



Aerial view of the Linde plant in Weilbach. With a workforce of 157, the plant produces around 180 counterweights for forklift trucks every day. The production volume is around 50,000 t per year (Photo: Linde)

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Qualified and in position for a sustainable future

The site of Linde Material Handling in Weilbach, Germany, has a long history. Founded originally as "Eisenwerk Weilbach" in 1822, Linde AG took over the foundry in 1975, celebrating its fortieth anniversary in 2015. The manufacturing programme encompasses counterweights for the electric and combustion engine counterbalanced trucks of Linde which are assembled at the Aschaffenburg based plant of Linde. The foundry commissioned the Dutch engineering service provider Gemco Engineers from Eindhoven in 2014 to improve the working conditions and handling at the shake-out station, to reduce sand spillage inside and outside the foundry as well as to extend the cooling time in the mold

The foundry produces some 50,000 t per year of various counterweights (**Figure 1**) on a semi-automatic no-bake flask molding line with flask sizes up to 2,600 x 1,800 x 800/800 mm and castings weighing several thousands of kilograms. For some time, Linde had already been seriously considering to upgrade the facility by optimizing working conditions, and the possibility of a capacity increase.

In 2012 Gemco was asked to perform a study for the improvement of the handling of the flasks and castings as well as improvement of the sand rec-

lamation, along with the feasibility of a capacity increase. With this study a complete technical report was established, defining all the required measures to be taken for the building as well as utilities in order to achieve the intended works optimization. A capacity increase proved not to be required. However, for Linde, the result of the study marked the initiation of a program for the upgrade of working and environmental conditions in order to assure a sustainable future for the foundry.

For Gemco, a follow-up on this study came in 2014 when it received the in-

quiry for engineering assistance with different topics related to working climate conditions, handling at the shake-out, sand spillage inside and outside the foundry and increasing of in-mold cooling time. Linde had originally considered these issues as separate topics with corresponding separate solutions from separate suppliers, and for Gemco apparently separate engineering assistance projects. Gemco took another approach by bundling the separate issues and looking for an integral concept addressing all the issues of casting and flask han-

