MEDICAL PLASTICS

MPD NEWSLETTER

JUNE 2015

LETTER FROM THE CHAIR

Hello Fellow Member of the Medical Plastics Division:
The Medical Plastics Division had an exciting and fruitful year which culminated at ANTEC 2015 in Orlando, FL at the end of March. The primary purpose of ANTEC has always been the technical presentations and Pierre Moulinie deserves resounding applause for the excellent program he assembled this year. We had three sessions which consisted of 14 papers and two keynote speakers. The MPD presented two awards, one for Best Paper to **Daniel Kaltbeitzel** and one for Best Presentation to **Conor Flavin**.

There were five members inducted as Fellows of the SPE at the Awards luncheon this year. Two of those members, Len Czuba and Maureen Reitman, were nominated and sponsored by the Medical Plastics Division. With the hard work of selected Board members, MPD was successful in having Len and Maureen recognized as Fellows of the Society. Our congratulations go to them.

Other accomplishments of MPD included the approval of bylaws for our Division by the membership at large. The bylaws describe the roles and responsibilities of the officers and the committees within the MPD in writing, so that it may be easier for people in the future to understand how the Board works and to encourage them to participate. In addition, the MPD received the Pinnacle Gold award and the Communications award from SPE.

The Medical Plastics Division made a donation to the Syracuse Museum of Plastic History in the name of Patsy Beall to honor her memory and donated $2500 to the SPE Student Activities Committee.

Division elections filled five positions on the MPD Board of Directors, with returning members Ali Ashter, Mark Bonifacio, Margie Hanna, Maureen Reitman, and new member Bob Herman. Len Czuba was elected Councilor for the Medical Plastics Division, replacing Margie Hanna who had served as Councilor for the previous six years.

SPE has rolled out The Chain, a new networking tool exclusively for SPE members. Check it out.

MPD will work on improving communication with it members and developing technical conferences in collaboration with regional sections, not to mention planning for next year's ANTEC 2016 in Indianapolis.

I look forward to 2015-2016 with anticipation of renewed energy and enthusiasm from all members of the Medical Plastics Division.

Norris M. Tollefson

In This Edition…

AND THE AWARD GOES TO…

This year, the Medical Plastics Division board handed out awards for best paper and best presentation at ANTEC. Daniel Kaltbeitzel won best paper for his work titled "Degradation of Microcellular PLGA-PEG Copolymer for Use in a Drug Delivery System for the Urinary Bladder." To read Daniel's paper, click here. Conor Flavin received the Best Presentation Award for his talks titled "Tuning the Micro-Architecture of Polymer/Bioceramic Scaffolds for Bone Tissue Engineering" and "Controlling the Architecture of Tissue Engineering Scaffolds in Extrusion-Based Additive Manufacturing: The Effect of Extrudate Swell." Congratulations to Conor and Daniel.

Conor Flavin with his Best Presentation Award

We would like to congratulate Maureen Reitman and Len Czuba on becoming Fellows of the Society during a ceremony at ANTEC 2015. The honor of becoming a Fellow was established in 1984 to recognize Society members who have made outstanding contributions in plastics science, engineering or management. In that time, only 309 members have become fellows. Please join us in congratulating Maureen and Len on their accomplishment and thanking them for their service to the Medical Plastics Division and SPE as a whole.

Also at ANTEC this year, the Medical Plastics Division received the Gold Pinnacle Award. The Pinnacle award program, established in 2005, recognizes Sections and Divisions that successfully create and deliver member value through technical programming, membership, and communication. In addition to the Pinnacle Award, MPD also received the Communication Excellence Award, which is awarded to Sections, Divisions, and Special Interest Groups that implement effective communication practices. Thank you to all who volunteer for the Medical Plastics Division and made these awards possible.

TECHNOLOGY AND NEWS

In order to bring content to the newsletter that is current and informative, we have partnered with Med Device Online, a source for breaking news, analysis and resources for the medical device industry. With this partnership, we will be able to link you directly to articles that touch the world of medical plastics. In this Newsletter, our feature article is from the Medical Plastics Matters series written by our very own Len Czuba.

SELECTING THE RIGHT MEDICAL PLASTICS TO COMBAT HOSPITAL-ACQUIRED INFECTIONS (HAIS)

By Len Czuba, President, Czuba Enterprises, Inc.

A Widespread Problem

It seems that everyone in healthcare is talking about how hospital-acquired infections — also called healthcare-associated infections, or HAIs — are a growing concern in the industry. Whether the cause is reduced staffing in hospitals (resulting in less time for healthcare workers to thoroughly disinfect between patient visits), the increasing resistance of certain pathogens to current sterilization procedures, or any of a dozen other reasons, this problem continues to affect our customers, i.e., patients needing healthcare.

