Innovations in High-Pressure Casting of Sanitaryware

F. Köppl

In the years 2004–2014, the global demand for ceramic sanitaryware showed an average growth of approx. 4,5 % per year. The main driving factors for this development are the population growth and urbanization in Asia (China, India and Indonesia). To some extent the regional growth rates in this regions are even higher than the average.
Since these trends are still ongoing presumably also the according growth in demand is actually continuing. Hence, the actual global production volume of ceramic sanitaryware can be estimated at 350–400 million parts per year.

Fig. 1 DORST Technologies DG180 with two independent moulds and handling robot

The majority of approx. 85 % of the global production volume of ceramic sanitaryware are produced in a conventional way in plaster moulds on casting benches. In contrast, the global share of ceramic sanitaryware produced by high-pressure casting can be estimated at approx. 15 % based on the number of according machines delivered by various suppliers. In many regions increasing salary expenses, energy costs and environmental regulations generate more and more pressure for modernization of conventional production lines. For this task, high-pressure casting technology is the proper solution in order to make the casting process more efficient, introduce a higher degree of automation and increase the quality of the articles.

For wash basins, kitchen sinks, shower trays, squat pans and water tanks, DORST Technologies provides the high-pressure casting machine DG180 for two-part moulds, which is extremely successful on the market since years. The DG180 is extremely flexible in terms of a wide range of feasible article sizes, number of moulds and cavities and positioning of the articles for demoulding. The mould clamping platens have a size of 2000 mm × 2100 mm and allow to apply up to two independent moulds with a maximum of three cavities each depending on the actual article size. The movable mould clamping plate can be brought into vertical or horizontal position for demoulding of the articles. The according frames and setters for demoulding can be handled by automatic demoulding trolleys or directly by robot.

In order to increase the overall efficiency of the DG180 high-pressure casting line, up to three closing units can be operated by one central control unit and hydraulic unit. The casting process can be adjusted and optimised in every detail for individual articles. This results in very high casting yield depending on according mould design, slip properties and boundary conditions.

For water closets (WCs), the DORST Technologies high-pressure casting machines WCM60 (bowl) and WRM60 (water rim and tank) cover the complete range of different article designs. The most challenging design in terms of casting technology are most certainly one-piece WC with covered trap commonly produced for Asian markets. For this type of WC, DORST Technologies has delivered two WCM60 and WRM60 high-pressure casting lines to customers in

Florian Köppl
DORST Technologies
82431 Kochel am See
Germany

E-mail: Florian.Koeppl@dorst.de
www.dorst.de

Keywords: high-pressure casting, sanitaryware, innovation, Industry 4.0

China and successfully put them in production over the last year.

For this task, the proven concept of the two high-pressure casting machines WCM60 and WRM60 combined with a handling robot for automatic garnishing is extended for additional mould parts. The casting of the toilet bowl is executed in a five-parted mould. For the simultaneous casting of the trap two additional mould parts including media supply are automatically placed in the mould, held in position during the casting cycle and removed for demoulding by handling robots. Using the same technology the WRM60 allows to produce water tanks with undercuts by introduction of one additional mould part.

The concept of the high-pressure casting machines WCM60 and WRM60 can be applied for almost any other established WC types by modular adaption.

For one-piece WCs with visible trap, mainly for the North American market, the mould of the toilet bowl is reduced to four parts without additional mould parts to be handled by robots. For rimless WCs and WCs with closed water rim mainly for the European market the toilet bowl is casted in a four or five-parted mould (WCM60). The water rim is casted in a two-parted mould (WRM60) and automatically combined with the bowl by the handling robot. WCs with open water rim can be casted completely in the WCM60 in four or five-parted moulds.

Therefore, the DORST Technologies WCM60 and WRM60 high-pressure casting machines enable to build up very flexible production lines that can be adapted to the actual market requirements. The production lines can be upgraded for more complex types of WCs in different modules, but at the same time they are always downward compatible for less complex WC types.

The increasing requirements for flexibility in the production and higher frequency of mould changes lead to more and more challenges to monitor the complete production process and to keep up efficiency. Two most common issues are the control and planned maintenance of the machines, as well as the tracking of each individual article through the production process.

In the framework of Industry 4.0, DORST Technologies follows up on two key issues. Already today, all DORST Technologies machines can record all article related data and communicate this data to subsequent data bases of customers. This allows to track i.e. the individual casting parameters of each article from the high-pressure casting machine until to the finished product ready for sale.

Fig. 2 View of the DORST Technologies WCM60 (center, background) and WRM60 (r.) high-pressure casting lines with handling robot (center, front) for the one-piece WC with concealed trap

Fig. 3 DORST Technologies SWS4 high-pressure casting machine with control unit and pressure vessel (l.) as well as mould carriage and mechanical demoulding unit (r.)

On the other hand, DORST Technologies develops solutions for autonomous monitoring of the machine condition. This will allow to manage the maintenance intervals of the machines according to the actual condition and requirements of the machines. Additionally, the planning security for both, the customer and DORST Technologies, in terms of spare parts availability and disposability of service staff will be increased.

