

HEAT TREATMENT AND MECHANICAL PROCESSING OF METALS USING SECO/WARWICK TECHNOLOGY

SECO/WARWICK

CaseMaster Evolution®

Case Study 2021



REVOLUTIONARY

– CASEMASTER EVOLUTION®

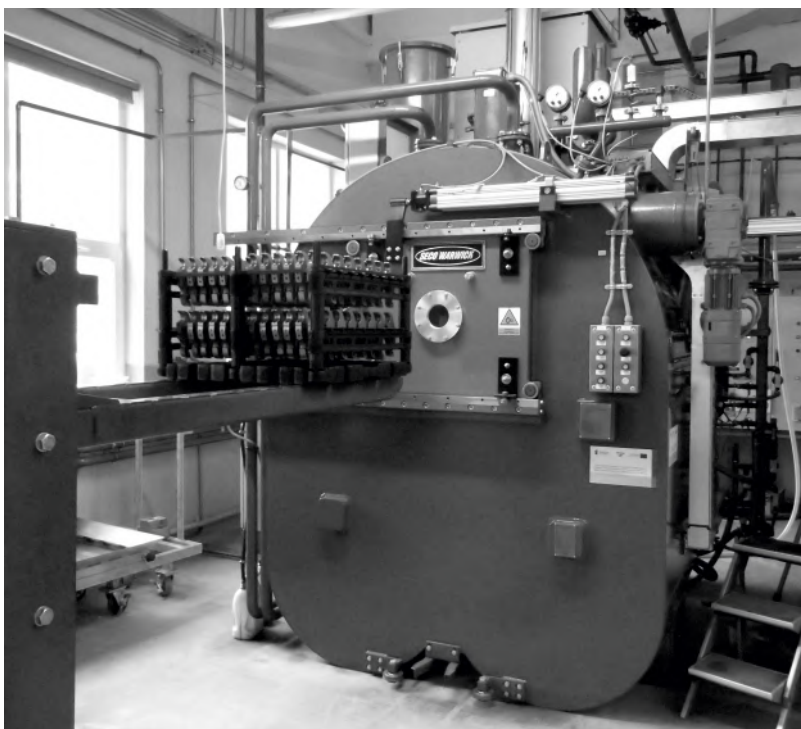
The CaseMaster Evolution furnaces are a new generation of vacuum furnaces which replaces the traditional furnaces working under endothermic atmosphere. They use vacuum carburizing (LPC), thus:

- the process cycle is shortened many times, and the carburizing of complex shapes and dense batches is uniform.

There is also no oxidation at the border of austenite grains. We should emphasize:

- high precision and repeatability of shaping the carburized layer,
- minimum consumption of process gases (hydrocarbons) and energy,
- absence of flammable or explosive atmosphere and of open flame,
- absence of CO and CO₂ emissions,
- neutrality in relation to the natural environment — SECO/ECO.

This is industrial equipment which work safely and completely automatically, and their operation is limited to loading and unloading the batch, selecting a recipe and starting a process. It can operate continuously or on a task-based conditions, upon request. It can be started and shut down immediately and does not require any time for changing or conditioning of the process atmosphere.



CASE STUDY

ZAP Mechanika, a business providing professional mechanical processing with machining and heat treatment, needed to decrease its processing costs. New technology and SECO/WARWICK came to help.

The implemented technology decreased the heat treatment costs by approx. 30% thanks to installing a two-chamber CaseMaste Evolution furnace for vacuum carburizing and oil quenching.

ABOUT THE COMPANY

ZAP MECHANIKA is a renowned company providing mechanical processing services, in particular in terms of machining and precise measurements. It has specialized machinery comprised of CNC lathes and CNC machining centers. The company cooperates with national and foreign companies in the machinery industry. It was established in 2000 in Ostrów Wielkopolski, Poland, and currently has 150 employees.

