2025

Summer Newsletter

spe PRODUCT DESIGN & DEVELOPMENT

Letter from the Chair

By: Erik Foltz

Hello Product Design and Development Division (PD3) Members!

It has been a busy and exciting start to the year. Our flagship event, ANTEC, was held in March where our board was instrumental in helping organize the Mike Sepe Symposium. This symposium highlighted the practical, applied use for the typical material and testing knowledge often presented at ANTEC. Our Past-Chair, Al McGovern, was one of the presenters and organizers of the event. During the symposium each of the speakers took their area of expertise and highlighted how incorporating their data helped companies save money in designing more robust parts. Helping to organize this symposium was a great way to follow through on our goal of bringing our members content that helps them better design sustainable plastic products. If you are interested in seeing the type of content that was shared, I encourage you to watch a small video clip of two of the presentations here. You will also see another example of content at ANTEC through our technical article. The article highlights how you can use multi-point, long-term data to make better material selection decisions for your next application. If you find this type of discussion and content interesting, I encourage you to consider attending ANTEC next year, where it will be held in Pittsburgh, PA.

This year also brought well-earned recognition to some of our amazing board members:

- Glenn Beall, one of our founding members, became PD3's very first Emeritus Member! Special thanks to Mark Wolverton for designing a beautiful trophy to commemorate Glenn's decades of guidance and leadership.
- Al McGovern received the Honored Service Member (HSM) award at ANTEC, recognizing his long-standing contributions to PD3 and the SPE Foundation.

These honors are a testament to the incredible talent and dedication within our division—and the amazing peers you can collaborate with as a PD3 member.

After ANTEC, PD3 finalized the merger with the Failure Analysis and Prevention Technical Interest Group (FAPTIG). FAPTIG approached PD3 as a potential partner because of the joint mission of helping the broader community design plastic parts and assemblies that resist failure. (Cont'd)

In this Issue:

Letter from the Chair

They saw how we were taking an active role in distributing our technical content and felt they could better serve their membership through the merger. There will be no major changes to PD3 with the merger, but we will gain valuable additional content that we can share with our design community. Todd Menna, previous FAPTIG chair, will be joining our board to help with the transition and highlight how we can utilize their core content to further enrich our community. If you just want to keep up on the latest events, make sure to follow us on LinkedIN and on our website.

Finally, this will be my last Chair message to you in our newsletter. In July, Mark MacLean-Blevins will take on the role of Chair. Mark, a product designer himself, has been a long-time board member of PD3, and will continue to help us bring content that is relevant to today's design community. I'll be excited to support Mark as I take on the Past-Chair role. As Past-Chair, I'll be putting more effort into our Design for… webinar series and other technical content. It has been a great pleasure serving as the Chair, and I'm excited to see what we will do next.

Thanks again, and I look forward to our next conversation!

Erik Foltz
PD3 Chair (2023-2025)
The Madison Group

Letter from the Editors

Dear PD3 Members,

As we wrap up another exciting edition of the SPE PD3 Newsletter, I want to take a moment to thank you for your continued interest and engagement. It has been a true pleasure serving as your Web and Newsletter Editor over the past seasons. Sharing the voices, insights, and milestones of this passionate design community has been an incredibly rewarding experience.

With that, I'm excited to announce that Abigail Milos, Marketing and Sales Coordinator from VRC Engineered Solutions, will be stepping in as the new Web and Newsletter Editor moving forward. Abigail brings sharp editorial skills, a creative spirit, and a strong connection to the mission of PD3. You'll be in very good hands with her leading the charge.

Thank you again for reading, sharing, and contributing to the stories that shape our community. I look forward to continuing my involvement with PD3 and supporting this fantastic team from new angles.

Warm regards,

Elizabeth Detampel
edetampel@sussexim.com
Web/Newsletter Editor
SPE Product Design & Development Division

Editor's Note:

The entire PD3 Division owes a debt of gratitude to Elizabeth for her wonderful support as our Newsletter and Web Editor these past almost 2 years. I am very grateful for her skill and diligence, and for the dedication she gave to PD3 while she was ramping up her commitments to Sussex IM. She hit the ground running and is personally handling the transition of her role to Abigail Milos in a professional and personal manner. I'm looking forward to working with Abigail and having her add her own touch to our Newsletter and Website.

Thank You, Elizabeth! Welcome Abigail!

Al McGovern

Past BOD Minutes

Meeting Minutes | February 6, 2025 | PD3 Board Meeting

Call to Order and Roll Call

- Meeting started at 1:05 PM Eastern Time
- Present: Erik Foltz, Al McGovern, Jason Suess, Chris Siler, Mark MacLean-Blevins, Larry Schneider, Akanksha Garg, Mark Wolverton, Kyle Kulwicki, Eric Rose, Lorena Skelley, Sue Milazzo Wojnicki
- Excused Absence: Ed Probst, Vik Bhargava, Glenn Beall, Elizabeth Detampel, Michael Paloian
- Absent: Pavan Valavala, Brandon Benvenuto, Luke Buerkley, Parvin Karimi

Past Meeting Minutes

- The link to previous meeting minutes was distributed prior to meeting
- Minutes were approved as recorded with motion and second from Mark Wolverton and Larry Schneider, respectively.

Treasurer Report

- No Treasurer report was discussed at this meeting

Councilor Report

- No Councilor report was discussed at this meeting

Membership Report

- No membership report was discussed at this meeting

Membership Outreach Report

- **Newsletter**
  - The Winter 2025 newsletter went out in January.
  - The next newsletter is planned to be out after ANTEC to capture those activities
  - Technical articles are needed for future newsletters
- **Website**
  - The website was updated to include the addition to the Board of Jason and Kyle
  - Technical events can be shared on the website or social media
  - Al asked us to always look for website Sponsors
- **FAPTIG**
  - Al talked with Todd at FAPTIG to see if there are people in the failure space that could be website sponsors, newsletter contributors, or event promoters.
- **SPE**
  - Sue mentioned that SPE HQ would be happy to feature a topic for PD3 in the SPE News
- **Design For...**
  - The next Design for... webinar is scheduled for March 13th with Rick Faulk from Mar-Bal. The topic is “Advantages of Thermosets”
  - Erik is looking for presenters for May, September, and November.

