

UPDATE.SPECIAL

GERRESHEIMER

Pharma Days 2016

May 25 – 26, 2016

Chicago and Chicago Heights, Illinois (USA)

UPDATE

GERRESHEIMER

SPECIAL

JUNE 2016

CONTENT

WELCOME

This is the seventh time that we have held our most important event for customers, Gerresheimer Pharma Days. And it met with vast interest. About 75 participants from all over the USA, Mexico and even Europe met in Chicago and Chicago Heights, IL at the end of May to listen to the presentations, take part in the workshops and network.

One of the highlights of the two-day event was a tour of the completely renovated Chicago Heights production plant which was recently put back into operation. Our guests took a great many interesting and lasting impressions back home with them and gave us some very positive feedback.

It has motivated us to continue the Pharma Days tradition and we will be organizing another event in 2017. This issue of Update provides a summary of Pharma Days 2016, plus a number of insights into the event. We're glad you were able to join us again or for the first time next year!

Jens Kürten
Group Senior Director
Communication & Marketing
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Gerresheimer Pharma Days 2016

On May 25 and 26, 2016 some 75 international pharmaceutical industry customers convened at the Gerresheimer Chicago Heights plant to visit the totally modernized production area and share experiences in a packed program of events. It was the third such event in the US after Peachtree City (GA) and Vineland (NJ).

On the first day a wide variety of presentations and workshops was offered. After the introduction of Roger Kurinsky Gerresheimer CEO Uwe Röhrhoff and Member of the Management Board Andreas Schütte provided some very interesting presentations introducing participants to the Gerresheimer world. While Uwe Röhrhoff gave an overview of our recent strategic adjustments, Andreas Schütte focused on trends in medical systems and plastic packaging. The external keynote speaker Mark Chipperfield, a well-known consultant to the pharma industry shared some insights into the regulatory and design framework for new drugs and drug delivery systems. The presentations were followed by workshop sessions on the latest news and developments with a focus on excellence, quality and innovation in pharmaceutical packaging and medical devices.

The new production area

On the second day of the event the guests were shown around our Primary Glass Packaging plant in Chicago Heights, Illinois, the only plant in the USA manufacturing type I borosilicate glass for moulded pharmaceutical packaging products. In late summer 2015 it not only secured a new furnace, but also underwent extensive conversion and modernization measures. Gerresheimer has made a mid-range double-digit million USD investment in the Chicago Heights plant with the objective of meeting both present and future customer requirements as increasingly stringent standards were introduced. After an introduction by Norman Angel the customers were given detailed insights during the plant tour. Gerresheimer experts provided explanations of the steps involved in the production of moulded glass pharma containers at six stations along the plant.

Summaries of the presentations and workshop reports, as well as numerous photos providing impressions of the two event days, are provided on the following pages.

SUMMARY OF PRESENTATIONS

Conference Chairman:

Roger Kurinsky
Gerresheimer Glass Inc.

Uwe Röhrhoff
Gerresheimer AG,
Chief Executive Officer

Gerresheimer – Global Excellence for the Pharma and Healthcare Industry

Gerresheimer is a global player with more than 40 sites and about 11,000 employees around the world. In 2016 we'll be investing between USD 130 and 140 million in our business. Our recent strategic alignments allow us to better serve our customers' needs. These include investments in US and Czech Republic plants for medical devices and the new plant for vials in India. The Centor acquisition broadens our US portfolio. Centor is the leading manufacturer of plastic packaging for prescription oral drugs in the US market. We have sold our glass tubing facilities in Pisa (Italy) and Vineland (USA) to Corning so that we can focus on our core competence of producing high quality primary packaging made of glass and plastics. A 10-year supply agreement with Corning will cover our glass tube requirements. We are investing in a new generation of vial manufacturing machines at plants around the world to increase quality and standardization for our global customers. The roll-out in the USA and Mexico is almost complete. Now the new machines will be rolled out at the European and Asian plants. We've also made substantial investments in our moulded glass operations. Chicago Heights (USA) sets the industry standard for Type 1 borosilicate glass production. Across all the divisions our quality initiatives, the Gerresheimer Management System (GMS) and our key account management are helping us to create value for our customers.

