MONICA FUMAGALLI, ipcm®

A flexible, hybrid cleaning process to meet high cleanliness standards in the Swiss watch industry

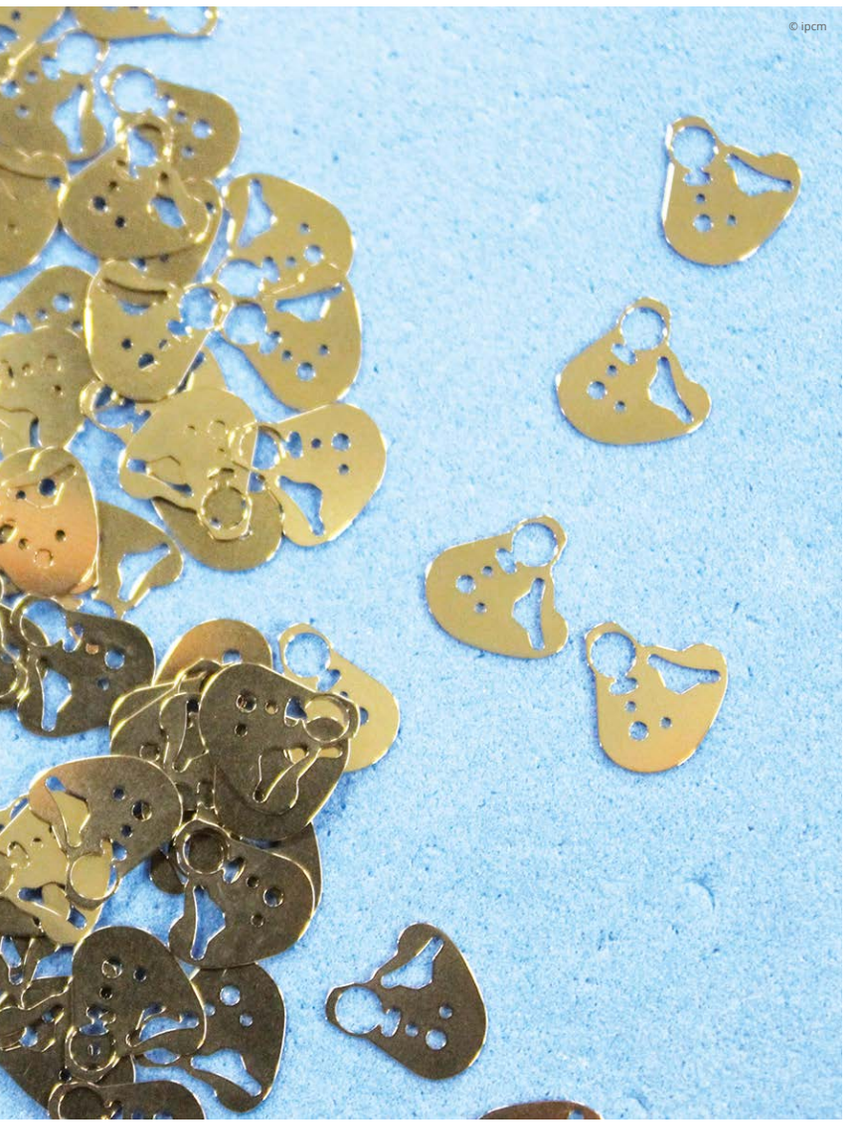
Immersion ultrasonic cleaning is the only solution that can be effective with the most diverse materials, particularly when it comes to precision micro-components with complex shapes. Cleaning plants expert MEG has made this technology even more effective by integrating it in a hybrid solution combining the use of water and detergent with solvent, in order to achieve the extreme flexibility degree required by companies such as Monwitt SA, a manufacturer of precision micro-components for the watchmaking industry.

A mechanical watch is a miniature machine consisting of at least 50 micro-gears: their constant movement is ensured by the perfect concatenation of one into the other to transmit the energy required for perpetual operation. One of the main production hubs for these masterpieces of mechanical engineering, which today are seen as elegant fashion accessories, lies in the heart of Europe, in the Swiss canton of Jura, which saw watchmaking become predominant as early as the 18th century. The history of Swiss watchmaking, however, has even older origins: it can be traced back to the ban imposed by Calvin around the middle of the 16th century on wearing any luxury item. The goldsmiths and jewellers of the region were thus forced to convert their businesses to the manufacture of watches, for which Switzerland is now known throughout the world.

The export growth of this country's watch industry, especially in the high-end segment, has not come to a halt even in the last few months, characterised by an uncertain political and economic situation in Europe: in the first quarter of 2023, it was around +12% compared with the same quarter in 2022. In fact, the sector exported almost 300,000 more watches in one month (source: FHS – Fédération de l'Horlogerie Suisse)1. As a consequence, the industry of precision components for the watchmaking sector is also facing a peak in production volumes combined with ever higher quality demands, including the perfect cleanliness of the tiniest gears.