According to a recent study by the Centers for Disease Control and Prevention, more than 722,000 cases of HAIs were reported in U.S. acute care hospitals in 2011. About 75,000 patients with HAIs died during their hospitalization, the CDC found. In addition, the added cost of treatment for patients who fall ill to HAIs represents a preventable burden to our healthcare system.

If we examine why our industry so readily adopted the use of plastic medical devices when they first were developed, we can see the features that made these products attractive: cleanliness, sterility, convenience, ease of use, and low cost. In and of itself, the use of plastic medical devices helps caregivers to control the HAI problem. But our industry is being asked to do more in controlling and reducing infections, and one way to help improve outcomes is through the use of antimicrobial plastics in the construction of various medical devices…

To see the full article at Med Device Online, follow this link.

Five Trends Transforming The Medical Device Industry In 2015

By MasterControl

Brace yourself for another year of opportunities and challenges in the medical device industry. For 2014, we predicted that longer life expectancies, emerging markets, increased regulatory scrutiny, and health care reform would drive industry change. As we move into 2015, we see many of those trends continuing to evolve, and some exciting new trends emerging.

For additional articles and content on medical device news, visit www.meddeviceonline.com

MED DEVICE ONLINE

The CHAIN

Where Plastics Professionals Conn

The Chain is SPE's new social media site for creating professional connections and facilitating collaborative problem solving among the plastics engineering community. Check out the content that is available by going to thechain.4spe.org. The communications team will be utilizing the chain to push additional content to Medical Plastics Division members. We look forward to developing this space into a useful resource for our members. In addition to division specific pages, there are five main forums at The Chain:

1. **Tech Talk** is where plastics professionals come together from around the world to discuss the latest technical issues and innovations within the marketplace.
2. In the **SPE Café**, engage in a wide range of topics a little on the lighter side and outside the normal technical jargon.
3. **Career Central** is a good place to check out if you are looking for new opportunities. You can browse job listings and the resume database to find the perfect fit for you.
4. For student members, **Campus Connection** offers an exclusive online community to ask questions and provide answers to hot topics of interest for today's engineering students.

We look forward to seeing you at **The Chain**!

CAREER CORNER

Career Corner is a new section of our newsletter that will be dedicated space for employers to post career opportunities that will reach the 1,000+ members of the Medical Plastics Division. If you are an employer and would like to use the newsletter to get the word out on potential career opportunities, please contact Jordan Freedman at mailto:jhfreedm@yahoo.com.

SOLVAY asking more from chemistry® | Plastics

Technical Marketing Engineer, Aromatics

Solvay Specialty Polymers is looking for an experienced Technical Marketing Engineer to support our aromatic polymers business lines. The Technical Marketing Engineer will be responsible for providing technical support and services to customers and the internal organization (R&D, Manufacturing). Primary markets supported in that role will be Healthcare and UltraPolymers markets, with possible involvement in some activities to support other fields (Mobile Electronics, Automotive, Aerospace and Industrial).
See the full description here. If you are interested in the position, contact Dane Waund at mailto:dane.waund@solvay.com.

EVENTS CALENDAR

ANTEC Dubai	Jan 12-13, 2016
MD&M West	Feb 9-11, 2016
Polyolefins Conference	Feb 21-24, 2016
MINITEC-Charlotte	Spring, 2016
ANTEC 2016, Indianapolis	May 23-25, 2016
MINITEC-Minneapolis	Fall, 2016

If you are interested in promoting your event or webinar in the MPD newsletter, please send an email to mailto:jhfreedm@yahoo.com.

COMMUNICATION TEAM NOTES….

We hope you enjoyed this June issue of the MPD Newsletter! We are looking forward to getting more involved with The Chain and passing more information through that media channel in this next quarter. Be on the lookout for information about The Chain and we encourage you to get involved! Until next time, Happy Reading!

MPD Communications Team

MEDICAL PLASTICS BOARD OF DIRECTORS

The volunteers that make up the Board of Directors are listed below, along with their contact information. We appreciate all our volunteers and we thank you for your involvement in the Medical Plastics Division of SPE. If you are interested in participating or would like more information, please reach out to anyone on the board. We look forward to hearing from you!