Past BOD Minutes

Meeting Minutes | February 6, 2025 | PD3 Board Meeting

Old Business

- **FAPTIG – PD3 Merger**
  - Al McGovern, Erik Foltz and Mark Wolverton met with Todd Menna of FAPTIG and SPE HQ to discuss this merger.
  - HQ will handle the paperwork, and this will take a few weeks. It can be completed before ANTEC, and there is no cost to PD3.
  - PD3 will continue with current name and modify our mission and vision statements to include failure analysis and prevention
  - FAPTIG will be transferring their remaining funds to Mike Sepe Scholarship
  - At least one current FAPTIG board member will join the PD3 board, and this is currently identified as Todd Menna of Element Material Technology
  - Erik Foltz made a motion to approve the merger of the Failure Analysis and Prevention Technical Interest Group (FAPTIG) with the Product Design and Development Division (PD3) within SPE. Erik Rose provided a second for the motion. The Board approved the merger of FAPTIG into PD3
  - The merger is planned to be announced on social media before ANTEC
- **ANTEC 2025**
  - The Mike Sepe seminar will be on Wednesday during ANTEC
  - There are now 7 speakers for this seminar (one presenter had to back out)
  - Board members attending ANTEC include Al, Akanksha, Jason, Mark M-B, Erik, and Todd

New Business

- **Student Travel Donation**
  - SPE asked PD3 if we would donate for student travel to ANTEC. Eric and Larry brought the proposal to the board to donate $500 for student travel. Mark MacLean-Blevins made a motion to support this donation. Eric Rose provided the second. The proposal to donate $500 was approved.
- **Board Succession**
  - Mark MacLean-Blevins has offered to take the Chair position starting in the second half of 2025.
  - Erik Foltz would remain on the Board as Past Chair and continue to support Design for… webinar series
  - Al McGovern will continue in membership outreach and as a back-up Treasurer
  - Other board positions will be discussed in upcoming meetings
  - Membership chair will be vacant with Mark M-B moving into the chair position
  - Al has reached out to David Kusuma to join the Board and David seems interested

Adjourn

- Meeting ended at 2:05 Eastern Time

Submitted by Chris Siler
February 14th, 2025

Glenn Beall Appointed Emeritus Member

By: Al McGovern

Glenn Beall, known internationally as the ‘Father of Plastics Design Principles’, and a founder of PD3, was recently celebrated as the Division’s first Emeritus Member for his extensive leadership and mentoring. The PD3 Board unanimously and exuberantly approved this long overdue recognition of Glenn’s innumerable contributions to the plastic design community.

A custom trophy, made from a cow horn and gold-toned metal mounted on a walnut plinth, was designed and obtained by Mark Wolverton, PD3 Board Member (and long-time friend of Glenn’s), who presented it to Glenn on March 17th. It recognizes Glenn’s long-term interest in plastics artifacts (see also Plastics Pioneers Reading Room at Bird Library in Syracuse University), particularly those made from horn, as evidenced by the fact that he is the only US member of the The Worshipful Company of Horners (UK). Here’s a brief excerpt from their History page to whet your appetite for learning more about this fascinating group that dates to at least the year 1284:

“Whilst the use of horn continued to decline, the twentieth century saw a considerable rise in the Company’s fortunes. Through a succession of enterprising Clerks and Masters, their numbers were allowed to rise to 100 in 1905 and then to 200 in 1925. Seven Horners have served as Lord Mayor and many others in the office of Sheriff. In 1943, recognising that the working of horn was no longer a viable industry, the Company had the great foresight to adopt its modern equivalent, the Plastics Industry. Since that time the Company has played a role, and kept pace with a significant international technological industry. Similarly, bottle production has progressed to be a major consumer of plastic materials, and bottlemaking once more fits the Horners’ portfolio.”

Glenn is also one of the Master Historians in The Honourable Company of Horners, a much newer US-based version of the UK group. Glenn was extremely appreciative of the Emeritus honor and most especially of the trophy, which he said will surely go to the front of his collection of previous awards—which include being an SPE Distinguished Member (one of only 6 such Members who were not first the SPE President); induction into the Plastics Hall of Fame in 1997, and; Member of the Plastics Pioneers of America.

Congratulations, Glenn, on this most worthy award!

COMPARATIVE CREEP EVALUATION OF POLYACETAL AND POLYKETONE RESINS

By: Jeffrey A. Jansen,
The Madison Group

Abstract

Failures occurred within threaded fasteners used in an outdoor industrial application. Specifically, cracking was observed within fasteners used to terminate a pipe conveying a gaseous chemical product. The parts had been installed leak free as verified through leak testing. However, failures occurred within some of the installations between four and five years, as identified by leakage of the gaseous product. A failure analysis identified that some of the fasteners had cracked though a mechanical short-term overload mechanism in which the stresses applied during installation exceeded the short-term strength of the material. Other parts, however, cracked through creep rupture, whereby the applied service stress exceeded the long-term strength of the material. In both cases, crack propagation and ultimate rupture were associated with the creep properties of the material. A material conversion was considered to increase the creep performance of the fasteners. This paper will review the testing performed to characterize and compare the creep performance of the incumbent and proposed materials.

Introduction

Leakage failure resulting from cracking had been observed within threaded fasteners. The fasteners had been used in hot and dry conditions in above-ground outdoor service in the Southwestern United States, functioning to terminate pipes conveying a gaseous chemical product. The failures were observed after four to five years of service. Leak testing of the pipe/fastener assembly shortly after installation did not reveal any signs of leakage.

