Greater Flexibility and a Higher Throughput with a One-Piece-Flow

Tailor-Made and Modular

State-of-the-art modular cleaning systems based on single-chamber machines combine the benefits of decentralised and centralised cleaning units, which makes them particularly flexible and efficient.

Over the past decade, centralised cleaning machines have increasingly been replaced by decentralised solutions designed to perform specific tasks, because of the shorter distances travelled by the parts being cleaned and the option of a redundant design to reduce bottlenecks. However, this has also meant foregoing the advantages of centralised systems, which include much lower maintenance and parts cleaning costs when the machine is used to full capacity. The latest modular cleaning systems based on single-chamber machines combine the benefits of both variants and offer a flexible, efficient and cost-effective solution. LPW Reinigungssysteme GmbH has recently demonstrated how this can work in practice with its range of innovative centralised systems. Among other things, the engineers at the company's plant in Riederich have developed a unique six-chamber machine.

Cleaning requirements

A well-known German manufacturer of high-quality components for car fuel injection systems needed to improve both its output and its cleaning quality. In addition to the introduction of a range of new and modified products, a new cleaning machine was required which could accommodate the workload of the existing systems. The end customer had also imposed additional criteria relating to the cleanliness of an existing group of products.

It soon became clear that these requirements could only be met using a new cleaning system with the following features:

Component 1: Final cleaning of steel components after machining and phosphate coating. Target: Particle size < 250 µm cubic, corrosion protection for at least six months.

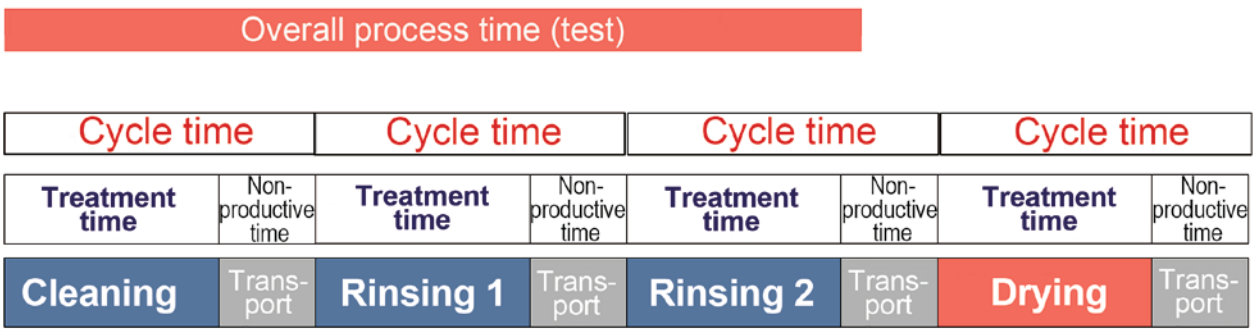
Component 2: Final cleaning of stainless steel components after machining and a brushing process. Target: Particle size < 200 µm, stain-free.

Initially, the different variants available on the basis of the modular LPW product range were discussed during the technical meetings. The goal was to develop one cleaning machine (PowerJet Twin) for each type of part with a shared automation system in the form of a shuttle. The other issue under consideration concerned the possibility of integrating the preliminary and interim cleaning processes for both components into the new machine.

In addition, extensive advance tests were carried out in the in-house test centre, which involved analysis of the residual contamination on the basis of the customer's and the chemical supplier's experience, in order to evaluate the feasibility of achieving current and future standards of cleanliness and to investigate the necessary cycle and process times.

After the necessary washing measures and preliminary processes had been defined, the results were verified again and used to determine the technical design of the machine:

- Batch size: maximum of 670 x 480 x 300 mm
- Batch weight: up to 200 kg
- Throughput: 6 to 12 batches per hour, depending on the type of process.
- (5 million steel parts per year, 13,000 to 14,000 batches. 30 million stainless steel parts per year, 25,000 to 26,000 batches.)
- Preliminary, interim and final cleaning processes in one machine
- Varied parts supply include one-piece-flow



Preliminary tests are carried out to determine the overall process time. The production cycle is used to break this time down into individual treatment and transport phases. The result is the number of treatment zones or chambers.

Selection process for the PowerJet modular system

Treatment chamber **1**
Number, size and function of the treatment chambers.
LPW Ultramodule: Precision cleaning in a specially designed treatment chamber.

Washing system **2**
Determining the pump pressure and flow rate, together with the nozzle arrangement depending on the function.
Determining the suitable ultrasound power and frequency as required depending on the function.

Tank design **3**
Determining the number and size of the fluid tanks with the respective function.
An upright container is used for the Ultramodule option.

Filtering system/Media processing **4**
Determining the type and design of the system to suit the individual treatment phases and process parameters. The filter system (for example, bag or cartridge filters) uses a full-flow process. The other media processing systems (including the ultrafiltration and distillation units and the centrifuge) use a partial flow.

Drying **5**
All the common types of hot air and vacuum drying systems are available.
The choice is based on the cycle time, the shape of the parts and the materials they are made from.

Automation **6**
LPW offers standard size modules for all the conventional roller conveyor and shuttle systems.
Cooling and demagnetisation units or external vacuum dryers can be incorporated at any time.

