



Athena's New Waste Water Treatment Plant Cancels the Anthropogenic Impact of the Chemical Nickel Plating of Engine Cylinders

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Galvanic processes are very delicate treatments in terms of both operation and possible environmental impact. Athena, a well-established company specialising in engine components, has developed a unique nickel plating treatment without losing sight of the importance of limiting the anthropogenic impact normally entailed by this kind of operations. This is why it turned to Water Energy, an industrial water treatment specialist, to find the most sustainable and innovative solution for the purification of its nickel plating process' liquids.

As is well known, the bodies responsible for the formulation of environmental regulations pay much attention to the management of galvanic treatments. Considered one of the processes with the greatest environmental impact, this technology

was born at the beginning of the nineteenth century, but it has been constantly upgraded up to being used on various substrates to give them particular surface characteristics. Many experts have emphasised the benefits that the use of this particular treatment can

The cylinders manufactured by Athena Spa.





An area of the machining department.

bring to products. For example, the website of Ecometal, a non-profit consortium promoted by Assogalvanica¹, states that “modern galvanic processes contribute to saving resources and reducing greenhouse gases and they are perfectly in line with the philosophy of sustainable development.

“Electrodeposition is now able to produce very thin linings of valuable metals such as zinc, nickel, chromium, etc. with a thickness of a few micrometres on base materials that would otherwise deteriorate very quickly. This allows, for example, protecting a tonne of steel screws against corrosion with just 1 kg of zinc. With the newest treatments, electrodeposition can enable to double the life of a car, also improving its efficiency in terms of fuel consumption and halving greenhouse gas emissions. Moreover, without thick hard chrome, modern airplanes could not fly and land (flap and landing gear movements).”²

This is certainly not the right place to open a debate on how polluting (or not) the galvanic technology can be. Here, we would just like to underline the importance that a company can assume by turning into

a benchmark business for other firms partnering with it or belonging to its supply chain through a wise environmental policy. This was the case of Athena, a company established in the production of components for internal combustion engines. With a corporate profile and history studded with product innovations and sustainable initiatives, it has recently upgraded its headquarters in Alonte (Vicenza, Italy) with an innovative continuous flow treatment system for the waste water generated by its galvanic processes, which has improved its water quality degree up to class A. The project was developed by the team of Water Energy (San Pietro in Casale, Bologna, Italy), a firm operating in the industrial water treatment sector since 2006 and specialising in the development of tools and technologies to optimise and reduce industrial consumption of water resources and thus improve its environmental impact.

One company, three souls

“Athena,” explains the company’s communication manager, Matteo Schenato, “is a world leader in the fields of motorcycle and car spare parts and technical products for the industry. In Italy, it is also a

¹ The Italian Association of Galvanic Industries.

² http://www.ecometal.org/art-32/storia_della_galvanica_moderna (04/11/2020)



The cleaning phases before and after the galvanic process are essential for the final quality of components.

distributor of some major brands of the sports sector. Established by current president Gianni L. Mancassola in Bagnolo di Lonigo (Italy) in 1973, its original core business was the production of gaskets, but it was subsequently expanded to include the variety of components that we are now able to manufacture. At the end of the 1980s, with the aim of becoming an innovative and advanced manufacturing centre of spare parts for motorcycles, we also started an aftermarket division. This launched the first components to carry our own brand, which now account for about 70% of our production."

With a turnover of 129 million Euros in 2019, the Athena Group now has 10 factories located in Italy and around the world (Spain, the United States, China, India, and Brazil) and approximately 750 employees. "The Athena Industries division is among the world leaders in the production of components for industrial applications and supplies for OEMs. It mainly designs and manufactures applications and supplies for the automotive, heating, earthmoving

and agricultural machinery, and professional appliance sectors. The Athena Parts division is an international benchmark provider for the fields of motorcycles, cars, and engines in general. It designs and produces spare parts for motorbikes, scooters, maxi-scooters, and off-road and automotive vehicles of any brand and type. The Athena Sportech division, finally, deals with the distribution in Italy of brands with high innovation content and appeal to meet the needs of passionate consumers in the fields of sport, technology, and the outdoors."

