

Modern Mold Manufacturing in the Course of Time Innovative Solutions to Constantly Increasingrequirements for State of the Art Mold Manufacturing

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Abstract :

In his statement about the above mentioned topic, the author Franz Horlbeck deals with the question which influences emerge for the mold manufacturers out of the constantly increasing customer-requirements regarding to quality and design of concrete products. In the beginning the reader will be provided with a short overview about the specific role of a paver mold during the productionprocess. To accomplish the goal of appropriating a detailed overview about the specific requirements as well as the current trends, the technological solutions and the thereof resulting advantages for the customer will be examined. Technical solutions, such as hardening- and dimensional-standards, as well asa modular construction, demonstrate the evolution from a customer requirement to a fully developed and sufficiently approved solution. For staying in the long term innovative, it is important to implement a certain number of strategic and organizational approaches. The main purpose of the following paper will be to illuminate the developed technological as well as organizational features. Besides of the historical development of mold manufacturing, another main focus will concentrate on the question which lessons were learned during the last decades.

Key Words : mold manufacturing; paver molds; concrete pavers; insert hardening; KOBRA Formen GmbH; customer requirements; modular construction; development; modularization; foresight; future stone trends

1. Introdouction

During the following chapters the author will provide an overview about the increasing demands on the mold manufacturer and the thereof developed solutions and features. Because of the constantly growing demand on stone-quality from the end consumers, also the claim of the concrete product producers on their tools and machines is rising. This fact confronts the supplier ofconcrete blocks, such as KOBRA, with particular challenges.To accomplish the goal of staying state of the art in innovation and technology, the mold manufacturer has to implement a certain number of strategic and organizational approaches.To illuminate the resulting technological features will be the main task of the following paper.

A further topic will also be the historical development of mold manufacturing and the technical innovations and features devised during the last decades. One of the focused categories will be for example the hardening quality as well as the general production standards. Illustrating the changes and developments in these category fields will be another goal of the following paper.

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In general, a paver mold should be understood as a special tool which is responsible for the outside dimensions of the concrete product.Another important fact is that a paver mold never can work independently. The mold only works in conjunction with a concrete block machine. It istherefore important to understand that a concrete paver mold is a highly specialized wear part into the production process of a modern block machine. So in fact, for achieving the goal of producing a high quality paver mold it is important to concentrate on the one side on internal quality and production standards andtargeting on the other hand the special customer needs.

Especially during the last twodecades there happened some major steps in the development of mold manufacturing. The production-and quality-standards were continuously improved. One example in which the technical development becomes particularly clear is the manufacturing method of the mold insert. Past in the days, the mold insert was flame cutted and polished in the next step. With the establishing of modern milling machines, this production procedure was not state of the art anymore, because it had the enormous disadvantage that it is more inaccurate and very labor intensive. By using high endmilling machines, the product accuracy and quality at the same time increased dramatically.Another remarkable step during the history of mold manufacturing is the establishment of the modular-system. In the past, most of the structural mold connections were welded together. This manufacturing method had the distinct disadvantage that the heat-influence during the process of welding destroys the hardening layer of the hardened steel parts. Thereof results, that the connection-points were the weakest points on the mold and also the reason for much lower cycle-times than todays molds. The solution for that problem was the developing of the modular-bolted design. Further information regarding this topic can be found under the chapters 2.1 Standards and 2.2 Modular Concept.

2. Method

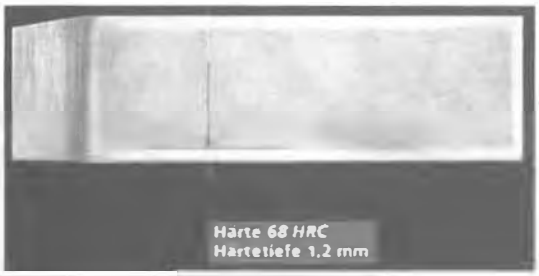
In the following chapters the author will provide an overview about the milestones in modern mold manufacturing developed during the last decades and also about the thereof resulting benefits for the customers. Besides topics like quality standards, the modular concept and a premium partnership, also project molds and an on demand customer service will be described and illustrated.

