

Biographical Statement Prof. Walter Friesenbichler



Prof. Walter Friesenbichler

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Web of Science ResearcherID:

J-6048-2019

Research Gate:

<https://www.researchgate.net/profile/Walter-Friesenbichler>

Google Scholar:

<https://scholar.google.com/citations?user=dbWsWYMAAAJ&hl=de>

Dr. Walter Friesenbichler is **Full-Professor for Injection Molding of Polymers** at Montanuniversitaet Leoben in Austria **since July 2010**, where he has carried out research and taught since graduating from Montanuniversitaet in 1984.

Professor Friesenbichler's research has centered on three areas:

- **Applied rheology**
- **Injection molding** and
- **Polymer nanocomposites.**

Since 1985 he has carried out research on

- **injection molding simulation**
- **standard and special injection molding technologies** such as rubber injection molding, injection molding compounding, exjection, rapid heat cycle molding, and
- **applied rheology** using extruders and injection molding machines
- **surface structures** of injection molded parts and
- **Systematic development of injection molded parts.**

The experimental effort in applied rheology has been aimed at polymer melts, wall slipping PVC compounds, rubber compounds, metal and ceramic feedstocks, PNCs and wood plastic composites.

Recent research is focused on

- **optimization of rubber injection molding,**
- **rheology of thermoplastics and rubber compounds** with regard to pressure dependence of viscosity, extensional rheology and viscoelastic melt behavior
- **injection molding simulation.**

Prof. Friesenbichler is Head of the Department of Polymer Engineering and Science at Montanuniversitaet and member of the Austrian Physical Society, the Polymer Processing Society and The Association of German Engineers VDI.

He received the "**Golden Batch of Honour**" of the Association of Austrian Plastics Processors in 2011 and the "**Herman F. Mark Medal**" in 2016.

Publications, presentations, patents

- **185 Publications** in international journals, conference proceedings and books
 - 63 *in peer-reviewed journals and peer-reviewed conference proceedings*
 - 18 *in non-peer-reviewed journals*
 - 90 *conference proceedings*
 - 3 *book chapters*
 - 11 *others*
- **More than 70 presentations at international conferences**
- **36 presentations at seminars for participants from industry**
- **5 Patents**
- **46 Research projects**
- **26 PhD theses (9 as Supervisor, 17 as Co-Supervisor)**
- **25 Master theses (supervised since 07/2010)**
- **48 Diploma or Master theses (supervised 1987 till 06/2010)**

