Randal Hill, Ph.D.
Kodiakhill Services LLC, Honor, MI 49640, (231)463-5235, rmhill@kodiakhillsvcs.com, www.linkedin.com/in/randalhill

Experienced and Respected Scientist and Chemist: Widely respected Scientist and Chemist with deep and broad experience in chemistry, analytical chemistry, chemical engineering and materials science. Uniquely wide experience of applying chemistry in household and personal care products, bio-derived surfactants, silicones, nanotechnology, electronic displays, agricultural adjuvants and oilfield chemicals. Readily adapts his experience and knowledge to new problems.

Product Development & Innovation: Influencer behind individual and collaborative innovations in the areas of surfactant applications, agricultural adjuvants, emulsions, microemulsions, and silicones. Career defining innovations include the serendipitous development of superhydrophobic silicone nanofibers, leading-edge microemulsion treatments with new dimensions of performance, and momentous diversification of Flotek's patent portfolio (which grew by 1400%).

Thought Leadership: Distinguished product innovator credited with 64 patents. Involved member of multiple organizations, including American Chemical Society, Society of Petroleum Engineers, American Physical Society, and American Oil Chemists Society. Author of 59 publications, including an authoritative book: "Silicone Surfactants." Highly awarded inventor with accolades that include 3 Dow Corning Technical Achievement Awards, as well as the 2017 AOCS Samuel Rosen Award for Surfactant Chemistry.

Career Progression

Kodiakhill Services LLC — Honor, MI
Scientist Consultant and Expert Witness Services — April 2020 to present
Provided consulting services on projects including formulating agricultural products, surfactant formulations for fire-fighting foam and oilfield chemicals, thread lubricants, design of new bio-based surfactants, silicone construction applications, silicone defoamers, silicone surfactants, and silicone foams. Utilized broad experience including colloid science, formulation development, and intellectual property protection.

Flotek Chemistry LLC — Houston, TX
Research Fellow — June 2015 to April 2020
Lead product development work as both an individual contributor and team/project manager on projects involving microemulsion formulation challenges and quantitative methods for reservoir characterization. Developed and leveraged a comprehensive understanding of Flotek's products to improve performance, communicate product characteristics for business and promotional purposes, and formulate the next generation of products tailored to market requirements and demand.
Achieved diversification of surfactant and CnF® solvent chemistry to provide cost effective and generally improved performance in lowering surface tension, enhancing wetting, providing demulsification, and achieving freeze protection.
Discovered that certain low surface tension solvents in microemulsion give surface tension values in confined pore space of a dry/wet gas well far below the surfactant alone to increase flowback and well productivity. Patent applied for, and concept formulated into a new kind of product introduced to the gas well market in early 2020.

Invented a new kind of agricultural adjuvant based on bio-sourced surfactants and solvents that combined spreading over and softening of the waxy leaf cuticle to facilitate penetration of highly hydrophilic active ingredients such as micronutrients, herbicides, and antibiotics.

Flotek Chemistry LLC Houston, TX
Formulation Development Manager November 2011 to April 2020
Owned product development output and drove R&D performance across 10-person Formulation Development (FormDev) Group. Propelled research, testing, and commercialization of oil/gas and agriculture products that utilized solvents and surfactants. Partnered with cross functional teams (legal, go-to-market, etc.) to manage/expand product portfolio. Led product innovation stage-gate process from planning, viability assessment, and raw material validation to scale up and intellectual property (IP) patenting.
Enhanced data reporting and presentation. Reviewed business and manufacturing directives and aligned/prioritized project portfolio to address needs and requirements. Administered $2M group budget and managed capital, lab, and travel expenses. Trained and mentored Research Scientists.
Developed 40 new products over tenure with 30 realizing full commercialization. Revised and reformulated an additional 40 products to improve manufacturability, reduce production cost, and adapt to customers' evolving needs.
Grew patent portfolio from 6 to 93 in 7-years to protect all aspects of company's newly developed well-treatment technology. Diversified patent protection to include wide range of bio-derived and mineral spirit solvents as well as diverse surfactants.
Built a FormDev Group that was renowned for expertise in microemulsion phase behavior and efficient formulation of new kinds of CnF® products. Established a culture of scientific excellence in all areas relevant to product performance.
Amplified efficacy of statistical analysis by implementing data evaluation best practices.
Demonstrated that CnF® product performance (to enhance well productivity in certain wells) is due to solvent mobilizing asphaltenic residues to increase near wellbore permeability. Developed demo to show this to potential customers.