A failure analysis was conducted, which identified two different modes of failure. Some of the part failures initiated though a mechanical short-term overload mechanism in which the stresses applied during installation exceeded the short-term strength of the material. Other field failures as well as engineering test parts cracked through creep rupture, whereby the applied stress exceeded the long-term strength of the material. In both cases, crack propagation and ultimate catastrophic splitting was associated with the creep rupture.

The fasteners had been produced from Celcon® M90, a general-purpose, medium viscosity polyacetal copolymer from Celanese Corporation, containing a black colorant. A material review was conducted, and a potential replacement material was identified, Poketone® M630, an unfilled, general-purpose aliphatic polyketone terpolymer from Hyosung Chemical Corporation.

Creep testing was subsequently performed to assess and compare the long-term properties of the two materials. This paper will review that comparative creep evaluation.

Material Background

Polyacetal (POM), also known as polyoxymthylene, is a semi-crystalline thermoplastic resin characterized by relatively high strength and stiffness (modulus), hardness, and low friction properties. Polyacetal is produced through addition polymerization. Two different types of polyacetal resins are available, homopolymers and copolymers. The homopolymer consists of a backbone exclusively made up of alternating CH2 and O functionality. Within polyacetal copolymers, approximately 1.0% to 1.5% of the -CH2O- groups are replaced with -CH2CH2O-.[1,2] The polyacetal copolymer structure is presented in Figure 1.

The presence of the copolymerized oxyethyl segment results in a lower degree of crystallinity, which brings a reduction in strength and modulus, as well as a reduction in the upper limit short-term use temperature. The presence of the additional hydrocarbon linkage in the copolymer backbone provides for improved resistance to oxidation.[3] This corresponds to improved property retention after long-term exposure to elevated temperatures, as well as improved chemical resistance. However, the lower level of crystallinity within the copolymer also translates into decreased bearing properties as well as reduction in fatigue and creep resistance.[3]

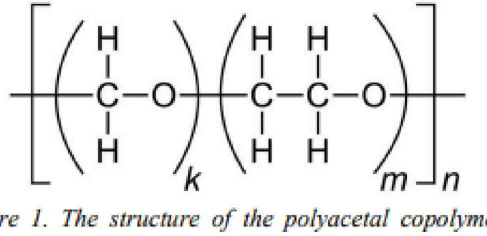

Figure 1. The structure of the polyacetal copolymer is shown.

Similar to polyacetal, aliphatic polyketone (POK) is a semi-crystalline thermoplastic resin. It is known for a balance of processing and performance properties. Polyketone is commercially available as a copolymer, polymerized through the reaction of carbon monoxide and ethylene, or as a terpolymer when propylene is added to the reaction. The polymer backbone consists exclusively of carbon-carbon units with a perfectly alternating structure with the ketone functionality. The polymer

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By: Jeffrey A. Jansen,
The Madison Group

chains are flexible and possess molecular symmetry and cohesive energy resulting in a tough, high-melting-point semi-crystalline structure.[4] The symmetry and chain flexibility promote crystallization with polyketone. The carbonyl structure leads to strong intermolecular attractive interaction between neighboring polymer chains, producing a relatively high melting point and heat of fusion. The polyketone terpolymer structure is presented in Figure 2.

The crystallinity, melting point and glass transition temperature are influenced by the introduction of the third monomer, propylene, within the terpolymer. A 6 mole% propylene is typical and reduces the melting point from 257 °C to 222 °C.[4]

Typical characteristics of polyketone include high tensile strength and stiffness, as well as good impact strength. They are noted for exceptionally high abrasion resistance with minimal wear characteristics. The terpolymer is noted for outstanding chemical and hydrolysis resistance.[5]

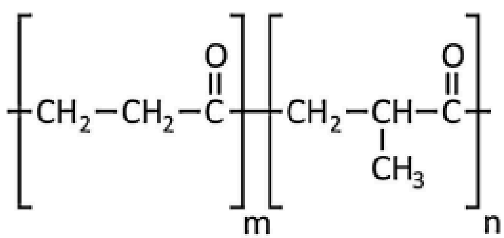

Figure 2. The structure of the polyketone terpolymer is shown.

Testing

Sample Preparation

For the creep evaluation, the supplied Celcon® M90 and Poketone® M630 resins were molded into ASTM D638 Type I tensile bars using resin supplier recommended conditions. The tensile bars were molded without knit lines using a mold configured with a single injection molding gate design.

Temperature-Dependent Behavior

The materials were evaluated for temperature-dependent behavior by dynamic mechanical analysis (DMA). The samples were evaluated from -50 °C at a heating rate of 2 °C/min. to an upper temperature based upon each material's thermal response. The center portion of the ASTM D638 Type I tensile bar was tested under an oscillatory stress at a frequency of 1 Hz in accordance with ASTM D4065. The storage modulus (E'), loss modulus (E"), and tan delta (E"/E') were plotted as a function of temperature. Glass transition temperatures (T_g) were determined as the localized maxima in the loss moduli. The resulting DMA thermograms are shown in Figures 1 through 3.

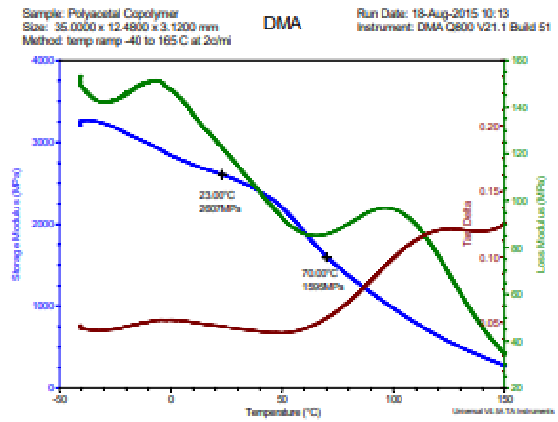

Figure 1. The DMA temperature sweep for the polyacetal copolymer is presented.