Research Projects

Finished projects

1. FFF-Project Spritzprägen von Membranen, AKG GmbH/Battenfeld Austria GmbH, (07/1986 - 06/1989)
2. FFF-Project "Entwicklung eines Extrusionsrheometers für die praxisnahe Materialcharakterisierung von extrudierbaren thermoplastischen Kunststoffen". (Rosendahl Maschinen Ges.m.b.H., C.A. Greiner & Söhne GmbH – Extrusionstechnik /Institut für Kunststoffverarbeitung Leoben, Nr. 6/702, 1.6.1993 – 30.6.1996)
3. FWF-Project Schnelle Temperaturmessung an Kunststoffen, (Nr. P10942-ÖTE, 1.10.1995 – 31.12.1997)
4. FFF-Project "Entwicklung einer Verschleißapparatur mit integrierter Meßtechnik zur Messung des Abrasions/Korrosionsverschleißes an hochwertigen Kunststoff-Formenstählen" Böhler Edelstahl GmbH/Institut für Kunststoffverarbeitung Leoben, Nr. 3/13042, 1.9.1997 bis 31.8.1998)
5. FFF-Project „Entwicklung einer Verschleißapparatur mit integrierter Meßtechnik zur Messung des Abrasions/Korrosionsverschleißes an hochwertigen Kunststoff-Formstählen, Phase II“ (Böhler Edelstahl GmbH / Institut für Kunststoffverarbeitung Leoben, Nr. 800999/2938, (1.1.99 – 31.12.99)
6. EU-Project "Practical simulations of injection-moulding processes using special polymers for small parts", Acronym SIMULATIONMOLDINGSME, G5ST-CT-2002-50307, 1.3.2003 – 28.2.2005
7. PCCL multi-firm Project 3.2 „Reproduzierbare Herstellung von Oberflächenstrukturen und Oberflächenqualitäten an Spritzgießteilen“ (Projektleitung bis 30.6.2006, Key-Researcher von 07/2006-06/2009).
8. PCCL-Project S.6 "Characterization and parameterization of the visual appearance of given cavity and corresponding injection molded part surfaces", (1.7.2006 – 30.6.2009)
9. PCCL-Project S.10 "Thermal conductivity of polymers as a function of temperature and pressure in solid- and melt-state", (1.7.2006 – 30.6.2009)
10. EU-Project "New product development guidance system (PDGS) for complex injection moulded plastic parts by enhanced injection moulding simulation and material data measurement applicable by SMEs (Acronym: Pro4Plast), Proposal No. 030205-2; Collective research project, sixth framework programme; Project Coordinator: Gesamtverband Kunststoffverarbeitende Industrie e.V. (GKV), Frankfurt, Deutschland (09/2006-08/2009), MUL-IKV bezogene Aufgaben.
11. EU-Project „New Material Laws for Powder Injection Moulding Feedstocks“ Acronym: MATLAW, Co-operative Research Project (CRAFT); Project Coordinator Fraunhofer-Institut für Fertigungstechnik und angewandte Materialforschung (IFAM), Bremen (12/2006-11/2008)
12. FFG-Bridge Project "Grundlagen des Expansionsspritzgießens und dessen Simulation", Nr. 812967 (2/2007 – 01/2010)
13. PCCL multi-firm Project 3.15 "Surface quality improvement of injection molded parts using infrared-variotherm process control" (07/2008 – 06/2009)
14. PCCL-Project S.16 "Improvement and adaptation of an energetic wear model to predict abrasive wear on plastic mould steels" (1.1.2007 – 31.12.2008)
15. FFG-Bridge Project "Auslegung eines kämmend konisch gleichlaufenden Doppelschneckenextruders", Nr. 818087 (10/2008 – 09/2011)
16. Research Studio Austria Poly-Sens "Eigenintelligente Hochleistungsmesstechnik für komplexe Fertigungsprozesse für die Kunststofftechnik" (02/2009 – 01/2012)
17. COIN-Project ProK „Neue Prozesse und Technologien für die Entwicklung komplexer Kunststoffbauteile in der Kooperation zwischen OEM und KMU (07/2009-05/2011)
18. FFG-Bridge-Project „Heizzeitverkürzung im Kautschukspritzguss unter Ausnützung der Scher-, Dehn- und Kompressionserwärmung“ (11/2010 bis 10/2013)
19. EU CORNET-Project "Advanced PartSim2: Advanced Simulation Methods for part and process development of complex injection moulded plastic parts tailored for SMEs" (1.1.2011 - 30.4.2013)
20. PCCL-Project IV-2.03: Temperature management in injection molding by the E-Variotherm-process (1.1.2010 – 31.12.2013)