Andreas Schütte
Gerresheimer AG,
Member of the Management Board with responsibility for Plastics & Devices

Our Global Competence for Customized Medical Systems

The specialty pharmaceuticals market is outpacing the traditional pharma market. Its share of the market is expected to increase from 25% in 2013 to 36% in 2020. Gerresheimer offers a broad portfolio of services and products for the packaging and delivery of these challenging drugs. Our business units Centor and Plastic Packaging provide high quality plastic packaging products. Medical Systems Business Unit develops drug delivery devices in plastic and glass, from initial concept to series production readiness. At our development centers, our Technical Competence Centers, in Peachtree City (USA), Bünde, Münster and Wackersdorf (Germany) and Dongguan City (China), interdisciplinary experts work hand-in-hand to engineer and industrialize custom products. The products are then manufactured at our seven production facilities on three continents. Medical Systems has 50,000 m^2 of clean room facilities and 100,000 m^2 of production facilities. Our syringe portfolio includes a wide range of prefillable Gx RTF® glass syringes and accessories. Our ClearJect® COP syringes are an excellent alternative to glass syringes. The news here is that we are just starting to manufacture prefillable Gx RTF® ClearJect® syringes 1ml long in Europe. Our Plastic Packaging innovations include the MultiShell® and Duma® Twist-off Protect-containers, which offer excellent barrier properties, the Duma® Combi container and the Duma® Twist-off closure with combined CR and TE function, the eco-friendly BioPack container and DropAid for ophthalmic applications. Our objective is to evolve Plastics & Devices from contract manufacturer to full service provider by extending our design, development and filling competences.

Mark A. Chipperfield M.Sc., B.Eng. (Hons)
Corvus Device, Principal Consultant

Pharma, Suppliers and Combination Products

Historically, drugs were drugs and devices were devices. The development focus was on the drug, its use and its interaction with the primary packaging. Now, the trend has shifted towards combination products, driven by factors such as chronic disease becoming more commonplace, as well as higher requirements of economics, specificity and convenience. A very diverse field of device requirements makes the regulatory environment for combination products complex and challenging. The resulting pharma strategies extend from device recommendations, to packaging a general use device with the drug to custom source & provide concepts. In the device development process, the drug, the therapy and the use scenario all have a decisive impact on product design. For example, the project might include the identification of a suitable dosing spoon, or a standalone injection needle (simple systems), through to full design and development of a smart, electromechanical body-worn patch injector (an advanced system). Device development is associated with many challenges for the pharma industry. Often, the need or desire for a device is recognized too late. Systematic design planning with the clear assignment of responsibilities among the pharma companies and device manufacturers, and a risk management plan covering all risks associated with the combination product/process are essential. Above all, the relationship between the pharma company and device manufacturer is key. It shouldn't just be based on formal agreements, but on personal relationships between the teams involved.

TOPIC 1 EXCELLENCE IN AMERICA

Norman Angel
Gerresheimer Primary Packaging Glass

Our Moulded Glass Production in America – A New Dimension of Quality

Gerresheimer has one US moulded glass plant, four European plants and one Indian plant. The US plant in Chicago Heights, Illinois, specializes in pharmaceutical primary packaging products. They range in size from 3 ml single dose containers to 1000 ml bottles. The core product family surrounds the 10 ml to 100 ml containers, particularly high-quality pharmaceutical serum bottles and sulfur treated bottles. Over 150 people work at the plant, which has one oxy-fuel furnace, three lines and manufactures products in type 1 borosilicate flint glass. Chicago Heights is the only facility offering this glass type in the USA. The plant has been upgraded so that it can match tighter market requirements and regulations. A total of more than $30 million has been invested in the project to establish a state-of-the-art manufacturing, infrastructure, inspection, packaging and process control. At the hot end, melting capacity has been increased by 20% with a significant reduction of energy consumption. At the cold end, a new controlled environment for inspection and packaging has been created. The inspection equipment on all manufacturing lines has been modernized and standardized. An additional 'neutral zone' has also been set up as a barrier between the hot end and cold end to minimize particulates. The entire production process is designed to reduce particulates to the minimum with the objectives of improving the quality of the packaged drugs and patient safety.