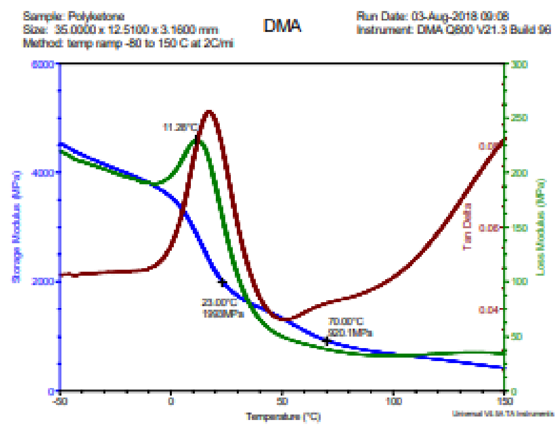

Figure 2. The DMA temperature sweep for the polyketone is presented.

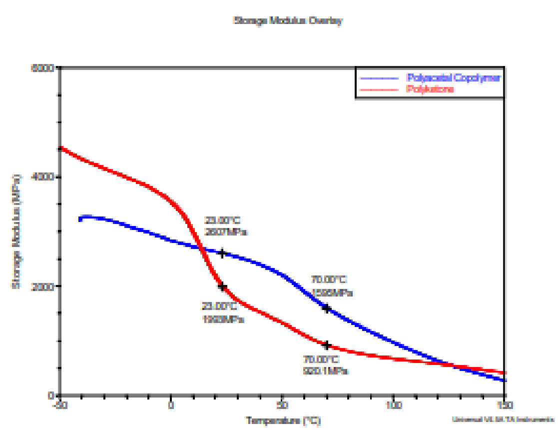

Figure 3. Overlay comparing the storage moduli of the two materials.

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Both materials demonstrated a continuous decline in modulus with increasing temperature. The storage moduli were determined for the two materials at two temperatures, 23 °C and 70 °C.

The polyacetal copolymer displayed a steady modulus reduction over the analysis temperature range. A minor inflection was noted at approximately 50 °C, above which the rate of decline was slightly higher. The DMA results were in agreement with a semi-crystalline resin above the glass transition temperature (T_g), and specifically the observed behavior was consistent with that expected for a polyacetal resin.

The polyketone terpolymer presented a variable decline in modulus with increasing temperature. The subambient modulus was greater than that of the polyacetal copolymer. A major inflection in the polyketone terpolymer storage modulus was noted at approximately 10 °C. This was accompanied by maxima in the loss modulus and tan Delta responses. This event represented a glass transition within the material and a glass transition temperature (T_g) of 12 °C was determined. The modulus of the polyketone was lower than that of the polyacetal copolymer above this temperature. However, the rate of decline was lower, and the two modulus curves crossed over at approximately 125 °C. The polyketone terpolymer DMA results were in agreement with a semi-crystalline resin passing through glass transition, and the observed behavior was consistent with that expected for a polyketone resin.

Tensile Properties

Tensile tests were performed on samples representing the two materials in accordance with ASTM D638 at 23 °C. Injection molded Type I tensile bars were tested using a universal mechanical tester equipped with a contact extensometer. The testing was performed using crosshead speeds of 0.2 in./min. and 2 in./min. for the polyacetal copolymer and polyketone terpolymer respectively, based on their observed tensile properties and compliance with the test standard. The average results of five specimens are presented below in Table 1, and the stress – strain curves are illustrated in Figure 4 through 6.

Table 1. Tensile Test Results – 23 °C

Parameter	Polyacetal Copolymer	Polyketone
Modulus, MPa	2,837	1,630
Tensile Strength at Yield, MPa	61.1	59.8
Elongation at Yield, %	8.51	22.2
Tensile Stress at Break, MPa	55.2	55.7
Elongation at Break, %	31.9	243
Proportional Limit, %	0.625	0.719
Linear Equivalent of Yield, %	2.144	3.555

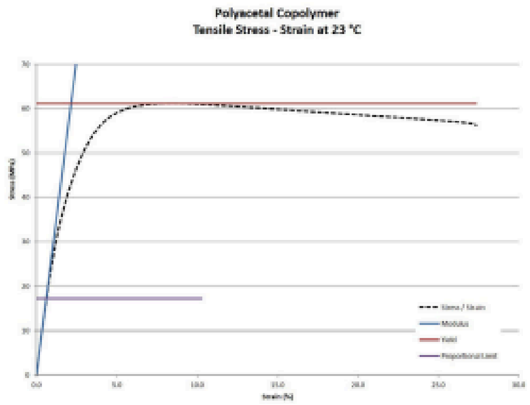

Figure 4. The tensile stress-strain curve is shown for the polyacetal copolymer.

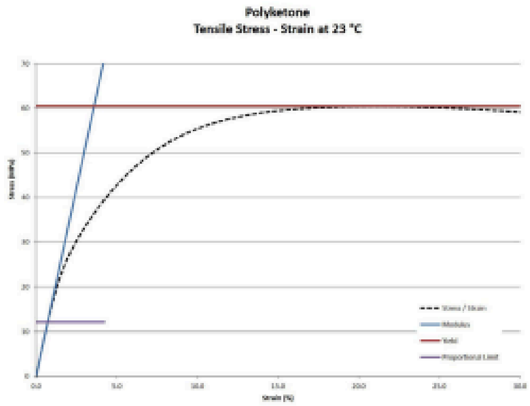

Figure 5. The tensile stress-strain curve is shown for the polyketone.