We talked about this with Pascal Monbaron and Paola Fra, the Technical Sales Manager and Finishing Manager respectively of Monwitt SA, a company based in Courtelary and specialising in precision machining with wire and die-sinking electro-discharge machining (EDM) systems and component cleaning with a hybrid ultrasound system.

[1] http://www.fhs.swiss/file/59/comm_230303_a.pdf



This was designed and installed by Italian company MEG Srl, which has been making plants for cleaning parts in a wide variety of sectors for over thirty years. "In watchmaking, the perfect manufacture and cleanliness of workpieces are crucial," explains Monbaron. "If the tiniest residue remains on a component's surface, the gear may malfunction or, in the worst case, get jammed."

A Bernese company

Located in the heart of the Bernese Jura region, Monwitt is currently managed by the third generation of its founder's family. "My grandfather established this firm to mould products mainly intended for the military and textile industries," confirms Monbaron. "Then, thanks to my father's essential contribution, in the 1990s we started working for the watchmaking sector. This has now become our main target market, so much so that we have structured our entire company around its needs." This industry, however, is becoming increasingly strict in terms of the cleanliness demands placed on the micro-gears of these timekeeping devices, particularly high-end watches.

"We design our punching dies according to the drawings we receive from customers," indicates Monbaron, "and we produce all dies and tools in-house by wire and die-sinking EDM. We carry out numerous tests to ensure that they correspond exactly to our customer's wishes. Afterwards, we proceed with the blanking operation. The components are then subjected to heat treatment and to deburring and polishing with suitable pastes. If required, galvanic treatments are outsourced. The micro-gears then undergo quality control and packaging before final dispatch."

During this process, the components are cleaned both between one phase and the other and as a final step: in fact, they are subjected to cleaning after blanking, after heat treatments, and finally after deburring before packaging. "Today, we clean 100% of the components we manufacture in the most diverse materials – steel, copper, brass, and aluminium," notes Monbaron. "Before installing our new cleaning system, we used to carry out a simple manual degreasing operation to remove the lubricating oils employed for blanking, which was useful to prevent oxidation of metal in the subsequent stages, and then to remove the polishing pastes. We soon realised, however, that the market was evolving and changing its needs very quickly: to keep up, we had to invest in a more advanced and complex machine and process. This is why we started our collaboration with MEG."

Monwitt SA got specialised in the production of precision micro-components for the watchmaking industry in the 1990s.

Monwitt Sa's finishing department (left photo).

The basket loading station (right photo).

One of the two basket-handling robots.

Some tanks in the plant.

The basket unloading station.

A hybrid system for two types of cleaning process

The system installed a year and a half ago at Monwitt's premises is equipped with 2 Cartesian robots for basket handling and rotation, 4 dual-frequency ultrasonic immersion cleaning tanks using water and detergent, 2 rinsing tanks, 1 dewatering station, 1 ultrasonic cleaning section using a co-solvent, and 3 ultrasonic cleaning/rinsing sections using solvent and/or solvent vapours.

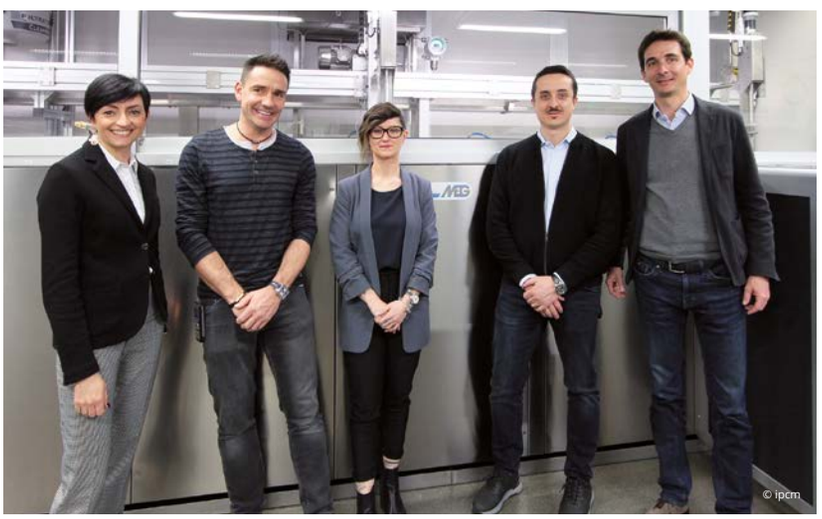
"This hybrid plant," states Alberto Gnoato, the Operations Director of MEG, "can therefore perform multiple cleaning steps that allow removing a wide range of contaminants while guaranteeing a high degree of cleanliness of the treated components. The first cleaning phase takes place in a water and detergent solution. Here, the workpieces can be treated with different chemicals, as the 4 tanks can be filled with as many types of detergent. The mechanical action generated by dual-frequency ultrasound and the rotation of the basket in the tank ensure very high cleaning results already in this first step. The second treatment phase, which takes place after dewatering to remove rinse water, is in turn composed of a stage using co-solvent and 3 further possible stages in the 3 cleaning/rinsing/drying sections using new-generation solvents. This enables to further refine the cleaning process, bringing the cleanliness results to excellent levels, and at the same time improves and speeds up the drying phase of the treated parts, which, among other things, can be immediately handled upon unloading. Finally, the use of new-generation solvents reduces electricity consumption and costs and the need for periodic replacement of baths, thanks to the performance of low-temperature distillation."