Name	Position	email
Norris M. Tollefson	**Chair**	norris.tollefson@alcon.com
Mark Bonifacio	Past **Chair**	mark@bonifacioconsulting.com
Ben Poon	Secretary	benjamin.poon@baxter.com
Austin Coffey	EU Rep.	austin.coffey@gmail.com
Pierre Mouline	Tech. Program Com.* **Chair**	pierre.moulinie@bayer.com
John Thomas		johnt@bonifacioconsulting.com
Lorie Lodico	Communications Com.	lorie.lodico@gmail.com
Glenn L. Beall	Historian	glennbeallplas@msn.com
Ali Ashter	Treasurer/Finance Com./Tech. Program Com.	ashter2000@gmail.com
Len Czuba	Councilor/Finance Com./Tech. Program Com.	lczuba@aol.com
Margie Hanna	Finance Com.	m_hanna@yahoo.com
Steve McCarthy	Finance Com. **Chair**	stephen_mccarthy@uml.edu
Michael Wallick	Awards Com. **Chair**	mwallick@invibio.com
Jordan Freedman	Communications Com. **Chair**	jordan.freedman@biomet.com
Maureen Reitman	Tech. Program Com./Awards Com.	mreitman@exponent.com
Ed Fewkes	Membership Com. **Chair**	fewkesej@corning.com
Harrison Yu	Awards Com.	harrisonyu@comcast.net
Kathy Schacht	SPE Liaison	kschacht@4spe.org
James Madenjian		jmplastics@aol.com
Vipul Dave		vdave1@its.jnj.com
Nitin Soon	Communications Com.	Sood_nitink@yahoo.com
Bob Herman	Education Com. **Chair**	quarkreh1@gmail.com

*Com. Is shorthand for Committee.

MEDICAL PLASTICS BEST PAPER—ANTEC 2015

DEGRADATION OF MICROCELLULAR PLGA-PEG COPOLYMER FOR USE IN A DRUG DELIVERY SYSTEM FOR THE URINARY BLADDER

Christian Hopmann, Daniel Kaltbeitzel, Theresa Kauth, Institute of Plastics Processing at RWTH Aachen University (IKV), Aachen, Germany
Barbara Dittrich, DWI at RWTH Aachen, Aachen, Germany
Joachim Grosse, Nadine Huppertz, Department of Urology at University Hospital Aachen, Aachen, Germany
Ulrich Schwantes, Claudia Neumeister, Dr. Pfleger GmbH, Bamberg, Germany
Matthias von Walter, Hemoteq AG, Würselen, Germany

Abstract

For the treatment of diseases of the bladder a drug delivery system (DDS) has been developed which can be applied intravesically. The DDS is composed of multiple carriers that consist of non-absorbable, drug-carrying microspheres which are embedded in a foamed absorbable matrix. After degradation of the absorbable matrix, the non-absorbable microspheres are eliminated through the urethra.

The foamed absorbable matrix is fabricated out of a poly(D,L-lactide-co-glycolide)-co-polyethylen glycol diblock copolymers due to its short degradation time. These polymers are temperature sensitive and therefore manufactured by the CESP process (Controlled Expansion of Saturated Polymers). The foam structure, which influences the degradation, is controlled by the process parameters.

Within this paper the influence of the process parameters on the degradation of the implants is investigated.

Introduction

The overactive bladder syndrome (OAB) is a symptom complex which is defined by the International Continence Society (ICS) as urinary urgency even when the bladder is not completely filled (51 % of the cases) combined with or without involuntary urinary loss and frequent urination of more than 8 times during day time and 2 times at night (86 % of the cases) [1, 2]. In population-based studies, OAB prevalence rates range from 7 % to 27 % in men, and 9 % to 43 % in women [3].

The OAB is treated with anticholinergic agents [4]. Anticholinergic agents affect the human body by inhibiting specific receptors, which is supposed to suppress the permanent or sudden urge to urinate. Usually the agents for the treatment of OAB are given orally, but the large number of side effects of the anticholinergic agents is a severe problem. By taking the anticholinergic agents orally the agents are distributed over the disgestive tract and the bloodstream to the whole organism. Therefore, the agents do not only inhibit the receptors of the bladder but also affect other receptors of the organism. This causes many side effects like mouth dryness, digestive disorder, impaired vision, depression or dizziness [5, 6]. For that reason 70 % of the patients abandon the therapy and accept the unpleasant afflictions of the OAB instead, since the side effects overburden the patient [7].

By applying the agent intravesically, the side effects can be minimized significantly [4]. During intravesical medication the agent is applied to the bladder via a catheter through the urethra. Therefore, it is necessary to insert the catheter daily (possibly even several times a day) to administer the agent, which is dissolved in sodium chloride solution. Because of the catheterization most of the patients do not choose this type of medication though the side effects are minor.