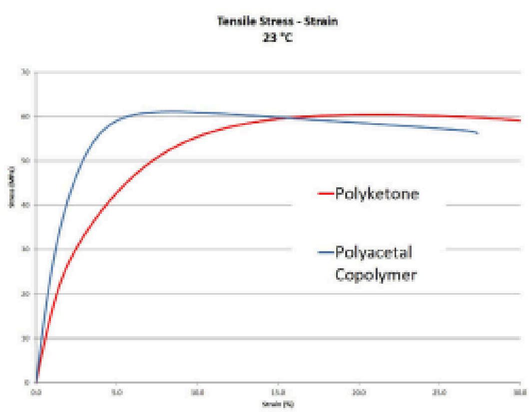

Figure 6. Overlay showing the stress-strain curves for the two materials.

The results obtained for the two materials, were consistent with those expected based upon their respective technical

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data sheets. The two materials showed very similar tensile strength at yield and tensile stress at break values. However, a significant difference was noted in the elongation properties. The polyketone demonstrated substantially higher elongations for both yield and break. This correlated with the markedly elevated modulus of the polyacetal copolymer, consistent with comparative results from the DMA temperature sweep. In summary, the tensile test results indicated that the polyacetal copolymer was stiffer, but the polyketone was more ductile.

Creep Properties

The assessment of creep properties was conducted via dynamic mechanical analysis (DMA) by running multiple determinations for fifteen-minute periods at isothermal conditions ranging from 10 °C to 150 ° C in increments of 5 °C. The evaluations were conducted using a dual cantilever configuration. The polyacetal copolymer and polyketone were tested using stresses of 1.5 MPa and 1.9 MPa, respectively, based on their room-temperature modulus values. These data were used to develop master curves for the materials that extended to 200,000 hours at a reference temperature of 23 °C. These are illustrated as semi-log plots of apparent modulus as a function of time in Figures 7 through 9. A review of the creep response of the materials showed very good correlation to the temperature dependent behavior demonstrated by each during the DMA temperature sweep.

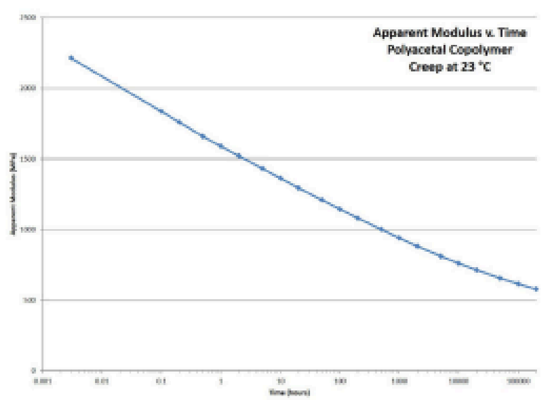

Figure 7. The plot of apparent modulus over time is shown for the polyacetal copolymer.

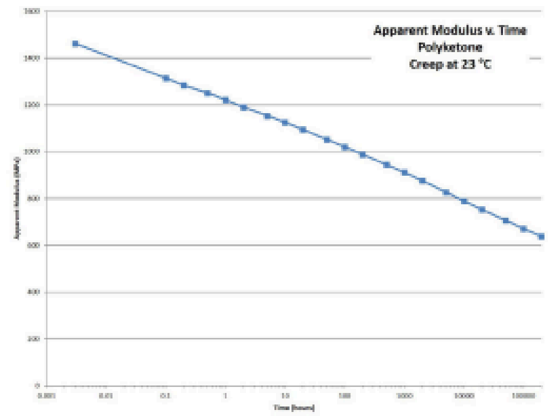

Figure 8. The plot of apparent modulus over time is shown for the polyketone.

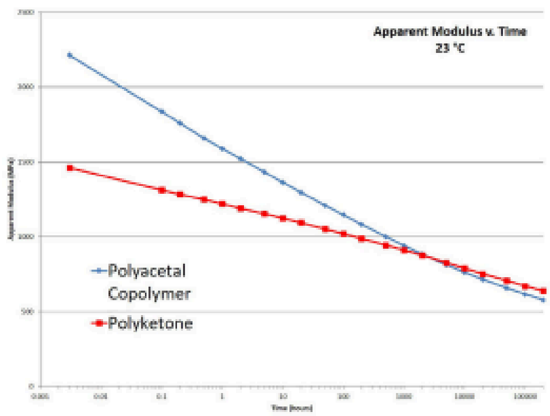

Figure 9. Overlay of the creep master curves for the two materials.

A comparison of the master curves representing the two materials showed that the polyacetal copolymer exhibited a higher apparent modulus at time zero. This was in agreement with the DMA temperature sweep and the tensile test data. Over time, the two apparent moduli converged, with the polyketone terpolymer have a slightly higher apparent modulus above and beyond 50,000 hours. Again, this was consistent with the comparative temperature-dependent data.

Dynamic mechanical analysis (DMA) creep data is generated at very low stress levels; therefore, the behavior documented by this method tends to be in the portion of the stress-strain curve that is below the proportional limit. Consequently, the apparent modulus data represented by the DMA results assumes linear elastic behavior throughout. However, apparent modulus behavior is translated into strain versus time behavior by applying various stresses. These stresses frequently result in plastic deformation that extends into the non-linear portion of the stress-strain profile. The actual stress-strain data presented

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by the tensile tests is used to correct the DMA data to include the non-linear response.

Strains were calculated for the two materials for a constant applied stress level of 14 MPa, the nominal stress identified for the fastener in field service. The results of these calculations were plotted versus time and are illustrated in Figure 10.

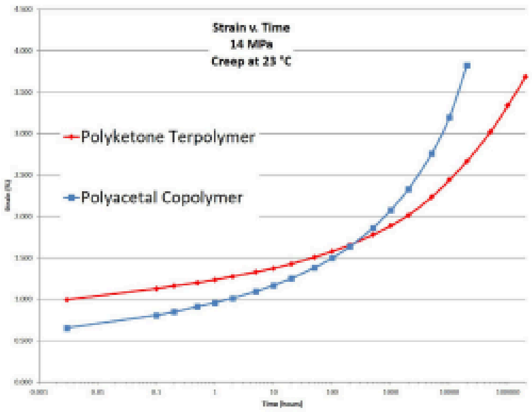

Figure 10. Plot of strain over time for the polyacetal copolymer and polyketone terpolymer.