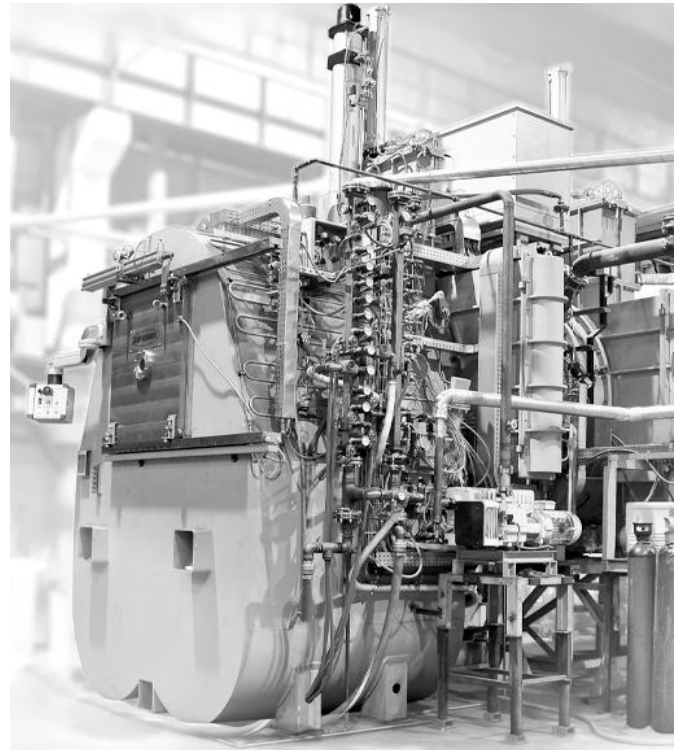
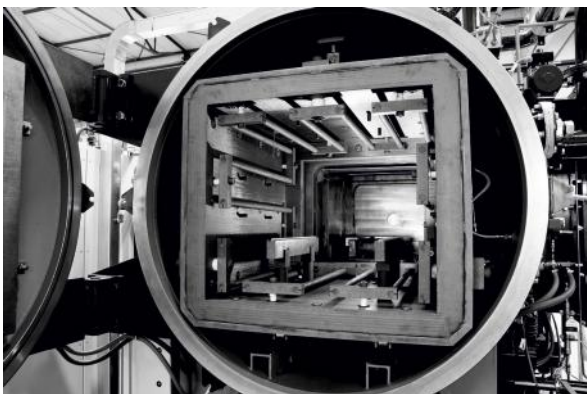
DELIVERY AND INTENDED PURPOSE

- OF THE FURNACE

A CMe D6 furnace — we delivered this model to our customer — is a two-chamber vacuum furnace with a heating chamber and an oil quenching chamber. Both chambers are separated with internal vacuum- and gas-tight door. The batch is moved between the chambers by the internal transport mechanism fitted with an elevator for immersing in oil.

The heating chamber is used for carrying out the thermal and thermal and chemical process (LPC using the FineCarb® method) and is equipped with the thermal insulation and heating system. It enables operation up to 1200°C with uniformity of +/- 5°C under vacuum of 10-2 hPa, under partial pressure or in nitrogen.

During vacuum carburizing, the working space is supplied with hydrocarbons following an appropriate time sequence. The quenching chamber is fitted with a horizontal and vertical transport mechanism, mixers and heat exchanger for controlling the oil circulation and temperature. The batch is loaded into the quenching chamber and then moved under vacuum to the heating chamber for the thermoprocessing. Then it is returned to the quenching chamber and immersed in the oil in order to be quenched. Once the process is completed, the batch is removed from the quenching chamber. The dimensions of the D6 furnace enable loading the batch of gross weight of 400 kg into the space of 600x400x600 mm (WxHxD).



CMe D6 furnace for ZAP Mechanika

- Was manufactured within 5 months and then installed, commissioned, and handed over for operation within 4 weeks in 2013.
- The solution is intended for carburizing and hardening of tools intended for press-fitting of plumbing installations. Parts made of 20MnCr5 steel are carburized with a layer of 0.5 mm, quenched and tempered in order to achieve a surface hardness of 58-62 HRC. Oxidation at the grain border and carbide precipitation cannot occur in the layer structure. The required mechanical strength of the parts is 20,000 working cycles (50,000 for the type test).