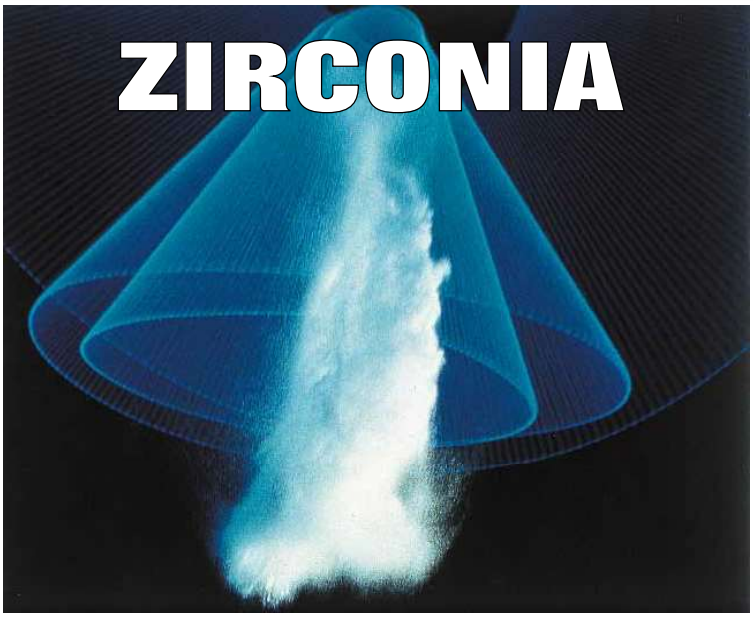
Already during the ceramitec 2015, DORST Technologies presented the entirely novel Super Whizzheart high-pressure casting system for solid casting articles in two-parted moulds. The closing and sealing of the moulds is executed by surrounding isostatic pressure. Therefore, the mould itself only experiences a minimum pressure difference between the isostatic pressure and the internal slip pressure.

As a consequence, the recurring elastic deformation of the moulds during the casting cycle is eliminated, the moulds do not require a steel frame and the weight of the moulds can be reduced significantly. This generates positive effects on the mould costs and opens up new potential for mould changes by robot. At the same time even steep-walled articles like water tanks can be casted at casting pressures up to 18 bar without subsequent problems during demoulding. DORST Technologies is currently developing a further extension of the system for hollow-casting articles like wash basins. Overall, DORST Technologies will remain the leading supplier for high-pressure casting machines in the future and has groundbreaking technologies at its disposal to cover all customer and market requirements. The novel Super Whizzheart System leads the way to innovative casting processes and new possibilities in terms of article design and robot automation.

TZ ZIRCONIA POWDER FROM TOSOH

THE

ULTIMATE



If you are looking for the best in purity, homogeneity, reproducibility, and ease in sintering, come to TOSOH. With our line of yttria stabilized "TZ" zirconia powders, you will find the ultimate in your processing and sintering properties. As the world leader in high purity zirconia powder for advanced engineering ceramic applications, our powders have set the standards that have come to be accepted worldwide, including various regulatory approvals on sintered bodies. Whether it is for injection molding, pressing, slipcasting or extrusion, our zirconia will provide you with outstanding properties, so that you can take the lead. With the largest capacity in the world, and worldwide technical support through offices in Europe, USA and Japan, you can depend on **TOSOH for the ULTIMATE in zirconia!**

TOSOH ZIRCONIA Powder Series	Partially Stabilized Zirconia		Binder "Plus" Grade		Fully Stabilized Zirconia	
	3YE	3YSE	3YBE	3YSBE	8Y	8YS
Specification						
Y_2O_3 (mol%)	3	3	3	3	8	8
ZrO_2 (wt%)	(94.8)	(94.8)	(94.8)	(94.8)	(86.7)	(86.7)
Al_2O_3 (wt%)	0.25±0.1	0.25±0.1	0.25±0.1	0.25±0.1	≤0.1	≤0.1
SiO_2 (wt%)	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02	≤0.02
Specific Surface Area (m^2/g)	16±3	7±2	(16±3)	(7±2)	16±3	7±2
Typical Properties						
Sintered Density (g/cm^3)	6.05	6.05	6.05	6.05	5.90	5.90
Bending Strength R.T. (MPa)*	1200	1200	1200	1200	300	300

*** 3 point Bending Test**

Some of the many applications where TOSOH Zirconia is used.

TOSOH

TOSOH CORPORATION

Visit us at www.tosoh.com

Head Office: Tosoh Corporation, Advanced Ceramics Dept., 3-8-2 Shiba. Minato-ku, Tokyo 105-8623, Japan Tel: +81 03-5427-5170 Fax: +81 03-5427-5217
North American Office: Tosoh USA, Inc. 3600 Gantz Road, Grove City, OH 43123 Toll free tel: 866-844-6953 Fax: 614-875-8066
European Office: Tosoh Europe B.V., Crown Bldg. South, Hullenbergweg 359, 1101 CP Amsterdam Z.O., The Netherlands Tel: +31 020-565-0014 Fax: +31 020-691-5458