Failure is defined as the point at which the calculated strain equals the yield strain, at which time cracking is expected. The anticipated lifetimes for the two materials were determined at 23 °C and a stress level of 14 MPa.

At 23 °C the polyacetal copolymer is projected to result in failure at approximately 50,000 hours (5.7 years). The polyketone terpolymer is predicted to provide performance beyond 200,000 hours (22.8 years) at 14 MPa.

It should be noted that since the polyacetal copolymer, and to an even great extent the polyketone terpolymer, exhibit an ultimate strain limit that is considerably greater than the yield strain, the actual time to catastrophic failure at the stress level evaluated may be somewhat greater than those predicted by the model. This technique cannot quantify the timeframe associated with the tertiary creep that immediately precedes complete failure. However, since tertiary creep is characterized by an increase in strain that does not require the application of additional stress, the time frame is expected to represent a relatively small percentage of the time required to reach the yield strain.

Conclusions

It is the conclusion of this work that the Poketone® M630 polyketone terpolymer displayed superior creep rupture resistance properties compared with the Celcon® M90 polyacetal copolymer under the controlled parameters of this evaluation. Specifically, the modeling was conducted using a temperature of 23 °C and a stress level of 14 MPa. The creep study indicated that the polyacetal copolymer was projected to result in failure at approximately 50,000 hours (5.7 years), while the polyketone terpolymer was predicted to provide performance beyond 200,000 hours (22.8 years). Given the creep testing outcome, the enhanced performance of the polyketone terpolymer appears to be primarily related to the substantially higher elongation at yield value, in sprite of a lower modulus at the modeling temperature. This study suggests that the polyketone terpolymer may be a good candidate for material replacement in this fastener application. It should be noted that the stress level of 14 MPa would be expected to reduce overtime due to stress relaxation. This would increase the time to failure to a degree. However, stress relaxation would affect both materials, and the comparative performance results obtained during this study remain applicable.

It is significant to remember that the tensile bar specimens used for the evaluation were injection molded using an end-gated tool. Such specimens afford the optimal geometry and flow for mechanical properties. The mechanical properties, including tensile strength and creep resistance, will likely be lower in injection molded parts. Any environmental conditions that can produce structural changes in the polymer, such as, molecular degradation or environmental stress cracking, will reduce the predicted time to failure.

In the application, specifically the installation locations where failure was observed, the service temperatures would be expected to exceed that used to model this evaluation. Further work should include addition testing to account for this variation in service conditions.

With any material conversion, it is recommended that adequate performance testing be conducted to assure the intended performance. Sufficient information cannot be obtained from material property data sheets, and final performance should be evaluated through testing. In this application, additional recommended testing includes:

- Impact testing to account for high strain rate loading during assembly and installation.
- Weather testing to evaluate outdoor exposure performance.
- Short-term burst testing to test the pressure rating of the molded fasteners in service.

Keywords

creep, dynamic mechanical analysis, time-temperature superposition, failure analysis, polyacetal, polyketone,

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The Madison Group

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Mike Sepe Memorial Symposium

By: Al McGovern

Once again, PD3 was instrumental in presenting a full-day symposium at ANTEC. The event, held on March 5th at ANTEC25 in Philadelphia, PA USA, was the Mike Sepe Memorial Symposium that was dedicated to Mike, known to many as “The Materials Guy”, who had passed away a few weeks after presenting at the Glenn Beall Symposium at ANTEC24. This event featured 7 different speakers, all of whom were personally chosen by Jeff Jansen (of The Madison Group), Mike’s longtime friend and associate.

Jeff began the event by beautifully reading a note from Mike’s widow, Audrey, entitled, “The Plastics Industry’s Gift to Mike”. She offered the note as a means of sharing what the plastics community meant to Mike. Here are the last few sentences of her note:

“Mike’s life was a collection of cherished moments woven together forming his life’s journey. All of you who shared yourselves with him provided him with everlasting kinship that brought him great joy.

He did not get to say goodbye to any of you, but on his behalf, I assure you that you were all an integral part of who he was, and an integral part of what can be carried forward. That is the true gift he received from you, for you are the very heart and soul of the plastics industry.

For this gift, both Michael and I are forever grateful.”

While reading Audrey’s poignant note, Jeff projected this photo of Mike and Audrey taken beside the Grand Canyon, which Mike (who lived in Sedona, AZ USA) loved to hike around and within. It was an emotional start to a day filled with lots of great technical information sprinkled with personal memories of Mike by his friends.

Mike Sepe Memorial Symposium

By: Al McGovern

After reading Audrey Sepe's note, Jeff gave his presentation, followed by 6 other speakers over the course of the day. Each of the speakers shared their expertise in material property data acquisition and application, highlighting how this knowledge improves plastic part design. The speakers, in order of appearance, were: Jeff Jansen, Albert McGovern, Mary Kosarzycki, John Beaumont, John Bozzelli (recorded earlier via Zoom) Paul Gramann and Elena Moore. Each included their personal connection with Mike during their careers as part of their presentation.

The Symposium was first conceived by Jeff Jansen, and came together with support from SPE HQ and PD3. Al McGovern, past PD3 Chair moderated the event. Attendees we asked to write a personal message on one of two posters that were sent to Audrey after the event, along with a video of the start of the Symposium (see link in the President's Message at the front of this newsletter to view the video).