E Ink Corp Cambridge, MA
Pigment Group Leader and Principal Scientist August 2008 to November 2011
Oversaw a lab and projects dedicated to facilitating the science behind electrophoretic ink displays (specifically development of polymer pigment surface treatments with controlled grafting density, molecular weight, and chemical composition). Expanded pigment team from 3 to 10 scientists by selecting and hiring leading chemists, including polymerization specialists. Collaborated with Product Development and Physics Groups to advance development efforts. Served as member of Vice President's leadership team.
Achieved precise and quantitative control of electrophoretic pigment particle charge by means of control of polymer grafting density, MW, and fluoro composition. Demonstration that switching (from black to white to black) progressed from none to strong and back to none as the system progressed from nearly neutral particles to highly charged.
Successfully demonstrated that black fines from the black pigment were contaminating the white pigment and limiting the achievable white state of the display.
Completed preparation of well-defined silica coated core-shell titania nanoparticles to improve white state of the display.
Accomplished demonstration of making black ink particles with extremely high extinction coefficient lacking the presence of fines and potentially eliminating the contamination problem.

Proposed model for the charge mechanism of electrophoretic pigment particles with fluoro-polymer shell that was consistent with lab results.

Dow Silicones Corporation (Formerly Dow Corning Corporation) Midland, MI
MIT Visiting Scientist September 2003 to April 2008
Leveraged expertise with self-assembly to support work conducted by the Institute for Soldier Nanotechnology (ISN), a joint venture between MIT, Dow Corning, and the U.S. Army.
Contributed extensively to projects surrounding block copolymers and development of superhydrophobic silicone nanofibers. Identified emerging innovations in nanotechnology that aligned with Dow's business interests and courted partnerships with 9 professors behind said innovations. Obtained funding to progress work on prototypes.
Invented surface functionalized superhydrophobic silicone nanofibers, in collaboration with Professors Rutledge and Hammond at MIT ISN, resulting in a Langmuir paper (cited 558 times since publication in 2005), and 2 patents.
Successfully acquired 3 years of U.S. Army funding to further the evolution of nanofiber membranes used in breathable protective textiles, resulting in first-stage integration of components into a prototype, 3 patent applications, and several journal articles.
Spearheaded global incubator project on self-assembling nanostructured silicone materials for photonic applications that led to a patent application and an Army grant to support joint work with MIT and the University of Ioannina in Greece.
Developed techniques to synthesize very high MW silicone block copolymers and characterize self-assembly to form materials with a visible wavelength photonic bandgap.

Associate Research Scientist June 1998 to September 2003
Collaborated with product development teams to further develop silicone surfactant technologies for personal and household care applications resulting in a new low viscosity transparent gel for a major customer, formulation of silicone vesicles into personal care products, and multiple patents issued.
Lead a Joint Development project with a Silicon Valley startup to develop a transparent nanocomposite silicone material with a refractive index >1.55, resulting in one patent application.
Lead a joint project with Stanford University that substantially broadened the formulation space of transparent personal care products based on silicone copolymers and generated new understanding of gel formation.

Senior Research Specialist February 1988 to June 1998
Research Specialist
Co-authored and published a book entitled "Silicone Surfactants."
Initiated a 5-year collaboration with the University of Minnesota that generated new scientific understanding of silicone surfactants that laid the foundation for many new patented product technologies that have become New Product – New Market Sales. Developed new antifoam technology leading to a new product launch with a major household care products customer.

Horizon Chemical Co. Decatur, IL
Senior Research Chemist September 1986 to February 1988
Developed understanding of the physical chemistry and applications of alkyl polyglycoside surfactants. Provided fundamental understanding and interacted extensively with customers to facilitate rapid application development of these materials.

Lever Research Inc. Edgewater, NJ
Principal Research Chemist November 1982 to September 1986
Assigned to Unilever Research, Vlaardingen, The Netherlands June 1984 to June 1985 to learn detergent enzyme technology.
Developed a new automatic dishwashing detergent formulation based on enzymes.
Developed a new laundry detergent formulation based on mixed surfactant systems and enzymes.
Transferred enzyme technology from Unilever Research (Netherlands) to Lever Research US.