Due to the unsatisfactory therapy options a DDS is developed by a consortium of different companies and research facilities (Dr. R. Pfleger GmbH, Bamberg, Germany, DWI at RWTH Aachen, Aachen, Germany, Institute of Plastics Processing (IKV) at RWTH Aachen, Aachen, Germany, Department of Urology at University Hospital Aachen (UKA), Aachen, Germany and Hemoteq AG, Würselen, Germany). The DDS, which releases the anticholinergic agent trospium chloride, can be applied into the bladder through the urethra. It is composed of multiple carriers that consist of non-absorbable, drug-carrying microspheres which are embedded in an absorbable matrix. After degradation of the absorbable matrix, the non-absorbable microspheres are eliminated through the urethra. The approach focuses on a continuous drug release out of the microspheres and an elimination of the DDS after less than 4 weeks to avoid side effects like incrustation due to salt deposition.

The design of the implant and its application is shown in Figure 1.

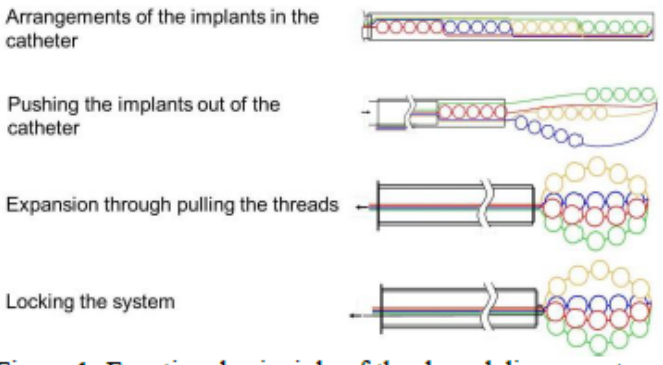

Figure 1: Functional principle of the drug delivery system composed of multiple implants which are connected flexible with each other by means of an absorbable suture.

The DDS consists of multiple carriers (spheres or pills) which are connected flexibly with each other through an absorbable suture. The implants are arranged in a way that they can be expanded in the bladder after insertion through the urethra via a catheter. Due to the change in shape it stays safely in the bladder [8].

Materials

The absorbable matrix is fabricated out of Resomer RGP d5055 (Evonik Industries AG, Essen, Germany), which is a poly-D, L-lactide-co-glycolide-co-polyethylene glycol (PLGA-PEG). The material was chosen due to its short degradation time (3 - 5 weeks). The material has a PEG ratio of 3 - 7 % [9]. The inherent viscosity (25 °C, 0.1 %, $CHCl_3$) is 0.93 dl/g and was specified by the manufacturer. The glass transition temperature of the polymer is T_G = 38.7 °C [10].

Instead of trospium chloride, the microspheres are loaded with barium sulfate, which enables the analysis of the microstructure with a micro-computer tomography scanner (µCT). Polydimethylsiloxane (PDMS) is used for encapsulation of the agent. The size of the microspheres is up to 30 µm.

Methods

Barium sulfate is embedded in the microspheres using a modified solvent evaporation process [11] at DWI at RWTH Aachen.

Due to their temperature sensitivity of the polymer and the agent, the materials are processed in the CESP process (Controlled Expansion of Saturated Polymers) [12]. With the CESP-process polymers can be processed to a foamed part at low temperatures. Therefore, temperature sensitive materials like absorbable polymers or active agents can be processed without loss of their properties (Figure 2).

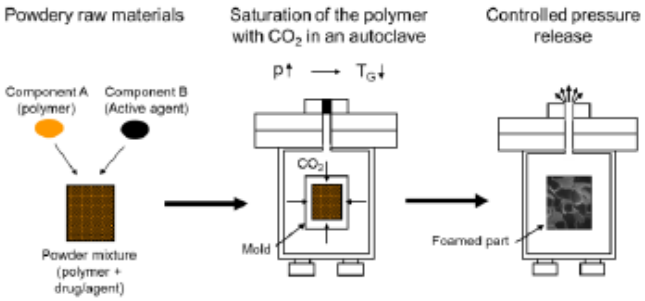

Figure 2: Schematic diagram of the CESP process.