Al McGovern

June 9, 2025

Sepe Symposium Speakers
(L-R) Elena Moore, Mary Kosarzycki, Jeff Jansen, Paul Gramann, John Beaumont, Al McGovern

"The Gallery of Goofs"

By: Glenn Beall
Glenn Beall Plastics Inc.

Human beings are not infallible(1). They make mistakes. Plastic product designers are human beings and can therefore be expected to make mistakes. I am reluctant to admit it, but I have made more than my fair share of plastic product design mistakes. My only excuse is that plastic technology was not taught at my university. As a result, I learned about designing with plastic on the job, in the school of hard knocks, by reading the plastics industry magazines and the few relevant books that existed back then.

I like to believe I also learned from my own frequent mistakes. However, it didn't take very long for me to realize that it would be faster and less costly to learn from the mistakes being made by other designer engineers. I started saving stories of these mistakes in design.

In September of 1981, I had the good fortune to be named the design editor of the highly respected Plastic Design Forum (PDF) magazine. This was a wonderful job that gave me an opportunity and the freedom to promote my design philosophy to the plastics products design community.

In the normal course of events, I wrote an article about a plastic part that failed due to a lack of attention to the basic plastic part design guidelines. That mistake resulted in the death of an innocent person. This article was well-received and the PDF editors asked for more stories about why plastic parts failed and how those failures were eliminated. After a few part failure articles, the editors established a recurring PDF column entitled "The Gallery of Goofs". They chose the word goof(2) instead of failure or mistake as those words sounded too harsh in the politically correct society we were living in at that time. For obvious reasons, the names of the people, companies, and suppliers mentioned in these articles were changed to protect the guilty. In some articles, the application was also disguised.

I have been designing plastic parts since 1957. Unfortunately, the same mistakes I made over sixty years ago are still being made today. I admit that my work as a consultant and expert witness in plastic product failure litigations brings me into contact with more plastic part failures than the average product designer. Be that as it may, there is obviously something missing in how plastic designers are being educated.

With that thought in mind, SPE's Product Design and Development Division will be including some of the PDF Gallery of Goofs articles in future newsletters. Hopefully, those reading the newsletter will benefit by learning about these reviews of real-life plastic part failures and how these defects were resolved.

Glenn L. Beall
Glenn Beall Plastics

Webster's Dictionary
(1) Infallible – incapable of erring.
(2) Goof – an incompetent, foolish, or stupid person.
A careless mistake or a slip.

“The Gallery of Goofs” - Part III

By: Glenn Beall
Glenn Beall Plastics Inc.

This is the third in a continuing series that reports on errors of judgment made in the design and engineering of actual plastic parts and products.
This case history reviews an all-too-frequent oversight in the design of plastic parts with tapered pipe threads, and describes how the resulting product failure was corrected with a simple design modification. The author is Glenn L. Beall, president of Glenn Beall Plastics and former design editor of Plastics Design Forum magazine.

The product was a small, replaceable-cartridge-type water filtering unit typical of those being used increasingly in homes and small commercial establishments to improve the quality of consumable water. It was intended to be installed in the central plumbing system by homeowners as well as by experienced plumbers.
The vast majority of plumbing systems used in the United States prior to 1960 were metal with tapered threaded fittings. This filtering unit was designed to be inserted into a water inlet pipe between the water meter and the water heater. It was anticipated that a section of the inlet pipe would be removed and that the filter would be inserted, utilizing the standard tapered pipe fittings and one union. While many other uses were expected, this was a primary one.
The filter body that accepted the threaded tapered pipe fittings was injection molded in a medium-impact ABS plastic. The single-cavity production mold was top-centersprue-gated (Figure 1).
The product was designed to withstand a water pressure of 150 psi, which is the maximum residential-use pressure. Allowances were made for cyclic loading, water pound, and road-vibration effects. Extensive preintroduction testing indicated that the tapered pipe fittings were satisfactory and, in fact, were overdesigned.
Reports of product failures were received shortly after the product was introduced. Two incidents were especially noteworthy. One unit installed on a drinking-water cooler on the fifth floor of an office building developed a leak on a weekend while the building was unattended. Water ran across the floor and down a nearby elevator shaft, causing extensive damage on each successive floor.
Another unit was given to the owner of a large chain of plumbing-supply houses as a promotional sample for his personal use. The unit failed, and the plumbing-supply tycoon's basement was flooded—while he was away on vacation. Many other units failed, but—it is hoped—under less distressing circumstances. Examination of defective units that were returned revealed that all of the failures were the result of stress cracks in the inside tapered pipe threads used for attaching the unit to the central plumbing system. In all cases, the failures were located below the thread as shown in Figure 2. None of the returned units were of the type adapted to be used with soldered-copper solvent-bonded plastic pipe.

"The Gallery of Goofs" - Part III

By: Glenn Beall
Glenn Beall Plastics Inc.

Considering the location of the gate and the flow of the melt (Figure 1), it is obvious that the filter bodies contained weld lines in the inside thread in the area of the failures. Careful examination of returned units also indicated that all of the defects had at least started in the weld line below the thread. Inspection of unsold filter bodies molded at the same time, as well as observations made on the failed units, indicated that the parts had been properly molded. The weld lines were completely closed and well-knitted.

It is a known fact that weld lines always weaken a structure. However, in this case, weakness at the weld lines had not been a problem during the extensive preproduction testing program. Inquiries revealed that the technician who conducted the tests was aware of and had observed stress cracking in the area below the thread. This problem had been eliminated by taking care not to overtighten the threaded fitting.

It was concluded that the stress cracks were due to overzealous tightening of the tapered pipe thread fittings. In retrospect, overtightening was an anticipatable misuse prompted by a desire to avoid leakage at the fitting. It was also speculated that overtightening was encouraged by the fact that during assembly the inside and outside threads gradually became tight with no positive indication of when a seal had been made. Metal fittings of this type abruptly become too tight to turn further. Thermoplastic parts with inside tapered threads are capable of expanding as the outside tapered thread is driven deeper into the inside tapered thread. Figure 3a illustrates this condition.