Bill Torris
Gerresheimer Medical Systems
Technical Competence Center

Development of a Medical Device, Industrialization and Manufacturing

The Technical Competence Centers (TCC) are the "technical heart" of Gerresheimer Medical Systems. The three TCCs in Wackersdorf (Germany), Peachtree City (USA) and Dongguan (China) provide global customers with a full service partner for development and industrialization. By pooling all TCC capabilities we ensure worldwide uniform standards. The TCCs cover all development stages, from initial vision to mass production-ready product in glass or plastic. We have injection moulding machines, in house mould making and in house automation design and build, product finishing capabilities and clean rooms for the production of samples and small production runs. By directly integrating Design for Manufacturing in the product development process, we reduce project lead times, overall costs and project risks. A case study shows how we developed an innovative drug delivery device in less than 8 months, from product concept to clinical trials. Concurrent engineering with the customer made it possible to develop the automation, tooling and facility strategies during the device design process. The resulting device had 7 moulded components, five purchased components and three sub-assemblies. Assembly, printing and packaging systems were also developed. The project was so successful that the customer requested us to mass manufacture the device.

Patrick O'Connell
Centor

Who is Centor – A Profile of the US Pour & Count Prescription Market

Centor is the leading manufacturer of plastic packaging for prescription drugs in the US market. It supplies more than 60,000 dispensing pharmacies in the USA. It also supplies supermarkets and wholesalers throughout the country. Based in Berlin, Ohio, this Gerresheimer Group company has around 200 employees. The primary product families are Screw Loc®, Plastainer® and 1-Clic® vials, round and oval bottles with different closure types and ointment jars. The pour and count prescription packaging for pharmacies is far more economical than unit of use packaging, especially when the filling process is automated. This is why Centor has strategic alliances with manufacturers of robot systems, and it designs its products for optimized filling and labelling on automated lines. One of Centor's special strengths is regulatory compliant products. In particular, its products satisfy child-resistant packaging, low moisture permeation and light transmission requirements. Patients also profit because bottle and vial packaging is far more convenient than blister packaging. For example, the Screw Loc® and 1-Clic® packaging systems are both child-resistant and senior-friendly.

TOPIC 2 PROCESS AND QUALITY INNOVATION IN PRIMARY PACKAGING GLASS

Jim Baldwin
Gerresheimer Primary Packaging Glass

High Quality Injection Vials – The Gerresheimer Global Machine Strategy

The global standardization of technology, quality and training delivers added value to our customers. The first step towards enhancing product quality in the converting process is dynamic length pad control (LPC) a control software that compensates for chuck to chuck length variation for improved length process capability. The Gx® RHOC system provides 100% inline dimensional inspections of the vial lip, base, length and interior diameter. Real-time feedback allows improved process stability. There is an automated inline cosmetic inspection system located in the pack room. Our proprietary Gx® G3 system inspects the vials at three separate stations with five cameras for defects ranging from particulate to scratches and cracks. The high resolution cameras combine bright and dark field inspection. Improved lighting techniques make defects on sulfate treated surfaces or complex geometries such as shoulder or lip more reliably detectable. All data from the Gx® RHOC dimensional gauge and Gx® G3 cosmetic defect inspection is automatically imported into Infinity QS software to assist the Operator in reducing process variability and identify maintenance requirements. Standardized manuals and training content for all technologies ensures that a uniform high level of quality can be achieved worldwide.