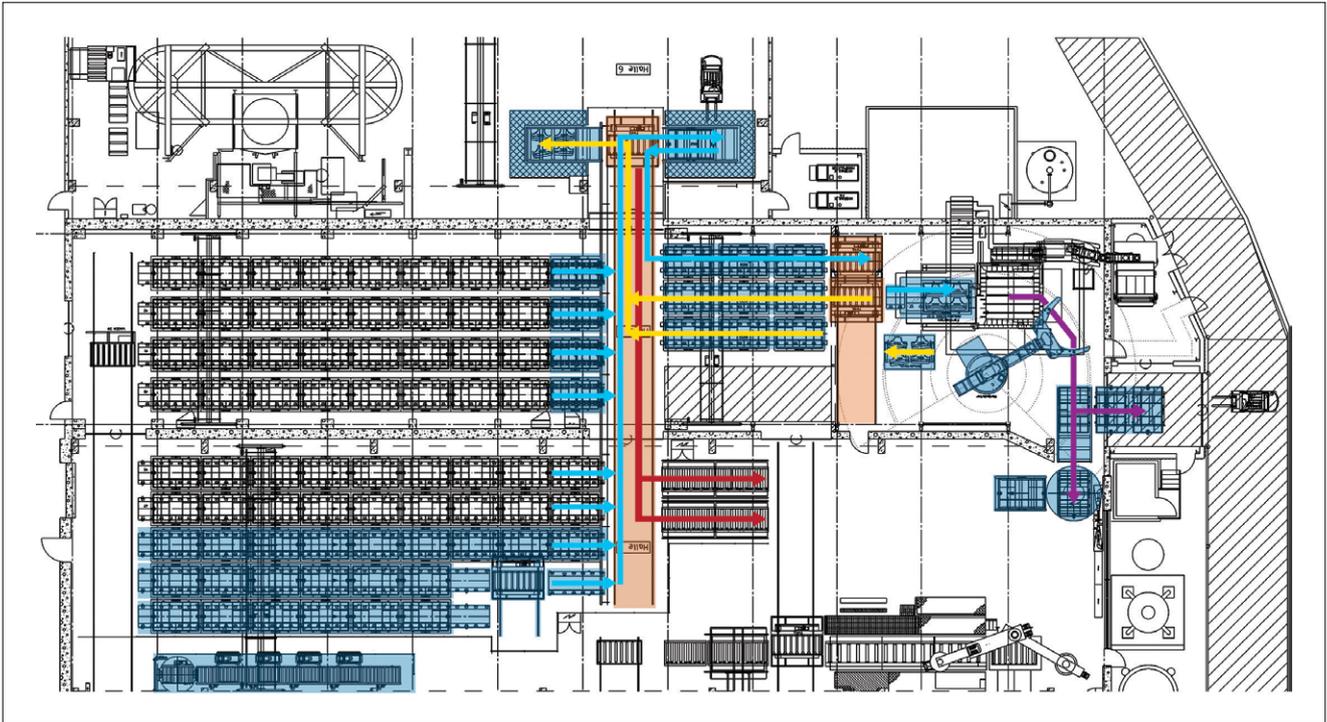


Figure 3: Logistics in the integrated concept, with automated conveyors and transport car, as well as manipulator for operations in the shake-out area, and additional cooling lines and mechanized molding logistics

castings in the shake-out area. Moreover, a specially designed lifting and tilting table alongside the shake-out would significantly increase direct sand recuperation, consequently reducing sand loss and spillage both inside and outside. The operator, safely at work inside the air-conditioned and noise-insulated cabin of the manipulator, would be the only worker in the hall, in a position to control and overview all movements in that area. The concept further included the extension of in-mold cooling places and a significant change in the molding logistics, and even provided for the future possibility to implement forced casting-cooling lines in direct connection to the shot-blaster in order to eliminate the necessity for outside cooling (**Figure 3**). The concept was presented with a budget and realization planning.

Linde approved the concept and calculated investment costs and the project was made part of a foundry-wide program focusing on best working and environmental conditions. Other projects to be realized during 2014-2016 – some of which by Linde – included a

new coke storage bunker, a new sand mixer and the change from alcohol to water coating necessitating a big mold drying oven.

No space, no time... no problem

The project was carried out from 2014 to 2016 with Gemco as the engineering and project management partner closely cooperating with the Linde personnel in charge. In the process several hurdles needed to be taken. Detailing of the project was challenged by the very limited space in the existing foundry, the realization of very complex and heavy foundations in an old building and the fact that production could not be discontinued outside the planned holidays. The other challenge was that controls for the new system had to be included in the existing overall plant control.

The complex circumstances and the requirement of continuing production demanded that the realization be planned and performed in multiple stages. In 2015 in-mold cooling lines were added and the core logistics to the molding line were considerably modified. The manual core



Figure 4: This specially developed manipulator separates molds and castings. In the foreground: Martin Severing (l.), Project Manager/Head of Engineering Counterweights, and Klemens Raub (r.), Plant Manager Linde Weilbach, with Maurits Brandt, Gemco Engineers



Figure 5: Automatic roller conveyor system for the shake-out station. Up to 25 t of mold boxes can be transported here

transport to the molding line was replaced by a compact mechanized system comprising conveyors and elevators.

Then, during the 2015 Christmas holidays, the foundation for the manipulator (safe working load 11,000 kg) had to be carried out and completed. This was quite an undertaking due the fact that the manipulator is mounted right at the edge of a deep pit.

Starting 2016, several modifications in the hall were planned by Gemco and Linde in order to prepare the large overhaul which was to take place in the summer of 2016. Preparation encompassed the relocation, and sometimes the removal, of several control cabinets, mechanical structures, doors, walls and certain utility systems. Again, this was all carried out outside production hours, without compromising working procedures. On the weekends before the summer holidays the main equipment contractors, for the manipulator (**Figure 4**) and for the logistics systems (rolling conveyors, **Figure 5**), started installation of their equipment. During the summer holidays the large part of the installation took place consisting of several conveyors for full flasks – weighing up to 25 tons –, castings and empty flasks, and a special lifting and tilting table next to the shake-out (**Figure 6**) from



Figure 6: Shake-out station with a special lifting and tilting table from which the manipulator picks up molds and mold boxes

which the manipulator takes the flasks and the castings. Also several noise dampening structures and a complete network of dust extraction and fresh air supply was installed. At the same time Linde conducted the installation of the new mold drying oven and sand mixer.

Prior to the installation the operator(s) assigned to work in this revamped working environment were trained to handle flasks and castings with the manipulator and get used to the completely new logistics and communication procedures.

After three very intensive weeks during the summer holidays the foundry was ready to ramp up production while Linde, Gemco and the suppliers, always in close cooperation, addressed the complex start-up related to the tailor-made equipment and high level of automation. A good concept and outstanding teamwork made for a successfully completed project. The Weilbach site is ready for a sustainable future.

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