Individual solutions **7**
Specific process engineering, washing or automation solutions can be developed to meet individual customers' needs on the basis of the modular system.

The tailor-made, modular system offers a wide range of options.

The new six-chamber machine is 13 metres wide and almost nine metres deep.

- Cleaning and first rinse for all components in all programmes
- Separate high-performance flood rinse with deionised water for stainless steel components
- Separate drying process for stainless steel components
- Anti-corrosion bath for steel components

Turning two into six

On the basis of these requirements, the customer and LPW came to the conclusion that a highly-flexible and powerful machine based on the PowerJet modular range was the best solution. This was partly because it would meet the criteria in all the areas and partly because it was the most efficient option in terms of operating costs (energy and staff utilisation) when compared with conventional multiple bath immersion systems.

As a result, the LPW engineers developed the PowerJet T5 Hexa six-chamber cleaning machine. In treatment chamber 1, bath 1, the steel and stainless steel components are subjected to a low-pressure cleaning process or to high-pressure agitation at 18 bar and to ultrasound. In treatment chamber 2, bath 2, the steel and stainless steel parts are rinsed at 2.5 bar. In treatment chamber 3, bath 3, the steel parts and, in some cases, also the stainless steel components are rinsed using a frequency-controlled low-pressure pump and a large volume of rinsing agent. This chamber is equipped with a high-performance filter system. Chamber 4, bath 4, rinses the stainless steel components in deionised water. This chamber is also fitted with a frequency-controlled low-pressure pump and uses a large volume of rinsing agent. It too has a high-performance filter system. Treatment chamber 5, bath 5, is a low-pressure anti-corrosion bath for steel components. This has an improved media supply system that allows the use of emulsion corrosion inhibitors which have a tendency to foam. In treatment chamber 6 the stainless steel parts are vacuum-dried.

All the chambers are fitted with drying fans. The baths are supplied from the deionised water tank in bath 4. The fluids are recycled using a full-flow filter system in each bath and a large coalescing oil separator with magnet inserts and a conical base, together with a heated distillation unit in baths 1 and 2. A two-position automated shuttle system is used for loading the machine. It is connected to the loading and unloading circuit and has an integrated parts container return system and an RFID system.

The shuttle allows the parts to be transported to and from the machine quickly and easily.

Modular system for increased flexibility

Regardless of their size, tailor-made machines based on a modular system are the ideal solution for performing large centralised tasks or decentralised functions on a smaller scale. The advanced modular concept allows cleaning systems to be developed that meet both current and future requirements, are not unnecessarily complex and involve a low level of technical risk.

Using this modular single-chamber technology, multi-chamber machines have been produced for several years with a focus on improving throughput and flexibility. The decisive criteria in this respect are based

on market requirements. These include high standards of cleanliness, a throughput of 15 to 20 batches per hour, low base load costs which make it possible to respond flexibly to variations in output, the option of integrating the machine into existing in-house logistics systems and, of course, low maintenance and operating costs.

In addition, cleaning machines must be able to accommodate the needs of individual parts without being designed as a special solution for specific components. Other common requirements are the ability to upgrade or expand the machine, the use of redundant processing units to reduce bottlenecks, the option of connecting to clean rooms and the provision of primary cleaning (such as preliminary and interim cleaning) and precision cleaning functions. One-piece-flow also plays a role, together with the integration of long-term corrosion protection (aqueous or solvent-based) or phosphate coating, for example.

LPW decided to expand its existing modular system so that it could meet some or all of these market requirements with one cleaning machine. Its customers now have a variety of different combinations available to them. The number of fluid tanks is determined on the basis of the cleaning, rinsing and additional processes (such as corrosion protection) that are required. The level of redundancy also has an influence in this area. The number of treatment chambers is based on the required throughput and process time and on the media used, with a focus on minimal carry-over.

Coordinated automation systems play a key role

In addition to the modular structure of the treatment chambers and fluid tanks, a variety of full-flow and bypass filter systems are available, depending on the customer's requirements. Independent units can also be combined and maintained in a central location. To allow the benefits of these systems to be exploited to the full, suitable automation solutions are needed which meet the following criteria:

- Fast transport and loading speeds
- Transport to any treatment chamber in different sequences (overtaking)
- Selection of any treatment programme
- Option of separating dirty and clean components
- Clean room connection possible
- Data management using RFID systems
- Possibility of including additional cleaning modules without the need for further investment in the automation system
- Integration of a pallet/parts container return system without additional conveyors
- Option of including other tasks (such as cooling and measurement units)

The shuttle transport system fulfils all these requirements. In addition to the necessary flexibility, it also has only a small number of moving parts and requires little maintenance. Furthermore, the investment costs are much lower than those of traditional automation solutions with a smaller range of functions used for multi-chamber systems.

In conclusion, it is important that in the case of industrial cleaning systems the solution is designed to fit the tasks, rather than the tasks being adapted to the available systems. With LPW's tailor-made, modular approach, it is possible to achieve this objective with a flexible, cost-effective and future-proof system.

Useful basic and practical information on industrial parts cleaning, together with explanatory graphics and videos can be found at *http://www.modulare-bauteilreinigung.de*

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