2.1 Standards

During the following paragraphs the reader gets an overview about the industry standards in today´s modern mold manufacturing. The here described standards refer to the internal quality requirements of the company KOBRA Formen GmbH. As an example for one of the most important standards, when it comes to paver molds, is the hardness of the mold insert and shoes (plates which are responsible for the surface of the stones). There is a simple reason why the hardness is that important for the manufacturers. These two wear parts are getting during every production cycle in direct contact with concrete and are mainly responsible for the geometry and future quality of the stone. This is why they are confronted with an enormous abrasion wear. Another important factor for the intense abrasion wear inside the cavity walls is the pre- and main vibration process during every single production cycle. During this vibration process acting enormous forces on the shoes, as well as on the cavity wall. Exactly these two main factors are most responsible for the lifetime of an mold. Therefore it is necessary to know that the lifetime of a mold is not counted in years or months, but rather in production cycles. A plant manager, or

machine operator always appreciates a mold which produces good quality stones for an high amount of cycles. Observing this customer demand after an increasing wear resistance, company KOBRA implemented their own insert hardening department within the production process. This was a crucial step to guarantee the future product development and is still today one of the most noticed quality features. As seen in Table1 KOBRA is able to deliver their molds, regarding to the different constructional designs, in three various qualities.

Table 1. Hardening Standards KOBRA Formen GmbH

	FORM carbo 68 plus - Hardening quality of min. 66 HRC (Rockwell). with a tollerance of +2 HRC and -0 HRC - Hardness depth of 1.2 mm
	FORM - Hardening quality of min. 62 HRC (Rockwell), with a tollerance of +2 HRC and -0 HRC - Hardness depth of 1.2 mm
	FORM - Hardening quality of 750-800 HV 10(≠ 60,1 HRC) - Hardness depth of 0,6 mm - Adaptable for all mold-geometries with a risk of distortion

Surface hardening, treatment of steel by heat or mechanical means to increase the hardness of the outer surfacewhile the core remains relatively soft. The combination of a hard surface and a soft interior is greatly valued in modern engineering because it can withstand very high stress and fatigue, a property that is required in such items as gears and anti-friction bearings. Surface-hardened steel is also valued for its superior flexibility in manufacturing.

The oldest surface-hardening method is carburizing, in which steel is placed at a high temperature for several hours in a carbonaceous environment. The carbon diffuses into the surface of the steel, rendering it harder. Various techniques of carburizing have been developed to increase efficiency and reduce cost. The depth of the carbon penetration depends on the exposure time and temperature. In gas carburizing the parts are heated in contact with such carbon-bearing gases as carbon monoxide, carbon dioxide, methane, or propane. This process is usually done in a large furnace into which the parts are fed at one end and from which they emerge at the other end inthe hardened state. The same process is used in carbonitriding except that ammonia is added to the furnace atmosphere and it takes place at lower temperatures that produce less distortion in the steel.[1]

During the last years, it was observable that the customers highly appreciate the increased hardness. Their biggest benefit out of this technique is an enhanced lifetime of their molds. In the next step a longer lifetime results in an cost- and efficiency advantage against the competition.

2.2 The modular concept

The development of an modular concept was another response on the customer requirement after an increased lifetime of the mold. To tackle this customer need KORA developed a solution with a complete new approach. So the focus while developing and implementing the modular system is not on improving the material quality, as shown in chapter 2.1. The modular concept is more concentrating on developing a constructional solution, which will allow the customer to exchange and replace the most important wear parts. So the main idea behind this approach was the past situation, that if a mold was worn out and the quality of the stones was getting worse and worse, the customer had to replacethe complete mold. This procedure was on the one hand very resource intensive, as on the other hand a very expensive and inefficient solution. To improve this situation, KOBRA developed a modular system where the frame parts in the first step and later then even the mold insert where manufactured out of singleparts which where bolted together. This constructional improvement had two major advantages. As mentioned in the chapter before, the two major parts which are wearing out fast are the shoes and the insert walls. The shoes where also replaceable before, but with the implementation of the modular concept the customer get the chance to replace and exchange the insert walls as well. This leads us directly to the next advantage. If the customer is able to replace wear parts, like insert walls and shoes, by themselves, it is possible to change these wear parts directly at his place. For the customer, that will result in an increase of flexibility and efficiency. It will be also be an cost advantage if you are able to reuse the frame construction.