Robert Hayes
Gerresheimer Primary Packaging Glass

The Next Generation of Primary Packaging Glass

Today the glass primary packaging market faces more stringent industry and customer requirements than ever before. As a market leader for Pharma packaging one of our challenges is to find ways to increase patient safety and reduce total cost of ownership for our customers. The Pharma Industry quality expectations for primary packaging are also moving beyond normal AQLs and towards various requirements for suppliers to deliver components that will meet ppm and ppb requirements for critical to quality features. One of the solutions that Gerresheimer provides today to meet these requirements is the family of Gx® Elite Glass products which is a Pharma friendly solution for our customers with industry leading features.

Gx® Elite Glass is made of type 1 borosilicate glass with market proven chemistry, so there is no need for our customers to re-file. It is cosmetically flawless and thus JP compliant, it has 2x–3x standard type 1 glass strength and is dimensionally superior. This level of product quality is achieved by the elimination and removal of identified systemic flaws and their sources in the production process beginning at the point of manufacture of the tubing and all the way through the final packaging process.

Gerresheimer supports this precision manufacturing process with proprietary converting technology and best in class inspection technology that will perform 100% verification for each piece of glass. The Gx® RHOC (robotic handling on conveyor) system inspects all critical to quality dimensional features and the Gx® G3 (Gerresheimer generation three) camera system identifies cosmetic defects. Another important consideration for pharma companies is that Gx® Elite Glass reduces the propensity of delamination in vials. Our Gx® THOR process ensures that the vials are produced with an optimum temperature profile to prevent delamination in the critical areas of the converting process. Vials produced with Gx® THOR technology comply with USP 1660 and Gx® FLASH test requirements. Gx® Elite Glass is offered with the option for a customer CoA and will be supported with an electronic batch file record using a data collection system that is compliant with 21 CFR Part 11 requirements.

Brad Boersen
Corning Inc.

Leveraging the Corning / Gerresheimer Relationship to Spark Innovation

Reflecting its business strategy focus on pharmaceutical packaging products, Gerresheimer sold its glass tubing business to Corning in 2015. The transaction included a 10-year LTSA to fulfil Gerresheimer's converting needs. In addition, an equity venture (75% Corning-owned) was formed to accelerate innovative packaging solutions. Corning Incorporated of Corning, New York (USA) is a world-leading innovator in materials science, with over 165 years of unparalleled expertise in specialty glass, ceramics, and optical physics. Corning has enabled pharmaceutical R&D for more than 60 years, and supplies products for all phases of biologics production. The new equity venture unites Corning's deep material understanding with Gerresheimer's superior glass forming expertise to develop innovative solutions that address industry challenges. The equity venture is working on projects to resolve glass container limitations such as lamellae formation, particulate generation, damage, breakage and operational inefficiencies. Evaluations of product performance on filling lines have demonstrated that the innovations improve quality. Many customers, including branded, generic and biotech companies, are currently evaluating Corning innovations.

TOPIC 3 INNOVATION IN PLASTICS & DEVICES

Dr. Wolfgang Dirk
Gerresheimer Plastic Packaging

Innovation in High Quality Primary Packaging

The Gerresheimer Plastic Packaging product range includes containers for solid-dose, ophthalmic and nasal applications, vials for parenterals as well as PET and PP bottles. We believe it is very important to collaborate closely with our customers in the development of plastic packaging and to listen to them in terms of what they really need. For example, an increasing number of people are self-medicating. Some of these will get their prescription drugs in very

Continuation
Dr. Wolfgang Dirk

simple tablet bottles, like the ones everyone has in their first-aid cabinet. But if the prescription drug is a pain-killer for someone with arthritis, the container has to be easy to open because people with arthritis tend to have limited movement and strength in their hands. So the bottle and lid have to be designed with this in mind. We've developed a closure that's both senior-friendly and child safe. It means that grandmas can take their medication without having to ask anyone to open the bottle and, at the same time, they know their small grandchildren are safe. To take another example, many people suffer from dry eyes, but just as many people find it difficult to administer eye drops. We now offer a device that helps people to optimally position the eye drop bottle above the eye so that the drops actually end up where they should. There are many more examples which show that packaging performs many important functions in protecting medicines like i.e. our recently developed Duma Twist-Off Protect container with a multilayer structure for improved gas and moisture protection of sensitive tablets or capsules. Our solutions contribute to the quality, handling, and appearance of pharmaceuticals.