Education

Ph.D., Physical Chemistry – University of Oklahoma (Norman, OK), 1982
B.S., Physics – Southern Nazarene University (Bethany, OK), 1976

Academic Roles

Adjunct Professor – University of Minnesota, 1993-1995
Adjunct Professor – Wayne State University, 2000-2005
Visiting Scholar – Stanford University, 2000-2003
Visiting Scientist – Massachusetts Institute of Technology (MIT)

Honors and Awards

Dow Corning Technical Achievement Award, “Silicone Microemulsions for Antiperspirants”, 2001
Dow Corning Technical Achievement Award, “New Personal Care Applications of Siloxane Surfactants”, 1995
Dow Corning Technical Achievement Award, “Foam Control Technologies”, 1990
AOCS Samuel Rosen Award for Surfactant Chemistry, 2017.

Invited Lectures and Symposia Organized

Hill, R.M. “Surfactant Enhanced Spreading”, Gordon Research Conference, “Chemistry at Interfaces”, July, 1998.
Hill, R.M., “The Dynamics of Surfactant Enhanced Spreading”, ACS National Meeting, Dallas, TX, March, 1998.
Hill, R.M., “The Dynamics of Surfactant Enhanced Spreading”, PRA, Orlando, FL March 1998.
Hill, R.M.; Stoebe, T.; Davis, H.T., “Wetting by mixtures of siloxane and hydrocarbon surfactant”, Workshop on Spreading, Gien, France, May 2000.
Member of the international organizing committee, Industrial-Academic Workshop on Spreading, Giens, France, May, 2000.
Co-organized with Prof. Darsh Wasan (IIT) a two day symposium on surfactant spreading at the Fall National ACS Meeting, Boston, August, 1998.

Publications and Patents
View Publications including citation statistics via Google Scholar (unfortunately, this is not complete) at: https://scholar.google.com/citations?user=iUKgILkAAAAJ&hl=en&oi=ao

Patents
64 issued patents, including US patents and selected international patents on material not granted in US.

64. Hill, R.M., Champagne, L.M., Lett, N.L., Dismuke, Keith I., Germack, D., Soeung, M., and Mast, N., Flotek Chemistry LLC, 2020. Methods and compositions for use in oil and/or gas wells, US20200332177A1, issued as US11254856B2 on 20220222.
63. Forbes, Natalie, James Silas, and Randal M. Hill. "Diluted microemulsions with low surface tensions." U.S. Patent Application 16/430,898, filed September 19, 2019. Published as US20190284467A1, issued as US11180690 on 20211123.
62. Penny, G.S., Dismuke, K.I., Fox, R.N., Zelenev, A., and Hill, R.M., Flotek Chemistry LLC, 2020. Siloxane surfactant additives for oil and gas applications. US20200216749A1. US11149189, 20211019.
61. Hill, Randal M., Paul Ashcraft, Angus Fursdon-Welsh, Lakia M. Champagne, and Natalie Forbes, US11053433B2, "Methods and compositions for stimulating the production of hydrocarbons from subterranean formations." U.S. Patent Application 16/206,304, filed June 6, 2019. Published as US20190169492A1, Mineral spirits + octanol, first type of solvent is a long chain hydrocarbon solvent, and the second type of solvent is an oxygenated solvent. Granted patent limits surfactant to ethoxylated TSP.
60. Lakia M. Champagne, Angus Fursdon-Welsh, Randal M. Hill, US11034879B2, 20210615, TSP with alkane solvents. U.S. Patent Application 16/430,138, filed October 17, 2019. Published as US20190316021A1. TSP case with alkane solvents.
59. Stephen J. Telfer, Richard J. Paolini, Jr., Sunil Krishna Sainis, Randal M. Hill, Isaac W. Moran, Lee Yezek, Alain Bouchard, William Vetterling, George G. Harris, Hywel Morgan, Luke Slominski, Jay William Anseth. Jennifer M. Morrison, Craig A. Herb, US11029576B2, 20210608, Method for driving two layer variable transmission display, E Ink Corp.
58. Trabelsi, Siwar, and Randal M. Hill. "Methods and compositions incorporating alkyl polyglycoside surfactant for use in oil and/or gas wells. US10941106. 20210309. U.S. Patent Application 16/454,511, filed October 17, 2019. Published as US20190315674A1. Continuation of APG case. Granted as US10941106.
57. Hill, R.M., Champagne, L.M., Lett, N.L., Dismuke, K.I., Germack, D., Mast, N., and Soeung, M., Flotek Chemistry LLC, 2020. Methods and compositions for stimulating the production of hydrocarbons from subterranean formations. US10738235B2.
56. Saboowala, H., Hill, R.M., Fursdon-Welsh, A., Flotek Chemistry LLC, 2020. Methods and compositions for use in oil and/or gas wells comprising microemulsions with terpene, silicone solvent, and surfactant. US10731071B2.
55. Hill, R.M., Champagne, L.M., Lett, N.L., Dismuke, Keith I., Germack, D., Soeung, M., and Mast, N., Flotek Chemistry LLC, 2020. Methods and compositions for use in oil and/or gas wells. US10703960B2.
54. Dismuke, K.I., Philpot, D., Hill, R.M., Pennypacker, R., Hill, S., and T.R. Sifferman, Flotek Chemistry LLC, 2020. Oxidative breakers in a silicone based suspension. US10696887B2.
53. Penny, G.S., Dismuke, K.I., Fox, R.N., Zelenev, A., and Hill, R.M., Flotek Chemistry LLC, 2020. Siloxane surfactant additives for oil and gas applications. US10590332B2.
52. Hill, R.M., Champagne, L.M., Lett, N.L., Green, M.E., and Saboowala, H., Flotek Chemistry LLC, 2020. Methods and compositions for stimulating the production of