21. PCCL-Project IV-2.04: Development of methods for the characterization of appearance properties of glossy surfaces (1.1.2010 – 31.12.2013)

22. PCCL-Project IV-2.S3: Correlation between topographical and perceptual surface structure properties of injection moulded parts manufactured by utilizing improved heating layer systems (1.1.2010 – 31.12.2013)
23. PCCL-Project IV-2.08: Advanced polymer based light-weight solutions in an E-Mobility environment (1.6.2011 – 31.12.2013)
24. PCCL-Project IV-2.09: Advanced Simulation Methods and improved Material Data for a robust Rubber Injection Moulding Process (1.1.2012 – 31.12.2013)
25. PCCL-Project IV-3.11: Characterization and development of polymer membranes for acoustic applications (1.1.2010 – 31.12.2013)
26. PCCL-Project IV-4.04: Reduction of friction between polymer and metal/ceramic surfaces (1.1.2010 – 31.12.2013)
27. FFG-Bridge-Project „In-Mould Aktuatoren zur Faserverteilungs- und Betriebsfestigkeits-optimierung in kurzfaserverstärkten Spritzgießteilen“ (01/2013 - 12/2016)
28. FFG-COIN Project HLK Langzeitgarantie - KMU-taugliche Methodik zur Abschätzung des Langzeitverhaltens multifunktionaler Bauteile aus Hochleistungskunststoffen (10/2014 - 09/2016)
29. PCCL-Project 2.03: “RubSim II- Further development of the robust rubber injection moulding process including process-structure-performance relations (1.1.2014 - 31.12.2016)
30. PCCL-Project 2.04: “RubPart – Improving the curing degree homogeneity in rubber parts by new methods in rubber injection moulding” (1.1.2014 - 31.12.2016)
31. PCCL-Project 2.S2: “Effect of Processing on Morphology of Injection Molded Parts” (1.1.2014 - 31.12.2016)
32. PCCL-Project 2.06: “Development of methods for the investigation of correlations of measured surface properties and human soft-feel sensation” (1.1.2014 - 31.12.2016)
33. PCCL-Project 2.07: “Development of novel methods for the advanced large-area quality characterization of transparent materials (1.1.2014 - 31.12.2016)
34. PCCL-Project 2.05: “Development of methods for the IN-LINE quality inspection of freeform plastic surfaces aided by multi-axial robotic systems” (1.1.2014 - 31.12.2016)
35. PCCL-Project 2.S3: “Development of advanced methods for the characterization of surface properties close to human sensation” (1.1.2014 - 31.12.2016)
36. FFG-Project, Funding framework Produktion der Zukunft - Leitprojekt addmanu: Stärkung der österreichischen Wertschöpfungsketten für generative Fertigung in der industriellen Produktion (08/2015 - 03/2018)
37. FFG-Bridge-Project „DehnSim – Polymer-Compounds mit erhöhter Homogenität und Performance durch gezielten Einsatz von Dehnströmungen“ (co-operation with JKU-Linz, Prof. Miethlinger), (04/2014 bis 12/2017)
38. FFG-Project Basis Program, Dietzel GmbH: Entwicklung eines neuen komplett halogenfreien flammwidrigen Elektroinstallationssystems für hohe technische Ansprüche (07/2015 - 06/2017)
39. AC2T-Comet-Project: „Oberflächendesign für Verschleißschutz bei Spritzgussmaschinen“ (07/2015 – 06/2018)
40. FFG-Project „InKuBa - Qualifizierungsnetz „Neueste Entwicklungen/Methoden für die Auslegung von intelligenten Kunststoff- und Hybridbauteilen“ (11/2016 - 04/2018)
41. FFG-Bridge-Project „Rubexject – Ein revolutionärer Ansatz zur Herstellung von nahtlosen Hochleistungskomponenten aus Elastomeren“ (10/2016 - 09/2019)
42. EU-Cornet Project “Corrosion and Abrasion Resistance of Anti-Adhesive Hybrid Coatings for Polymer Processing”. Laufzeit 04/2017 bis 03/2019
43. PCCL-Project VI-2.01: SORIM -Self-optimizing rubber injection moulding for zero failure manufacturing” (1.1.2017 - 31.12.2020)
44. PCCL-Project VI-2.02: “Virtual Rubber Injection Molding Machine (VRIM)” (1.1.2017 - 31.12.2020).