Within the process the powdery polymer is first mixed with microspheres with a weight ratio of 2 : 1. The mixture is then filled into a mold by a gravimetric dosing unit. Two different cavities are used, a spherical cavity with a diameter of 2.4 mm and a pill-shaped cavity with the same diameter and a length of 4 mm. For the spheres 3 mg and for the pills 5 mg of the mixture are filled into the cavities. The filled mold is then exposed to a carbon dioxide atmosphere under high pressure in an autoclave. Through the absorption of the carbon dioxide into the polymer the cohesive forces between the molecules are reduced so that the polymer is in a foamable state at low temperatures. As soon as the saturation of the polymer with carbon dioxide occurs the pressure in the autoclave is released. Hence the occurring oversaturation of the polymer with carbon dioxide leads to a foaming of the polymer and enables the shaping under reproducible conditions. The processing parameters pressure, temperature, pressure release gradient and saturation time influence the structure of the resulting foam [13]. The processing parameters are varied according Table 1. Saturation time is 30 minutes for all specimens. For each parameter set three specimens are investigated.

Table 1: Processing parameters for Resomer RGP d5055 mixed with microspheres

Temperature [°C]	Pressure [bar]	Pressure release gradient [bar/min]
55	50	5
65	100	20
75	150	100

Figure 3 shows an example of the DDS and a µCT-scan of one implant.

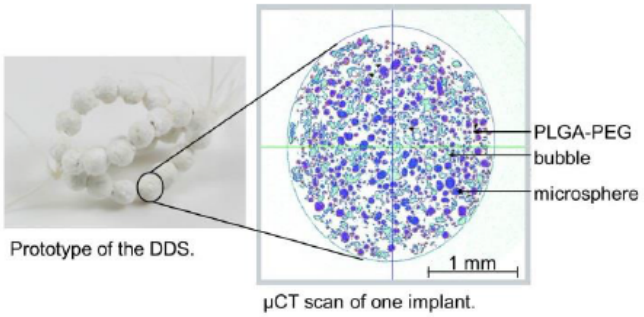

Figure 3: Prototype of the DDS (left) and µCT scan of one implant that consists of non-absorbable, drug-carrying microspheres which are embedded in an absorbable matrix.

The specimens are incubated individually in 5 ml artificial urine up to 27 days. The wet specimens are reweighed and the fluid is exchanged every three days. Furthermore, the pH value is measured. In case of breakage of the specimens, the experiment is continued with the bigger fragment. Total degradation of the specimen is noted with a weight of 0 mg. The specimens are weighed dry before incubation and after incubation and desiccation with silica gel and vacuum. For comparison of the specimens, the relative weight shift compared to the initial weight is used.

For statistical analysis of the influence of the process parameters on the degradation, the software Statistica (StatSoft GmbH, Hamburg, Germany) is used.

An optical microscope is used for characterization of the foam structure. The specimens are embedded in epoxide resin and cut into slices with a thickness of 50 µm by means of a microtome. For analysis the colored images are converted into binary images.

Results

The initial weight of the spheres is between 1.97 mg and 3.81 mg and of the pills is in the range of 3.94 mg and 5.37 mg. The specimens first float in the artificial urine and sink to the ground of the vessel between the first and the second week of incubation. Breakage of several specimens is observed between 14 and 27 days. Table 2 shows the parameter sets of specimens that totally dissolved within 27 days. The saturation pressure is at the lowest value investigated whereas the temperature and the release gradient of the pills demonstrate the initial point of the research plan. The release gradient of the spheres is the slowest pressure release investigated.

Table 2: CESP-parameter sets of total dissolution

Type	Temperature [°C]	Pressure [bar]	Pressure release gradient [bar/min]
sphere	65	50	5
pill	65	50	20

Figure 4 and Figure 5 show the relative weight of the specimens manufactured at 50 bar. During the first days the weight increases and starts decreasing after two weeks for the specimens produced at 50 bar and after three weeks for the specimens produced at 100 bar and 150 bar (Figure 6 - 9). The fastest degradation is observed with spheres manufactured at 65 °C, 50 bar and 5 bar/min (Δm_{Max} = -100 %) and pills manufactured at 65 °C, 50 bar and 20 bar/min (Δm_{Max} = -100 %). Least weight loss is observed with spheres manufactured at 55 °C, 100 bar and 100 bar/min (Δm_{Min} = +22.22 %) and pills manufactured at 55 °C, 100 bar and 100 bar/min (Δm_{Min} = -19.84 %).

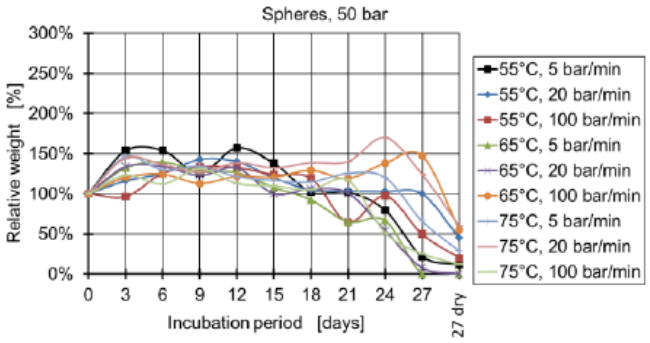

Figure 4: Relative weight of spheres manufactured at 50 bar.

