologies such as cyclic nucleation and hybrid procedures are available.

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The demand for ultra-fine cleaning solutions for increasingly complex tasks is growing in all areas of industry. These include medical technology products and components such as valves, cooling elements and cooling pipes in the semi-conductor sector, for example. New production processes, including additive manufacturing, together with special coating and bonding procedures and the increasing demand for high-quality sensors in the automotive industry are extending the range of applications where there is a need to remove ultra-fine particles and films. It is here that traditional ultrasound systems begin to reach the limits of their capabilities. Single or multiple chamber machines with hermetically sealed cleaning chambers offer a far wider range of options.

Problems in ultra-fine cleaning

The key risks involved in ultra-fine cleaning processes include cross contamination from upstream/downstream procedures and the effects caused by handling the parts and contact with the surrounding environment. These become particular problems as soon as complex-shaped parts have to undergo ultra-fine cleaning. On the one hand, it is important to prevent the parts from becoming contaminated with particles or films by means of process-related and mechanical components, such as valves, rotating movements and dead spots. However, on the other hand, greater importance must be placed on the design of the system's mechanical components and processes because of the critical shapes of the parts.

In addition, the parts that are to be cleaned undergo preliminary processes that often cause significant contamination, such as machining or grinding. If the contamination levels are high, the filtration rate must be increased, together with the volume of liquid used for cleaning. The resulting requirements include:

- High volume flow rates with specific media
- Higher spray and immersion pressures
- Relative movements such as pivoting, turning or rotating at intervals
- Low pressure cleaning processes, with and without ultrasound.

This is not possible in open multi-tank systems or only with significant restrictions. In addition, when cleaning parts with coated surfaces there is the risk of damage being caused by the ultrasound.

Fewer cleaning and rinsing processes needed

The cleaning processes provided by traditional ultrasound multi-tank immersion systems are based on the mechanical cleaning abilities of ultrasound and, in some cases, megasound, combined with appropriate chemicals and the num-

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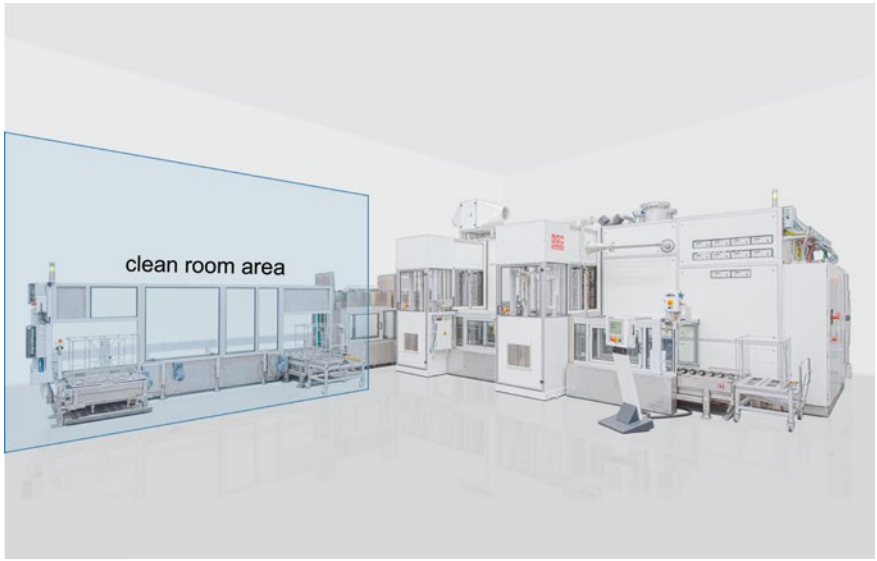
The benefits of enclosed chamber machines, in this case an automated top-loader, include the hermetically sealed cleaning chambers.



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Where there are two or more cleaning chambers, the cleaning and rinsing stages can be completely separated, with no risk of carry-over. This allows the system to be integrated into a clean room environment.

ber and quality of the cleaning baths. The circulating filtration systems are designed to remove floating contamination from the surface of the liquid, filter it out and return the cleaned liquid to the machine. In some cases the liquid is removed from below the surface of the bath. The movements of the parts are adapted to the ultrasound frequency and can include lifting and lowering or rotation.