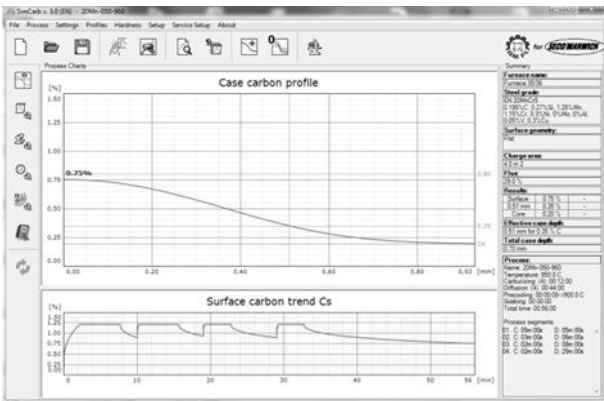
CMe perfect solution for Industries:



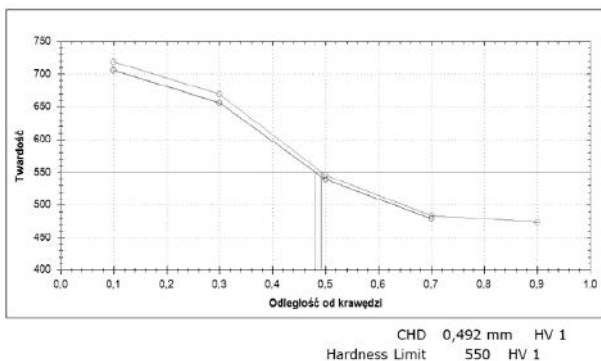
PROCESS. RESULTS. COSTS.

- CASEMASTER EVOLUTION

The parameters of the vacuum carburizing process were defined using the SimVaC® simulation software that precisely predicts the production of an appropriate carbon profile in the layer. The batch is carburized under 950°C in 60 minutes and is oil-quenched under 860°C. After quenching, the parts are cleaned and tempered at 180°C.



This process makes it possible to achieve the hardness profile with the following parameters: a layer thickness of 0.50 mm +/- 0.05 mm, surface hardness of 61 +/- 0.5 HRC. The results achieved for the workpieces in the entire volume of the batch meet the required criteria and prove the high precision, uniformity, and repeatability of the results of the processes performed with the CMe furnace.



Specimen	Row	Distance	Hardness	Method	Diagonal	CHD - Value
Próbka 80	Szereg 1	0,100	719	HV 1	50,779	0,492
		0,300	609	HV 1	52,662	
		0,500	545	HV 1	58,312	
		0,700	484	HV 1	61,883	
		0,900	473	HV 1	62,599	
	Szereg 2	0,100	706	HV 1	51,234	0,481
		0,300	656	HV 1	53,182	
		0,500	539	HV 1	58,638	
		0,700	479	HV 1	62,208	

Costs and operation of the vacuum furnace

A full batch is comprised of 196 parts with the weight of 150 kg and a surface area of 4 m². During the complete process (approx. 5 hours), the furnace consumes 260 kWh of electricity, 3 kg of liquid nitrogen, 300 g of hydrocarbons (acetylene/ethylene), 75 l of hydrogen and minor quantities of compressed air.

Performance and economy

The furnace is operated continuously, performing 4 processes a day. During a 12 month period, it completed more than 1000 processes, treating 200k parts with no rejects. The introduction of the CMe furnace brought significant financial benefits. The costs of heat treatment were reduced by approx. 30% compared to the costs of third-party services. In addition, the costs of workpiece transport and logistics were eliminated. It is estimated that the return on investment for the CMe furnace will be complete in 6 years.

Investments in modern heat treatment technologies carried out in furnaces such as the CaseMaster Evolution clearly improve the quality and efficiency of heat-treatment processes, reduce costs and are environmentally friendly. In the second half of 2014, the second two-chamber CaseMaster Evolution D9 furnace was delivered to ZAPMechanika and commissioned.

CaseMaster Evolution® (CMe®)

- hardening by low pressure carburizing and oil or gas quenching,
- an alternative for atmospheric sealed quench furnaces, continuous lines and multi-chamber systems,
- perfect for commercial hardening plants.

Read more about CMe: [link](#)