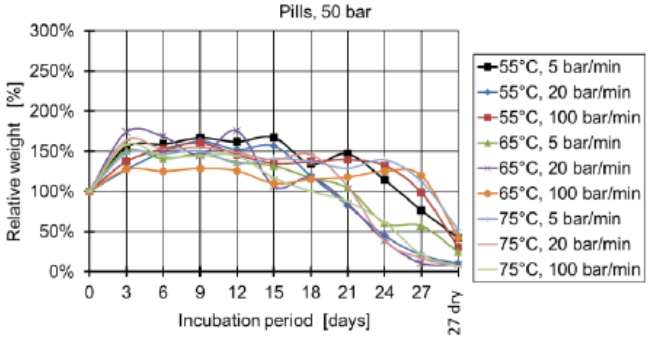

Figure 5: Relative weight of pills manufactured at 50 bar.

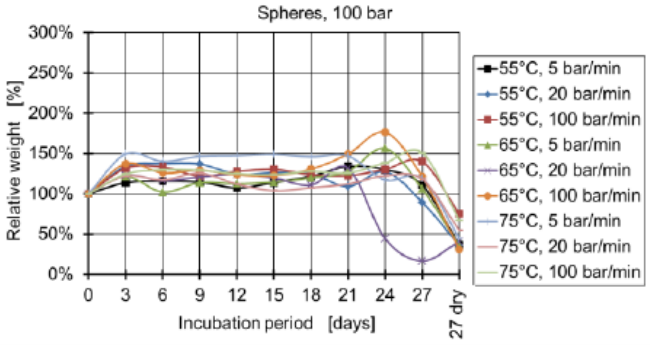

Figure 6: Relative weight of spheres manufactured at 100 bar.

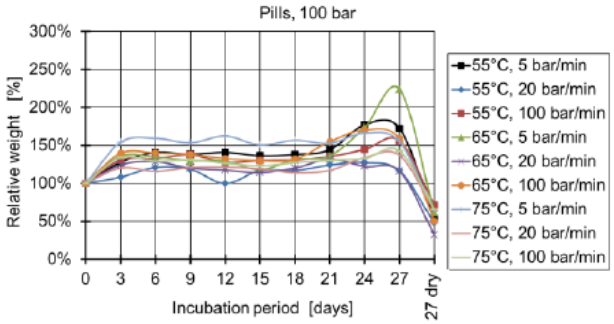

Figure 7: Relative weight of pills manufactured at 100 bar.

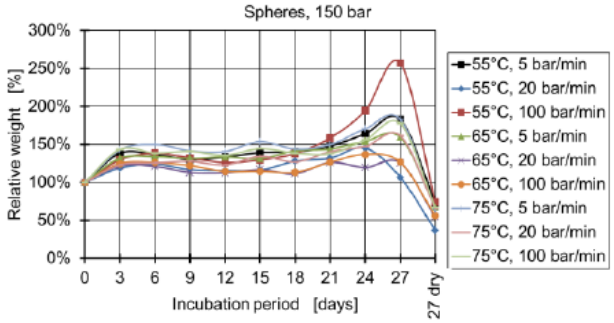

Figure 8: Relative weight of spheres manufactured at 150 bar.

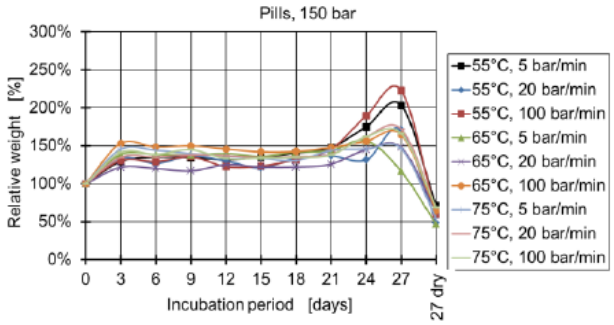

Figure 9: Relative weight of pills manufactured at 150 bar.

Microscopic analysis shows, that the average pore area is 1985.5 μm^2 for the faster degrading spheres (T = 65 °C, p = 50 bar, Δp = 5 bar/min) and 3812.7 μm^2 for the faster degrading pills (T = 65 °C, p = 50 bar, Δp = 20 bar/min). The average pore size of the slower degrading spheres (T = 55 °C, p = 100 bar, Δp = 100 bar/min) is 1873.9 μm^2 and of the slower degrading pills (T = 55 °C, p = 100 bar, Δp = 100 bar/min) is 2386.3 μm^2. The porosity is the ratio between the pore area and the sample area. The faster degrading specimens have a higher porosity than the slower degrading specimens.