Running Projects

1. PCCL-Project VI-2.02: “Virtual Rubber Injection Molding Machine II (VRIM-II)” (1.1.2021 - 31.12.2024).
2. FFG-Bridge Project KUFO-Verschleiß: KUFO Verschleiß - Einfluss der Dissipation auf den abrasiven Verschleiß an Formenstählen - Simulation und experimentelle Validierung, 1.10.2019 – 30.9.2022

List of Publications

Publications in Peer-reviewed Journals

- [1] W. Friesenbichler, W. Knappe, R. Rabitsch: Injection Molding without Packing. *International Polymer Processing III* (1988) 4, S. 191-197
- [2] B. Hribernik, J. Stamberger, W. Friesenbichler: Verschleiß von Werkzeugstählen unter den Bedingungen des Spritzgießens. *International STEEL & METALS Magazine*, Vol. 27 (1989) 3, S. 180-183 und *WERKSTOFFE & KONSTRUKTION*, Vol. 3 (1989) 3, S. 308-311
- [3] P. Zipper, P. M. Abuja, A. Jánosi, E. Wrentschur, W. Geymayer, E. Ingolic, W. Friesenbichler: Comparative Wide-angle X-ray and Microscopical Studies on the Layered Structure in Injection Molded Polypropylene Disks. *Intern. Polymer Processing X* (1995) 4, S. 341-350
- [4] I. Duretek, G. R. Langecker, W. Friesenbichler: Auswirkung der Versuchsparameter auf die Meßergebnisse von p-v-T-Diagrammen für Thermoplaste und Kautschuke. *Polimery* 17 (4) (1996), S. 177-182
- [5] P. Zipper, A. Jánosi, E. Wrentschur, W. Geymayer, E. Ingolic, W. Friesenbichler, F. Eigl: Wide-angle X-ray, Densitometric and Microscopical Studies on Injection Molded Polypropylene Disks. *Intern. Polymer Processing XII* (1997) 2, S. 192-199
- [6] W. Obendrauf, G. R. Langecker, W. Friesenbichler: Temperature Measuring in Plastics Processing with Infrared Radiation Thermometers – The Influence of the Absorption Coefficient. *Intern. Polymer Processing XIII* (1998) 1, S. 71 –77
- [7] Cramer A., W. Michaeli, W. Friesenbichler, I. Duretek: Simulation des Spritzgießprozesses von Mikrobautteilen. *Zeitschrift Kunststofftechnik/Journal of Plastics Technology* 3 (2007) 1, *Zeitschrift Kunststofftechnik* 3 (2007) 1, archivierte, rezensierte online-Zeitschrift des WAK, www.kunststofftech.com, S. 1-26
- [8] Braun J., I. Duretek, U. Müller, W. Friesenbichler, A. Endesfelder: Investigations of the Rheology and Reactivity of Extrudable Wood Resin Compounds. *Monatshefte für Chemie* 138, 337–341 (2007), DOI 10.1007/s00706-007-0610-9
- [9] G.R. Berger, W.Friesenbichler, G. Schöfer, G. Freudenschuß: Demolding Forces and Coefficients of Friction in Injection Molding. A new instrumented Mold and first results, *Plastics Age*, Vol. 55, (2009) pp. 87-94
- [10] S. Laske, M. Kracalik, M. Gschweidl, M. Feuchter, G. Maier, G. Pinter, R. Thomann, W. Friesenbichler, G. Langecker: Estimation of reinforcement in compatibilized polypropylene nanocomposites by extensional rheology. *J. Appl. Polym. Sci.* 111 (5), S. 2253 – 2259. DOI: 10.1002/app.29163.
- [11] M. Kracalik, S. Laske, M. Gschweidl, W. Friesenbichler, G. Langecker: Advanced compounding: extrusion of polypropylene nanocomposites using the melt pump, *Journal of Applied Polymer Science* 113 (2009), 3, p. 1422-1428. DOI: 10.1002/app.29888.
- [12] L. Olah, W. Friesenbichler, L. Borbas: Wear of plastic mold steels under injection molding conditions, *Transactions of FAMENA XXXIII-3* (2009), pp. 15-24
- [13] G.R. Berger, W. Friesenbichler, M.Reiter, S. Jutz, G. Langecker: Hochglanzoberflächen beim Spritzgießen. Quantitative topographische Beurteilung der Formenstahl- und Kunststoffoberfläche. *MP Materials Testing* 4 (2010), Seite 211-221, Direct Link: <http://www.materialstesting.de/directlink.asp?MP110121>
- [14] D. P. Gruber, G. Berger, G. Pacher, W. Friesenbichler: Novel approach to the measurement of the visual perceptibility of sink marks on injection molding parts. *Polymer testing* (2011) 30, p. 651-656
- [15] G. Berger, D.P. Gruber, W. Friesenbichler, C. Teichert, M. Burgsteiner: Replication of Stochastic and Geometric Micro Structures. Aspects of Visual Appearance. *Intern. Pol. Processing XXVI* (2011) 3, p. 313-322
- [16] W. Friesenbichler, I. Duretek, J. Rajganesh, S. Ramesh Kumar: Measuring the pressure dependent viscosity at high shear rates using a new rheological injection mould. *Polimery* 2011, 56, Nr. 1, p. 58-62
- [17] Perko L., W. Friesenbichler, M. Fasching: Ausnutzung der Scher- und Dehnerwärmung zur Heizzeitverkürzung bei der Verarbeitung von Elastomeren. *GAK* 9 (2013) Jg. 66, S. 622-624

- [18] L. Perko, W. Friesenbichler, V. Buchebner, G. Chaloupka, and W. Obendrauf, "Elongational viscosity of rubber compounds and improving corresponding models", *Adv. Pr. Eng. Man.*, 8, 63 (2013)
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- [20] G.R. Berger, S. Rook, G. Steinbichler, J. Giessauf, D.P. Gruber, W. Friesenbichler. More gloss, fewer weld lines with variothermal molding. *Plastics Technology (March) 2013*, Gardner Publications.
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- [22] Fasching, M., Berger, G., Friesenbichler, W., Filz, P., Helbich, B.: Robuste Prozessführung beim Kautschukspritzgießen unter Nutzung systematischer Simulation und verbesserter Materialdaten. *GAK Gummi Fasern Kunststoffe* 67 (2014), S. 640–644
- [23] Gruber D.P., J. Macher, D. Haba, G.R. Berger, G. Pacher, W. Friesenbichler: Measurement of the visual perceptibility of sink marks on injection molding parts by a new fast processing model, *Polymer Testing*, 33, 2014 p. 7-12
- [24] Johannes Macher, Dieter P. Gruber, Thomas Altenbuchner, Gernot A. Pacher, Gerald R. Berger, Walter Friesenbichler: A novel sink mark model for high gloss injection molded parts - Correlation of deflectometric and topographic measurements. *Polymer Testing* 39 (2014) 12-19; <http://dx.doi.org/10.1016/j.polymeresting.2014.07.001>
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Publications in peer-reviewed Conference Proceedings

- [1] G. R. Berger, G. A. Pacher, et al.: Influence of mold surface temperature on polymer part warpage in rapid heat cycle molding. AIP Conference Proceedings 1593.1 (Mai 2014), S. 189–194. url: <http://dx.doi.org/10.1063/1.4873761>, pp. 179–182.
- [2] G. A. Pacher, G. R. Berger et al.: In-Mold Sensor Concept to Calculate Process- Specific Rheological Properties. AIP Conference Proceedings 1593.1 (Mai 2014), S. 179–182. url: <http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4873759>
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