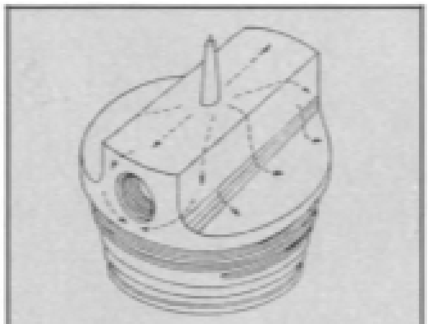


Figure 1.

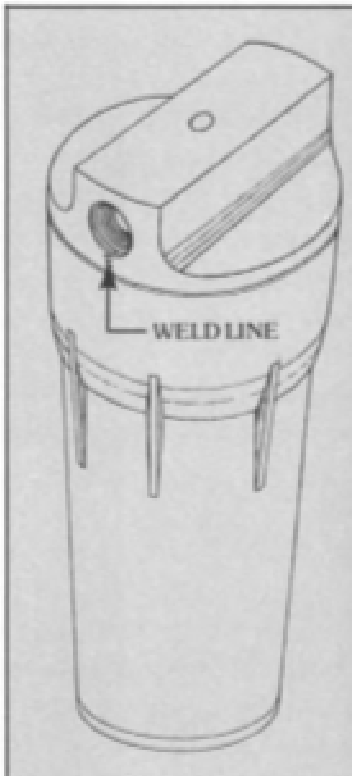


Figure 2.

“The Gallery of Goofs” - Part III

By: Glenn Beall
Glenn Beall Plastics Inc.

The threaded core pins in the filter-body mold subsequently were modified to provide a stop at the bottom of the thread as shown in Figure 3b. It was anticipated that this stop would provide an abrupt increase in torque that would indicate to the assembler that the fitting was tight enough.

This relatively simple modification of the product eliminated the failures that were being caused by overtightening of the fitting.

Thermoplastic materials have been used successfully for many years in applications requiring tapered pipe threads. It must be recognized, however, that driving the two tapered fittings together stretches the outside thread and imposes a high loop stress on the material surrounding the inside thread. Plastic materials with a high elongation can accommodate a high percentage of this type of loading. Given time, the creep of the plastic material will also relieve some of this hoop stress. Outside tapered threads are subjected to the same forces; however, in that case, the plastic part is loaded in compression and plastics are able to perform much better under that type of loading.

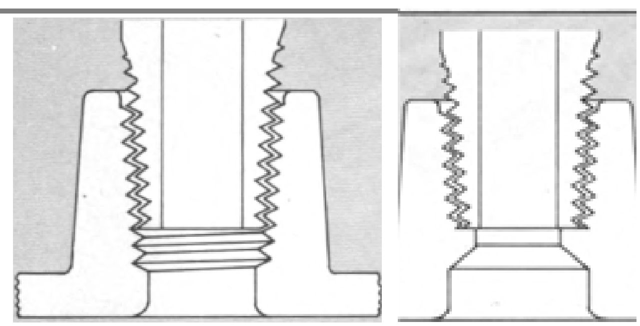
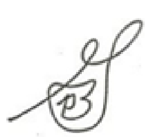


Figure 3. A B

Inside tapered threads are a troublesome design detail that cannot always be avoided. Many types of products rely on tapered threads for a positive seal—hydraulic, pneumatic, and plumbing applications are examples. But the designer should always watch for opportunities to replace tapered threaded fittings with other lower-stress-type fittings—nontapered threads, for example.

When contemplating the design of tapered inside threads, the designer must allow for the possibility of high hoop stress generated by overtightening of the fitting. The thread stop described above will be useful in some cases. The designer must also exercise care in providing an adequate thickness of material around the outside of inside tapered threads. Careful attention to sharp edges in and around the fitting that could act as stress concentrators should also be given careful attention. Inside threads almost always contain weld lines, and their inherent weakening effect on the part must not be overlooked.

The thread stop described above eliminated the water filtering unit failures that were the result of overtightening of the fitting.



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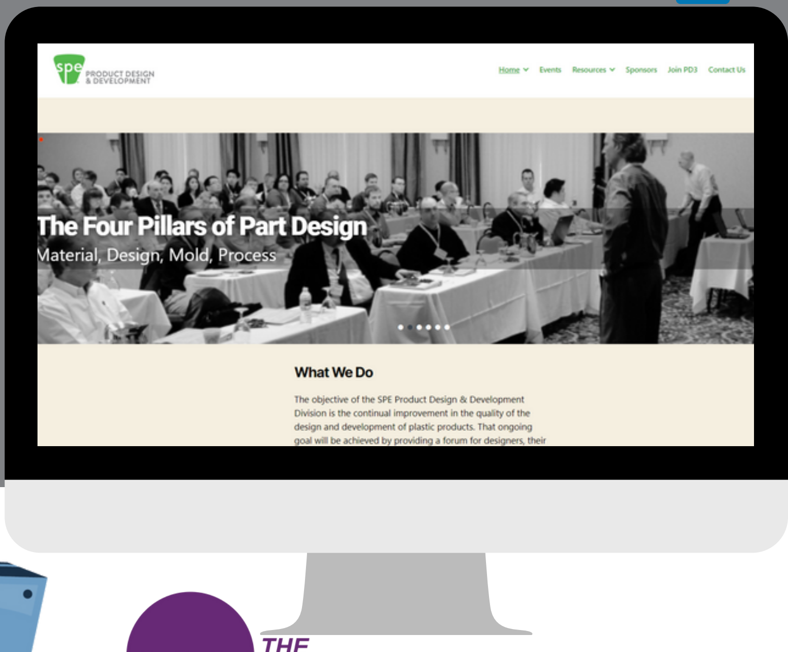

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