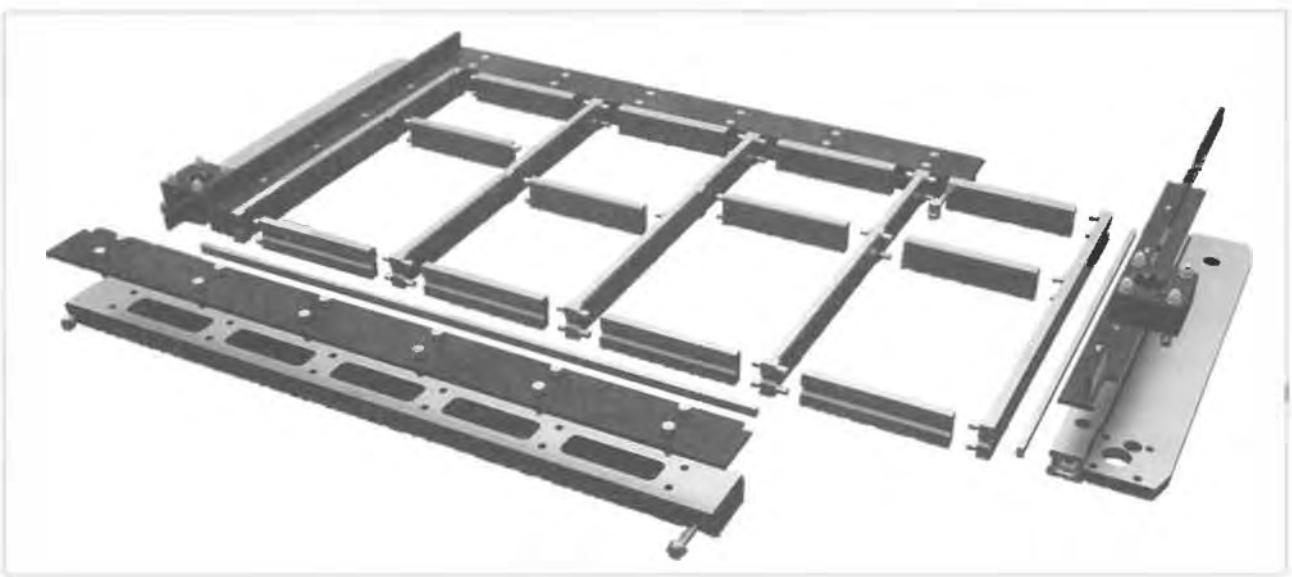


Figure 1. Example drawing for the modular concept (Source: Kobra Formen GmbH, 2018)

As seen in Figure 1. there are also a number of other wear parts which are, in the latest development status, changeable. Wear plates, the head guide system and the mud rails are also designed in the modular system and thereof replaceable.

3. Conclusion

The two above described chapters demonstrate clearly how specific customer requirements influence the technical development of mold manufacturing. It is important to have in mind that these two examples are exemplary for a wide range of additional technical solutions, developed during the last decades. With the goal to ensure and secure the customer satisfaction the increased customer demand for state of the art technical solutions are responsible for a various number of constructional improvements. During that development, it became more and more clear, that the ability to react on those changing customer demands will strengthen the strategic market position. On the one hand for the supplier it can be very exhausting and challenging to react on the steady growing customer demands, but on the other hand it forces the suppliers to continually improve their products and production processes. The biggestbenefit out of this development will get the end customer. Because of the improved mold constructions, better material quality and the increased quality requirements, the end customer gets access to a wide range of state of the art concrete products. Concrete stone producers, as well as mold manufacturers which will not following this trend, will facing on the long-term a very limited chance of survival.

References

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