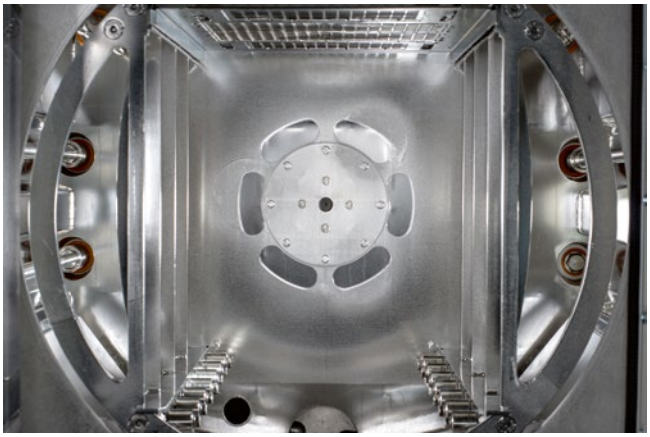
Enclosed chamber systems are used in the automotive supply sector and in other areas of industry. In many areas where ultra-fine cleaning is required, they are regarded as preferable to multi-tank immersion machines. The reason for this is that the hermetically sealed cleaning chambers offer a wider range of functions. They allow for cleaning processes under high or low pressure, almost unlimited volume flow rates and higher filtration rates, which makes it possible to remove the contamination much more quickly. In vacuum systems, the cleaning chambers can be filled with liquid at low pressure and this is less likely to have a negative impact on the cleaning chemicals.

The result is an improvement in the media quality in the cleaning and rinsing stages. The option of blow-drying the parts between the phases of the process and the use of improved media distribution systems keeps carry-over to a minimum and significantly reduces the total number of cleaning and rinsing processes required for each task, particularly when compared with multi-tank immersion systems.

Cleaning without carry-over

Re- or cross-contamination can be almost eliminated, as the entire area that comes into contact with the cleaning media is itself continuously cleaned. Other benefits include the fact that the media tank is generally 1.5 to 2 times larger than the cleaning chamber and that the hermetically sealed chamber can be directly connected to appropriate supplies of media such as air and liquids.

The enclosed machines are also ideal for ultra-fine cleaning of large components, such as these aluminium profiles which are 4000 × 700 × 700 mm in size.



Cleaning chambers and fittings with surfaces that have been specially treated and then electropolished contribute to the quality of the cleaning process.

In addition, if there are two or more cleaning chambers, the cleaning and rinsing stages can be completely separated, with no risk of carry-over. This also significantly increases the throughput. In this type of system the media tanks and the cleaning chambers are not connected as part the process and so, if necessary, they can be located in separate rooms. For example, the cleaning machines can be integrated into a clean room environment or into the clean room transition area as inline chambers. The storage tanks with the modules for filtering and recycling the cleaning media can be positioned outside the clean room or on another floor. These types of systems are available in all sizes. The integration of a vacuum-based cleaning process (cyclic nucleation) allows the inside of pipes or densely packed complex components, for example, to be cleaned easily (with the benefits of packing density). In addition, the chamber systems are ideal for cleaning batches of parts and individual components, for steam-cleaning and steam-rinsing applications and for the use of all common drying processes.

Example from the semi-conductor industry

Open multi-tank immersion systems are essential for cleaning wafers in the semiconductor industry. However, this type of machine is largely unsuitable for cleaning valve assemblies, mechanical units, heat exchangers and cooling pipes. For these types of application, LPW has developed a front-loading, dual-chamber system with three media tanks. After the machining process and before final assembly, machined aluminium components are cleaned in a clean room in batches with a maximum size of 800 × 500 × 650 mm. This is an excerpt from the cleaning criteria for this process:

- Films of organic contamination: 10 to 100 ng/cm² greater than C7
- Particle contamination: approximately 30 µm < 4 particles/10 cm² under UV light; 0.3 µm ≤ 10,000 particles/cm²; 0.2 µm ≤ 20,000 particles/cm².

Other limits were specified for metallic inorganic residues on around 40 metals and anions.

The components are transported automatically into the first chamber in a laminar flow. Here the parts are cleaned using a high-pressure agitation process at 18 bar with a high volume flow rate and then rinsed with distilled media. Then the parts are cleaned and rinsed using ultrasound. The parts are subjected to preliminary cleaning with a cyclic nucleation process in each bath. In the second chamber the parts undergo precision rinsing with ultrasound and cyclic nucleation and a final spray rinse with ultra-pure water. This is followed by a hot air and cyclic nucleation/vacuum drying process and then the parts are automatically transported into the neighbouring clean room.

Conclusion

Enclosed cleaning machines allow tried-and-tested liquid cleaning processes and all types of drying processes to be used for complex parts. In addition, all the benefits of new technologies such as cyclic nucleation and hybrid procedures are also available. The hermetically sealed chambers, which are supplied as front-loading, top-loading or inline systems, can easily be integrated into clean room environments. The option of locating the media tanks away from the area where the parts are cleaned ensures that both current and future requirements can be met. //

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