The design and production phase of thermal units

"One of our Athena Parts division's core products," says motorsport-technical product manager Luigi Vangelista, "are thermal units, consisting of an aluminium cylinder, a head, a piston, and a series of gaskets: the core of a two-wheeler's engine. The design and development phase can start within our R&D office following the

request of an OEM sending us a workpiece's technical drawing or due to our own need to develop an original spare part or fine-tune a component.

"We only outsource the production of cylinder moulds and the casting of raw cylinders: for the rest, our entire production cycle takes place within our factory. This includes machining, our galvanic process (performed through the deposit of Nikasil, an alloy of nickel and silicon used to coat cylinder liners and give them greater resistance to friction), grinding, and the assembly of the accessories that make up thermal kits. Between one phase and another, we perform numerous cleaning operations, crucial for the preparation of surfaces before the galvanic treatment and the subsequent grinding of cylinder liners. Quality controls also follow the various



Athena's warehouse, managed with the Kanban method.

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The waste water treatment plant designed and installed by Water Energy.



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phases. The production flow ends in our R&D Test Room, on one of our 6 acceleration or inertial test benches: in addition to conventional tests, Athena subjects its products to the Finite Element Method (FEM) test, which enables to carry out a comprehensive series of performance simulations to assess factors such as stiffness, strength, and the distribution and displacement of stress points." Finished parts are then stored in the warehouse and managed with the Kanban method. "Closely linked our production planning activities, this system enables us to reduce stocks, avoid the overabundance of material, reduce waste, and prevent our components from deteriorating or getting damaged due to a long storage period."

Nikasil: Athena's flagship galvanic plating process

Over the years, the Athena Parts division has specialised in the production of engine cylinders made with exclusive special treatments. "10% of our cylinders are made of aluminium with a co-cast steel liner," says Vangelista. "Their treatment starts with the delivery of the steel semi-finished parts to a foundry that inserts them into the moulds and performs the casting in the G Al Si 9 or 12 alloy. The blanks are then processed with a CNC machine and, after the galvanic treatment has been performed on the cylinder liners, they are completed through the last cycle phases. We are one of the few companies to have developed a process that enables aluminium cylinders with steel liners to be treated as if they were simple aluminium parts. We are also the only ones to have applied a galvanic treatment to steel parts (excluding endothermic cylinders)."

On the other hand, 90% of Athena cylinders are made entirely of aluminium, with a galvanic plating process called Nikasil. "Athena is one of the world's top three suppliers of engine cylinders obtained with the Nikasil plating technique. After casting, the cylinder in G Al Si 9 or 12 aluminium alloy is subjected to the galvanic treatment. A layer of nickel and silicon carbide is deposited on the inside of the liner with a thickness of 4 tenths of millimetre. This is then ground with a diamond tool to obtain perfect surface roughness and shape.

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An overview of the waste water treatment plant with the storage tank.

Thanks to this technology, we ensure our pistons to have adequate wear resistance."

The development of this system, representing the know-how of Athena, started about four years ago to find a solution to increase its engines' displacement without compromising their operation. "We work with near-limit thicknesses," says Vangelista. "The thickness of the liner cannot be less than 3 mm. This is why we started searching for a process enabling to treat steel as if it were aluminium and the result has rewarded us."

Waste water treatment, a fundamental operation in a galvanic process

"The frequency of our galvanic treatments has increased to keep pace with the ever-growing production of cylinders," states Francesco Fazio, the company's time and methods manager. "The chemical-physical water treatment plant we had been using for a long time had become a bottleneck. It was outdated and it had a technology and

plant structure no longer able to support our production. When we decided to replace it, we turned to several suppliers, but our choice fell on Water Energy because it offered a different solution than a conventional batch system, which stops after each treatment cycle. We liked the idea of a continuous flow plant, able to eliminate the risk of any loss of water quality and to cope with our target productivity. Another key factor in the selection phase was the supply service of the chemicals to be used for water treatment: besides designing and installing systems, Water Energy also provides chemical specialties, which it formulates in-house."