hydrocarbons from subterranean formations using emulsions comprising terpene. US10544355B2.
51. Dismuke, K., Philpot, D., Hill, R.M., Pennypacker, R., Hill, S., and Sifferman, T., Flotek Chemistry LLC, 2019. Oxidative breakers in a silicone based suspension. CA2906097C
50. Hill, R.M., Soeung, M., and Gonzalez-Roldan, M., Flotek Chemistry LLC, 2019. Methods and compositions for use in oil and/or gas wells. CA2904735C.
49. Hill, R.M., Champagne, L.M., Lett, N.L., Green, M.E., and Saboowala, H., Flotek Chemistry LLC, 2019. Methods and compositions for stimulating the production of hydrocarbons from subterranean formations. CA2906047C.
48. Saboowala, H., Hill, R.M., and Fursdon-Welsh, A., Flotek Chemistry LLC, 2019. Method and composition for oil well and/or gas well. CN105971571B.
47. Trabelsi, Siwar, and Hill, R.M., US10421707, Methods and compositions incorporating alkyl polyglycoside surfactant for use in oil and/or gas wells., 9/24/2019, to Flotek Chemistry LLC.
46. Hill, R.M., Champagne, L.M., et al., AU2017261565B2, Methods and compositions for stimulating the production of hydrocarbons from subterranean formations, 9/12/2019, to Flotek Chemistry LLC.
45. Michael A. Bryan, Hill, R.M., et al., Methods and compositions for use in oil and/or gas wells, AU2018201361B2, 5/16/2019, to Flotek Chemistry LLC.
44. Saboowala, H., Hill, R.M., Paul Ashcraft, Soeung, M., CN106837217B, For oil well and/or the composition and method comprising terpenol of gas well, 7/2/2019, to Flotek Chemistry LLC.
43. Saboowala, Hasnain, Hill, R.M., Paul Ashcraft, and Soeung, M.. US10287483, Methods and compositions for use in oil and/or gas wells comprising a terpene alcohol, 5/14/2019, to Flotek Chemistry LLC.
42. Saboowala, H., Hill, R.M., CA2904736C, Siloxane surfactant additives for oil and gas applications, 4/23/2019, to Flotek Chemistry LLC.
41. Randal Hill, Lakia Champagne, Nathan Lett, Maria E. Green, Saboowala, H., CN104755582B, Method for stimulating and composition for producing hydrocarbons from subsurface formations, 4/12/2019, to Flotek Chemistry LLC.
40. Randal Hill, Soeung, M., Monica Gonzalez-Roldan, CN105419750B, Method and composition for oil well and/or gas well, 3/22/2019, to Flotek Chemistry LLC.
39. Saboowala, H., Hill, R.M., Fursdon-Welsh, A., EP3067404A1, Methods and compositions for use in oil and/or gas wells, 3/6/2019, to Flotek Chemistry LLC.
38. Saboowala, H., Hill, R.M., Ashcraft, P.A., Soeung, M., AU2015227467B2, Terpene alcohol microemulsion additives, 2/21/2019, Flotek Chemistry.
37. Saboowala, H., Hill, R.M., Fursdon-Welsch, A., AU2015227471B2, Silicone solvent microemulsions for crude oil demulsification, 2/21/2019, Flotek Chemistry.
36. Hill, R.M., Soeung, M., Gonzalez-Roldan, M., AU2015227391B2, Silicone solvent microemulsion additives, 2/14/2019, Flotek Chemistry.
35. Hill, R.M., Champagne, L.C., et al., US10196557, Hydrocarbon solvent microemulsion additives, 2/5/2019, Flotek Chemistry.
34. Hill, R.M., Germack, D., Soeung, M., Holcomb, D.L., CA2897548C, Hydrophobic nanoparticle microemulsion additives, 10/30/2018, Flotek Chemistry.
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32. Saboowala, H., Hill, R.M., US10053619, Siloxane surfactant additives for oil and gas applications, 8/21/2018, Flotek Chemistry.