Linking Injection System Selection to Drug Delivery Strategies

Karen Kanyok / Claudia Petersen
Gerresheimer Medical Systems

In 2015 a total of around 3 billion prefillable syringes were sold, two-thirds of those with staked-in needles. The key markets are Europe, the USA and China. The main applications are the administration of heparins, vaccines, biotech and ophthalmic drugs. Customers expect prefillable syringes to have high biocompatibility, be safe for end-users, be compatible with devices such as auto-injectors and to offer a low total cost of ownership. We ensure end-user safety with proprietary systems such as the Gx TELC® luer lock system. Gx Baked-on RTF® siliconization offers a high level of biocompatibility by significantly reducing the volume of silicone oil particles. Tungsten residue inside syringes to be used for sensitive drugs can be significantly reduced using a washing process after glass forming or entirely eliminated in an optimized forming process with ceramic pins. Continuous process improvements and state-of-the art proprietary Gx® G3 camera systems will guarantee low cosmetic defects and thereby optimize total cost of ownership. Demanding and sensitive drugs can alternatively be packaged in COP ClearJect® syringes of different sizes and types rather than glass syringes. We offer the ClearJect® product portfolio in collaboration with our Japanese partner Taisei Kako since many years and are happy to announce the extension of this collaboration through the launch of the 1ml long SIN Gx RTF® Clearject® syringe which will be manufactured in Europe by ourselves.

Usability of Drug Delivery Devices

Jessica Kreher
Gerresheimer Medical Systems

Usability engineering has become increasingly important as a result of the higher complexity of drug delivery devices nowadays and their use by a wide range of users from healthcare professional to users with only limited training. The user-centered design process begins with an analysis of intended use, the context of use and potential hazards, proceeds with functional and esthetical product design and ends with the summative evaluation.

One method to increase the usability of a device even before starting the actual development is shown in the presentation with the example of a capsule inhaler. It is done via a task analysis, where foreseeable hazards can be identified step by step and mitigations can be included in the design input requirement specification where needed. This input will be part of the user requirements that designers need to start with the technical device development.

For example, one sub-task a user will have to do is opening the cap of the device. If he cannot open the device, he will not be able to inhale, so as a consequence there will be no dose delivered. As this is considered to be critical, there must be a requirement for opening the cap, such as "The cap of the device must be easy to open, even for users with limited dexterity." In the development activities later on, the designer will for example implement a grip feature on the cap to meet this specific requirement. By repeating this for every sub-task or function of the device, the presented method can be a very useful approach for complementing your design input (user) requirement specification and therefore improving the usability of your device.

Generally, usability engineering should be started in the device development process as early as possible and needs to be integrated into risk management in order to achieve optimal results and be compliant to the regulatory standards.

CHICAGO HEIGHTS

World-class quality

The Chicago Heights plant in the USA

The Chicago Heights plant, which has been part of the Gerresheimer Group since 1999, installed a brand new furnace in 2015. It closed for 2 months in July and August to also implement an extensive conversion and modernization program. The plant's production operations have recommenced with new maximized quality, efficiency and environmental standards as a result of investments in the best-available production and inspection technology, and infrastructure optimization.

The improvements predominantly affect the following aspects of the production process:

- Batch mixing and delivery
- Melting and bottle forming
- Inspection and packaging
- Supporting infrastructure (e.g. compressed air, gas, oxygen delivery, power supply)

The entire conversion and renovation process focused on particulate reduction. Maximizing hygiene standards is the number one priority in eliminating particulate and preventing patients from being harmed by a contaminated glass bottle.

Hot end:
New furnace and increased capacity

Both the furnace and the steel base underneath the furnace have been replaced. The new furnace has a 20% higher capacity and significantly lower energy consumption per tonne of glass. Raw material supply and batch house automation, plus modern furnace control systems, have significantly improved efficiency at the hot end.