The pressure has the main influence on the degradation of the specimens, when statistical analysis is conducted. A lower processing pressure leads to a lower final weight after 27 days of incubation. Regarding the processing temperatures, a temperature of 65 °C results for both types of specimens, spheres and pills in the lowest weights whereas 55 °C and 75 °C lead to higher final weights. The influence of the pressure release, however, is different for the spheres and pills. The lowest weights of spheres are observed with a pressure release of 5 bar/min closely followed by the 20 bar/min. The lowest weights of pills are observed at a pressure release of 20 bar/min. A clear reciprocal effect is observed with the pressure release and the temperature for the spheres. The manufacturing of spheres at 75 °C and 20 bar/min result in a high final weight of the specimens (less degradation).

Discussion

For the development of a DDS for the urinary bladder, the degradation and excretion of the implant within four weeks is crucial. Otherwise, incrustations due to salt depositions might lead to complications.

The degradation of the examined material PLGA-PEG is dominated by hydrolysis. The urine is first absorbed by the polymer and then hydrolysis starts [13]. Accumulating decomposition products have a catalytic effect on the hydrolysis. During this process on the one hand, water molecules are absorbed by the implant and water diffuses into the implant and on the other hand, degradation products diffuse out of the implant following the concentration gradient. With compact materials, this leads to an accelerated degradation in the center of the implant, which finally leads to a sudden breakage of the implant with a sudden release of the acid degradation products [13]. Considering a microcellular material, the diffusion path of the decomposition products is shorter and the degradation products can accumulate in the pores. Therefore, degradation is slower and a continuous degradation starting from the surface is promoted [13].

The influence of the CESP parameters on the morphology of the resulting foam of PDLLA was already described by *Pfannschmidt* [13]. He found, that the pressure has the main influence on the pore size. At higher pressures (130 bar) smaller pores are generated (average pore diameter of 40 µm, T = 41 °C) and at lower pressures (60 bar) bigger pores arise (average pore diameter 230 µm, T = 41 °C). Furthermore, at higher temperatures (T = 60 °C) bigger pores are generated (average pore diameter of 75 µm, p = 130 bar), but the influence of the temperature is minor. *Pfannschmidt* also investigated the influence of the foam structure on the degradation of the material. Specimens with an average pore diameter of 25 µm have a linear molecular weight reduction, whereas specimens with an average pore diameter of 75 µm first degrade slower and then faster than the specimens with smaller pores. The final molecular weights of the considered specimens are the same. The results within this paper confirm the influence of the microcellular structure of the specimens on their degradation. It was shown, that a bigger pore area and a higher porosity lead to a faster

degradation of the specimens. It is also confirmed, that the pressure has the main influence on the resulting pore structure and the degradation, respectively.

The reason for sinking of the specimens during incubation is most likely the fluid that is soaked by the specimens. The density of the soaked specimen is higher than the density of the artificial urine. This theory also fits to the observed initial increase of the weight. An explanation for the constant weight after the initial increase might be a parallel degradation of the polymer during diffusion of fluid into the foam. This leads to a decrease of the polymer mass which is not measured due to the fluid infiltration. Furthermore, the weight increase observed with single specimens might be due to deposition of salt crystals from the artificial urine in the specimens and inhomogeneous infiltration of fluid.

Conclusions

Degradation of PLGA-PEG implants is influenced by their microstructure, which can be set by the process parameters pressure, temperature and pressure release gradient of the CESP process. Spheres produced at 65 °C, 50 bar and 5 bar/min and pills produced at 65 °C, 50 bar and 20 bar/min degrade completely within four weeks. Due to their bigger volume, pills can be loaded with more microspheres. Therefore, pills are chosen for production of specimens for further investigations.

The development of the DDS is currently continued by means of optimizing the drug release and the application of the DDS into the bladder.

The investigations set out in this report received financial support from the *German Bundesministerium für Bildung und Forschung* (No. 13N11306), to whom we extend our thanks.

