Germany

CREMER Thermoprozessanlagen: New Generation of Cost-Efficient HIP Systems for PM Components

CREMER Thermoprozessanlagen GmbH was founded in 1968 in Düren/DE and, with its 130 employees today, has made a name for itself worldwide as an industrial furnace builder (especially belt conveyor and walking beam furnaces) for powder metallurgy.
In 2012, Dieffenbacher based in Eppingen/DE offered its range of HIP/CIP presses for sale, in order to concentrate on its core business – the engineering of integrated plants with continuous presses for chipboard and other materials. CREMER Thermoprozessanlagen took over the HIP range in a "technology buyout". At WorldPM16 in Hamburg, CREMER Thermoprozessanlagen presented a newly developed concept for HIP presses for post-compaction of components cast from metal powders [1]. In 2016, a new manufacturing facility (650 m^2 in the first stage) was built for the HIP range at the headquarters in Düren. When the first "Proof-of-Concept" press was ready for delivery there, we were able to talk to Ingo Cremer (IC), Managing Partner at CREMER Thermoprozessanlagen, on the motivation behind this development.

Fig. 1 Ingo Cremer, Managing Partner at CREMER Thermoprozessanlagen

cfi: *What developments have taken place in your company since the takeover of the HIP/CIP range from Dieffenbacher?*
IC: In the first phase, we had to learn a great deal to fulfil the big responsibility associated with the after-sales services of Dieffenbacher HIP-systems. Most of the systems were installed at ceramic manufacturers, others were used for post-compaction of components from metal powders.
Our team received expert training at Dieffenbacher and following on from this we have also received assistance in correct processing of the replacement part business – but no employees were transferred to us. So we had to widen our knowledge of thermal process engineering with regard to these requirements, which certainly brought us valuable additional knowledge for our traditional furnace engineering.
In a second step, we have brought in our specialist know-how from powder metallurgy and developed a concept tailored to this range of materials. Key goal was to make the HIP process cheaper without sacrificing quality. In the scope of all the continuing work, we have built up a completely new team of young engineers for our HIP programme. Their offices are also located in the new HIP facility.
cfi: *What approach have you chosen?*
IC: Various approaches: Specifically, we have addressed the basic principles and investigated what pressures and temperatures are really necessary in the process windows that constructively result.
For this, we sought support from RWTH University of Aachen/DE. Here, first, at the IWM Chair and Institute for Materials Applications in Mechanical Engineering, where we have run a real programme with various HIP cycles and evaluated metallurgically. In the tests, we took relevant material groups (austenitic stainless steel 316LA, nickel-steel FN08, soft magnetic alloys FeSi3, nickel superalloys Inconel 713 and precipitation-hardenable stainless steel 17-4PH) into consideration.
Second, at IOB Department for Industrial Furnaces and Heat Engineering, where with the help of the latest findings on the real

Fig. 2 Company building in Düren

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Fig. 3 The new HIP facility

state variables of argon at different pressures and temperatures we simulated the transient heating and cooling.

As a result, a rapid cooling could be developed for shortening process time. So we came step-by-step to the approach that maximum operating temperatures of 1150 °C are sufficient and we can limit the pressures to 1000 bar.

cfi: *Compared to HIP plants for temperatures to 2200 °C, you can no doubt offer lower cost plants. How does your new concept compare with conventional plants in respect of plant capacity?*

IC: With the help of simulation model, we have learned that cooling rates of 2–8 K/s are possible. Our plants are comparatively small and compact, can, however, with rapid cooling be cooled in 2 h instead of 5–6 h. With these shortened process times cold to cold, we achieve good throughput rates even with small plants.

cfi: *Are other structures "frozen" by this rapid cooling?*

IC: Yes, that does indeed offer other development possibilities, because with this the properties of the components can be selectively optimised.

cfi: *You got into HIP systems when additive manufacturing of PM components had not yet been implemented on industrial scale. With all advantages of additive manufacturing in respect of the complexity of the components and new possibilities of lightweight engineering, the production of pore-free microstructure is still a limit. Do you see a place for your new developments here?*

IC: Absolutely as many user segments, from automotive, through energy technology to medicine are demanding additive-manufactured components, but also zero porosity of the workpieces and high strengths. Here, new markets are opening up for HIP – that's why it is also so important that HIP processes become affordable.

cfi: *Are new developments of HIP plants planned for ceramic components, too?*

IC: We have now shown for years that we reliably support the plants used in ceramics production. For that reason, we are prepared to meet the market needs from this user segment.

cfi: *Can new developments in furnace engineering be expected from your company. too?*

IC: Naturally, we want to progress in our traditional business. We are busy finding a plant answer to the needs of powder metallurgy in respect of increased sintering temperatures, which belt conveyor furnaces can no longer achieve.

cfi: *Through the automotive industry, Industry 4.0 is being pushed ahead. How are you positioning yourself as a plant engineer with regard to this topic?*

IC: As a supplier to the PM industry, we can't, of course, get around it because the largest part of PM components goes to this user industry. It is a logical further development which we are approaching iteratively. Our plants have to be integrated in the quality management system. Our software solutions also incorporate TPC (Total Process Control) and HMI (Human Machine Interface) standards. We have also developed solutions for preventative maintenance of installed equipment.

cfi: *Thank you for talking to us.* KS

Reference

[1] Cremer, I.: HIP – a partner for MIM, SLS and AM. cfi/Ber. DKG **93** (2016) [10] E 15–E 17

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