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30. Telfer, S.J., Hill, R.M., et al., US9989829, Multi-color electro-optic displays, 6/5/2018, E Ink Corporation.
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28. Penny, G.S., Dismuke, K., Fox, R., Zelenev, A., Hill, R.M., CA2842208C, Siloxane surfactant additives for oil and gas applications, 5/1/2018, Flotek Chemistry.
27. Hill, R.M., et al., CN ZL201480002623.0, Alpha-olefin microemulsions for oil and gas applications, 4/24/2018, Flotek Chemistry.
26. Champagne, L.C., Hill, R.M., et al., AU2014236272B2, Amine solvent microemulsion additives for oil and gas applications, 3/15/2018.
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24. Saboowala, H., Hill, R.M., Fursdon-Welsh, A., US9868893, Silicone solvent microemulsions for crude oil demulsification, 1/16/2018, Flotek Chemistry.
23. Hill, R.M., Champagne, L.C., Lett, N.L., Dismuke, K.I., Germack, D., Mast, N., Seoung, M., AU2014278002B2, Hydrocarbon solvent microemulsions for oil and gas applications, 11/30/2017, Flotek Chemistry.
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20. Hill, R.M., Champagne, L.C., Lett, N.L., Green, M.E., Saboowala, H., US9428683, Methods and compositions for stimulating the production of hydrocarbons from subterranean formations, 2016, Flotek Chemistry.
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18. Telfer, S.J.; Hill, R.M.; et al., US9341916, Multi-color electro-optic displays, 2016, E Ink Corporation.
17. Hill, R.M.; Champagne, L.M.; Lett, N.L.; Green, M.E., US9068108, 2015, CESI Chemical.
16. Lee J.A., Krogman K.C., Hill R.M., Rutledge G.C., Hammond P.T., US8906814B2, 12/9/2014, to MIT.
15. Rutledge, G. C., Hill, R. M., Lowery, J. L., Ma, M. and S. Fridrikh, Superhydrophobic fibers and methods of preparation and use thereof, US8574713B2, 11/5/2013, to MIT.
14. Telfer, S.J.; Hill, R.M.; et al., US8576476, Multi-color electro-optic displays, 2013, E Ink Corporation.
13. Feng, Q.J., Z. Lin and R.M. Hill, Clear silicone microemulsions formed spontaneously, US6998424, 2006, Dow Corning Corp.
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10. Halloran, D.J., R.M. Hill, B.M. Wrolson, and B.L. Zimmerman, Polymerization of silicone microemulsions, US6479583, 2002, Dow Corning Corp.

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6. Hill, R.M., Spontaneously formed clear silicone microemulsions, US5705562, 1998, Dow Corning Corp.
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3. Hill, R.M. and S.A. Snow, Siloxane surfactant vesicles for entrapment of cosmetics and pharmaceuticals, US5364633, 1994, Dow Corning Corp.
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1. Hill, R.M. and S.A. Snow, Cationic diquaternary ammonium salt containing functional silicones, US5235082, 1993, Dow Corning Corp.

Articles

59. Swanson, C., Hill, W.A., Nilson, G., Griman, C., Hill, R., Sullivan, P., Aften, C., Jimenez, J.C., Pietrangeli, G., Shedd, D.C. and Pursley, J., 2018, September. Post-Frac-Hit Mitigation and Well Remediation of Woodford Horizontal Wells With Solvent/Surfactant Chemistry Blend. In Unconventional Resources Technology Conference, Houston, Texas, 23-25 July 2018 (pp. 1479-1494). Society of Exploration Geophysicists, American Association of Petroleum Geologists, Society of Petroleum Engineers.
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