Preparing the cylinders' surfaces for the galvanic treatment is a very delicate phase. "Dealing with two completely different materials featuring difficult-to-match mechanical properties, the parts must undergo a preparation phase with mordanting and pickling operations in order to optimise the adhesion of the Nikasil plating layer on aluminium. The chemical-physical plant is essential to manage the water coming from the various cleaning stages

undergone by the cylinders during such preparation phase."

An Industry 4.0-oriented chemical-physical plant

"The system we have installed at Athena's factory is linked to the two rinsing tanks of this pre-treatment system," indicates Water Energy owner Tommaso Ponara. "The storage tank supplied has been chosen based on its ability to guarantee consistent water quality in the preparation phase. The tank's recirculation pump allows mixing the water continuously and thus making it as homogeneous as possible for subsequent treatment."

"The plant consists of two tanks. At the entrance to the first one, acid coagulant is added to make any necessary corrections of the pH value, in order to both promote the formation and precipitation of flakes and comply with the legal parameters for the discharge of waste water. In addition to the acid coagulant, an adsorbent material is added through a hopper that contributes to the formation of flakes. When the fluid reaches the second tank, flocculant is added." "The plant ends with a sedimentation tank," explains Ponara. "Sludge has a greater density than water and therefore it tends to precipitate to the bottom of the container. A few blades clean the walls of the sedimentation tank by conveying the removed sludge to its bottom. Purified from chlorides and heavy metals, water precipitates and it is collected in a storage tank. During the clean water precipitation phase, we check the compliance of its pH value with legal requirements and the absence of any residues of suspended material through a turbidimeter."

The continuous control of parameters and the technical measures implemented to ensure constant water quality ensure class A water is produced: in conditions of hydrogeological balance, this process'



The storage tank.



Remote control of the system parameters.



One of the main advantages of this Water Energy system is its ease of management.

anthropic impact is null or negligible, in addition to meeting all the parameters for the discharge of surface water. "These controls on both the pH value and water turbidity are carried out continuously," says Fazio. "If the latter is not optimal, the system sends the liquid back to the beginning through a solenoid valve in order to repeat the waste water treatment cycle, while reporting the issue to the plant manager. We can perform these checks thanks to the connection of the Water Energy system with our company network, which allows its remote management. In case of problems, we can interface promptly with Water Energy's staff, who modifies the parameters so that the system is always able to meet the chemical-physical needs of our processes. This is a truly 4.0-oriented solution."

Athena's green philosophy

"The plant has been in operation since June," states Vangelista. "Besides the obvious environmental benefits, the quality of our waste water treatment phase has significantly improved. Moreover, our

old system required continuous operator interventions, whereas this one operates independently. Thanks to its Industry 4.0 readiness, we can even work remotely from home. This has greatly facilitated the management of the process and enabled the department manager to spend more time checking the characteristics of the galvanic baths, which represent Athena's know-how and, as such, must be managed accurately. Finally, the previous plant was not equipped with a filter press and sludge had to be stored and disposed of with high disposal costs, due to the volume of water contained. The addition of a filter press has guaranteed considerable economic savings: we have calculated that the ROI will be achieved very quickly."

"Our new Water Energy plant will become the green core of the factory," says Schenato. "We are assessing the idea to create a vertical garden and surround it with plants that we can water with the liquid treated by the system itself – an original idea to reconcile innovation, technology, and sustainability, on which Athena has insisted with all its partners ever since its establishment." ●

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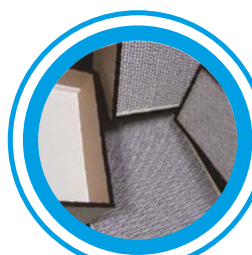
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