References

1. I. Milsom, P. Abrams, L. Cardozo, R.G. Roberts, J. Thüroff, and A.J. Wein, *How widespread are the symptoms of an overactive bladder and how are they managed? A population-based prevalence study* BJU International **87** (2001) 9, p. 760-766
2. P. Abrams, L. Cardozo, M. Fall, D. Griffiths, P. Rosier, U. Ulmsten, P. van Kerrebroeck, A. Victor, and A. Wein, *The standardisation of terminology of lower urinary tract function: Report from the standardisation sub-committee of the International Continence Society* Neurourology and Urodynamics **21** (2002) 2, p. 167-178
3. E. A. Gormley, D. J. Lightner, K. L. Burgio, T. C. Chai, J. Q. Clemens, D. J. Culkin, A. K. Das, H. E. Foster, H. M. Scarpero, C. D. Tessier, S. P. Vasavada, *Diagnosis and treatment of overactive bladder (Non-Neurogenic) in adults: AUA/SUFU Guideline* American Urological Association (AUA) Guideline (2012)
4. H. Madersbach, *Orale Anticholinergika bei überaktiver Blase* Der Urologe A **45** (2006) 7, p. 830-597
5. A. Haferkamp, M. Hohenfellner, *Intravesikale Therapie des Overactive-Bladder-Syndroms* Der Urologe A **45** (2006) 10, p. 1283-1288
6. N.N.: *Optimierung der Pharmakotherapie – Eine Information nach § 73 Abs. 8 SGB V, Kassenärztliche Vereinigung Westfalen-Lippe (KVWL)*, Dezember 2006
7. C. Hampel, R. Gillitzer, S. Pahernik, S.W. Melchior, and J.W. Thüroff, *Drug therapy of female urinary incontinence* Der Urologe A **44** (2005) 3, p. 244-255
8. W. Michaeli, I. Michaelis, J. Grosse, M. von Walter, E. Wintermantel, N. Laar, *SPE-ANTEC Tech. Papers*, **55**, 235 (2009).
9. N.N., Technical Information Resomer® RGP d 5055, Evonik Industries AG, Essen
10. H. Liedtke, Evonik Industries AG, Essen, personal communication.
11. B. Dittrich, D. Klee, H. Höcker, *Hocheffiziente Verkapselung eines wasserlöslichen Wirkstoffs in Siliconmikrosphären im Solvent-Evaporationsprozess*, Aachen-Dresden International Textile Conference, Aachen, 2007
12. W. Michaeli, L.-O. Pfannschmidt, *Microporous, Resorbable Implants Produced by the CESP Process* Advanced Engineering Materials **1** (1999) 3-4
13. L.-O. Pfannschmidt, *Herstellung resorbierbarer Implantate mit mikrozellulärer Schaumstruktur*, RWTH Aachen, Dissertation, 2002 – ISBN 3-89653-996-5

JOB TITLE: TECHNICAL MARKETING ENGINEER, AROMATICS

Job description

Solvay Specialty Polymers is looking for an experienced Technical Marketing Engineer to support our aromatic polymers business lines. The Technical Marketing Engineer will be responsible for providing technical support and services to customers and the internal organization (R&D, Manufacturing). Primary markets supported in that role will be Healthcare and UltraPolymers markets, with possible involvement in some activities to support other fields (Mobile Electronics, Automotive, Aerospace and Industrial).

Responsibilities

- Work with Sales Development teams to support application development efforts at our customers: guidance with polymer material choice and validation, tooling and processing assistance, metal to plastic conversion.
- Generate and gather material data to support new applications in our different markets: coordinate work with internal and externals labs to complete datasets, write technical literature using the data and cover marketing aspects (press releases, conferences).
- Provide product and processing expertise: develop strong knowledge of our polymer portfolio value proposition and be able to assist part design with processing expertise (mostly injection molding or extrusion).
- Support customers in troubleshooting activities involving our polymers: support molding trials, interface with R&D labs for material and part evaluations (mechanical, DSC, Rheology, FTIR, etc)
- Provide technical training about polymers, applications and processing.
- Play a key role as interface between R&D and the customer accounts: provide market information and trends to orient product developments and provide marketing support to guarantee business impact of new products launched.

Profile

- MS (or PhD) degree in Mechanical engineering or Material Science, with previous high performance polymers experience.
- Minimum 5 years of experience in a technical role concerning polymers, processing or design.
- Knowledge of CAE tools (injection molding simulation, FEA) is a plus.
- Experienced in polymer processing technologies: injection molding (mandatory), extrusion and possibly others (melt spinning, coatings, etc).
- Strong knowledge of polymer science, solid mechanics, material science.
- Previous experience in Application Development with polymers.
- Strong analytical skills, technically-oriented.
- Curious and innovative spirit.
- Able to work independently and effectively with both external customers and globally based internal team.
- Willing to travel in US up to 50% of the time. International travels possible.

For more information on this position, please contact Dane Waund at mailto:dane.waund@solvay.com.