Two of the three production lines are new; the third line underwent a general overhaul. Two IS (individual section) machines now operate with a triple gob technology. The additional cavities that have been installed significantly increase the production output and modern camera systems perform dimensional and visual inspections for early detection of non-conformities and defective products. The compressed air supply unit near the IS machines has been completely replaced. All production lines have new and larger annealing ovens, and the annealing oven on the third line was given a general overhaul. Finally, cullet from the hot end is now conveyed to a brand new quench tank.

CHICAGO HEIGHTS

Cold end:
Extensive modernization of inspection and packaging technology

The higher production output after the conversions made a cold end redesign and upgrade necessary. All inspections and packaging operations now take place in controlled environments and all the in-line inspection systems have been modernized and standardized. The Safe Pack technology has been upgraded so that larger containers can also be thermosealed. A new layout for the cold end has also reduced the number of actions involved in the packaging process.

Mission
particulate reduction

The USA's FDA (Food and Drug Administration) is strongly committed to eliminating particulate in injectable drugs to improve patient safety. Our customers in the pharmaceutical industry contribute to particulate reduction in their section of the supply chain, which involves washing, filling and sealing, whereas our efforts are focused on manufacturing particulate-free glass packaging. So the Chicago Heights upgrade and conversion project aimed to re-engineer the plant to satisfy even the strictest particulate requirements. The project also saw the introduction of innovative and patented technology at the Chicago Heights plant. Moreover, optimizing furnace, feeder and mold cleaning processes and the use of different materials have significantly reduced particulate contamination. State-of-the-art inspection systems also check the glass products for contamination and reject the ones that aren't up to standard before they are delivered to the customer.

Mission
conserving resources

Resource conservation and responsibility towards the environment played an important role in the conversion of the Chicago Heights plant. We've have been involved in the Carbon Disclosure Project for seven years now. The goal is to reduce the ratio of CO_2 emissions to revenues. State-of-the-art melting technology has allowed the Chicago Heights plant to substantially reduce energy consumption and CO_2 emissions per tonne of molten glass. Also, the new IS machines and annealing kilns operate considerably more efficiently, and the new compressed air supply units ensure that less resources are needed.

FACTS & FIGURES

PRODUCT PORTFOLIO

Core segment
Pharmaceutical glass packaging

Product range
From 3ml single-dose vials for injectable drugs to 1 liter glass bottles. Core sizes are 10 ml, 20 ml, 30 ml, 50 ml and 100 ml.

Specialty
High-quality pharmaceutical serum bottles

TECHNICAL DATA

- Furnace: 1
- Lines: 3
- Color: flint
- Type: type 1
- USP, EP & JP standards
- Sulfur treatment, EP
- Controlled environment at the cold end (inspection and packaging)
- In-house mould design and mould shop
- Safe Pack technology
- ISO 9001:2008

Gerresheimer Moulded Glass – Global Presence

Core products

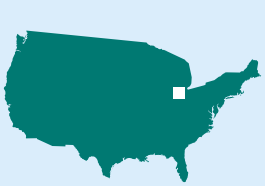
Bottles
Flacons
Jars

Segments

Pharmaceuticals
Fragrances & Cosmetics
Food & Beverage

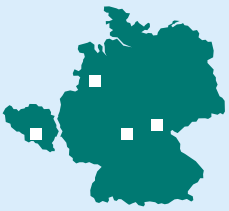
Plants

Europe: 4 (8 furnaces)
USA: 1 (1 furnace)
India: 1 (4 furnaces)



Moulded Glass US

- **Chicago, IL**
  Bottles, jars



Moulded Glass Europe

- **Momignies, Belgium**
  Flacons, cosmetic jars
- **Tettau, Germany**
  Flacons, cosmetic jars
- **Essen, Germany**
  Bottles, jars
- **Lohr, Germany**
  Bottles, jars

Moulded Glass India

- **Kosamba**
  Bottles

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