A targeted change

"Originally," says Paola Fra, "we had planned to subject our parts to both cleaning processes, i.e. with water and detergent and with solvent, but we soon realised that having the possibility of managing the two cycles separately as well would be more functional for achieving our expected quality results. We therefore made a targeted change to the path of the first robot, so that it did not stop at the dewatering station, but proceeded to take the basket to the first solvent-based cleaning/rinsing/drying section (tank no. 9 – see the plant layout on page 200). Here, the second robot picks it up for any further solvent treatment. This makes our machine more flexible and enables most of our components to reach directly the solvent-based cleaning phase, skipping the water and detergent-based one."

Increased cleaning quality and flexibility

"MEG's Hybrid plant series," emphasises Gnoato, "was designed and built to offer a hybrid cleaning option combining water-based detergent solutions with co-solvent and/or solvent-based solutions. The detergent is used to remove residues of a "polar nature", such as, for example, flux activators, salts, and contaminants from various processes. Together with the latest generation of fluorinated solvents, the co-solvent enables to remove "non-polar" contaminants such as waxes, oils, and colophony-based fluxes. The advantages of this process include lower water consumption and significantly shorter cycle times compared with a normal water-based process with oven drying. In the case of Monwitt, the complete cycle, which includes 2 cleaning phases and 2 rinses, lasts on average about 35 minutes." Finally, the cleaning plant is equipped with a steam extraction system to prevent the formation of moisture in the detergent-based cleaning area and a suction system with an active carbon filter in the solvent and co-solvent-based one. "Our old cleaning plant," confirms Paola Fra, "allowed selecting only two types of operation depending on the treated material – one for steel and one for all others. As long as we were producing components with a simpler geometry, it met all our requirements. When we started to manufacture components requiring more complex decoration work, e.g. cerclage, satin-finishing, and polishing, our cleaning requirements also changed: we can no longer afford to carry out bulk operations, but we rather treat a maximum of 50 workpieces per basket. This also means that our main needs have become process flexibility and increased cleaning performance – and the system designed and installed by MEG meets these needs perfectly. In fact, we can separate the 2 baths devoted to steel from the other 2 baths devoted to other materials and we can choose whether to use water and detergents alone, solvents alone, or both."



From top to bottom:

Two specially designed basket types, cylindrical and rectangular.

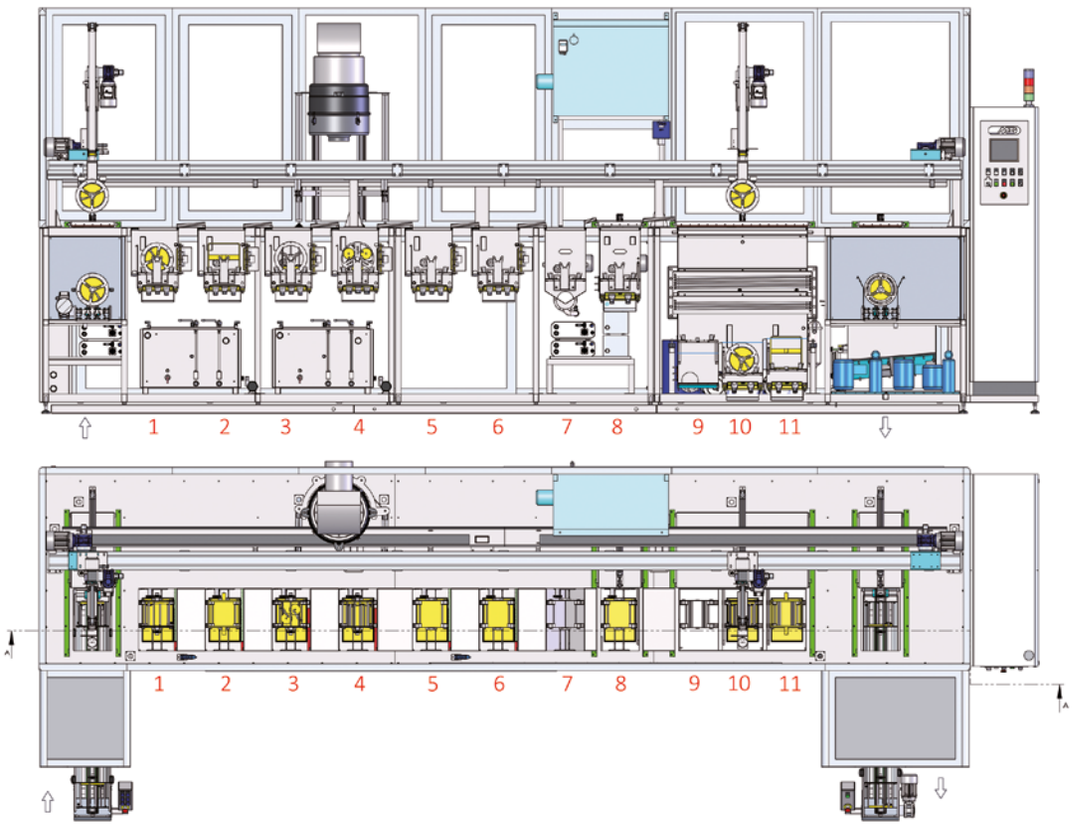
Some micro-gears manufactured and cleaned by Monwitt.

From left to right: Alessia Venturi from ipcm®, Pascal Monbaron and Paola Fra from Monwitt Sa, Gian Luca Desliens and Alberto Gnoato from MEG.

Basket loading station;

1. First dual-frequency ultrasonic cleaning stage in water-detergent, with basket rotation in the tank and/or on the robot;
2. Second dual-frequency ultrasonic cleaning stage in water-detergent, with basket rotation in the tank and/or on the robot;
3. Third dual-frequency ultrasonic cleaning stage in water-detergent, with basket rotation in the tank and/or on the robot;
4. Fourth dual-frequency ultrasonic cleaning stage in water-detergent, with basket rotation in the tank and/or on the robot;
5. First dual-frequency ultrasonic rinse in hot mains water, with basket rotation in the tank and/or on the robot;
6. Second dual-frequency ultrasonic rinse in hot mains water, with basket rotation in the tank and/or on the robot;
7. Removal of rinse water in a dewatering solution, with basket rotation;
8. Ultrasonic cleaning in a co-solvent, with basket rotation in the tank and/or on the robot;
9. Cleaning in a solvent and/or solvent vapours;
10. Cleaning/rinsing in a solvent and/or solvent vapours;
11. Cleaning/rinsing in a solvent and/or solvent vapours and drying in a cold area;

Basket unloading station.



160,000 workpieces cleaned in one cycle

The baskets were also specially conceived and manufactured to adapt to the extreme diversity of the micro-gears produced by Monwitt. "They can be rectangular or cylindrical", says Gian Luca Desliens from MEG's Sales Division, "depending on the type of workpiece to be processed, with holders and meshes specifically designed for each characteristic. The components can be arranged in a fixed position or in bulk. The machine is capable of processing around 160,000 parts at a time. Another special feature of this system is that the baskets can rotate both when hooked to the handling robots and when released into the tanks, based on pre-set programmes and according to any specific handling requirements." The water-based detergents used are supplied by company Borer Chemie AG. This is one of MEG's most well-established partners, so much so that it installed a hybrid cleaning system supplied by MEG itself at its Competence Centre built in 2019, where Monwitt's technical team was later hosted to carry out tests on its components. "The most complex aspect of this project," emphasises Paola Fra, "was not so much to understand the operating principles of a machine combining two processes with such different characteristics, but rather to identify the cycles best suited to our micro-gears. Once finished, these are mounted directly on watches without undergoing any further intermediate machining: therefore, effective cleaning is much more important than one might think. Now this is possible thanks to MEG's technical staff, who worked with us to determine which solutions and processes were best suited to our production. Thanks to them, today Monwitt can compete in an increasingly competitive market with more and more exclusive demands, including the high-end watches segment, for which our country is known throughout the world."

Pioneers in the development of precision cleaning technologies using non flammable halogenated solvents and in the reduction of consumption and emissions.

LESS HARMFUL EMISSIONS

LESS ENERGY CONSUMPTION

LESS POLLUTING SOLVENTS

LESS *is* MORE

WE CHOOSE TO DO MORE FOR THE ENVIRONMENT EVERY DAY BY POLLUTING LESS.

MEG

Machines for ultrasonic precision cleaning.