

## NAME AND CONTACT DETAILS

Name: Prof. Harry E.A. Van den Akker

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## CAREER PROFILE

### Education

1974 – 1978 PhD, Eindhoven University of Technology, Netherlands

1968 – 1974 MSc Chemical Engineering, Eindhoven University of Technology, Neth.

### Employment

2013 – University of Limerick (Ireland): Bernal Professor in Fluid Mechanics

1988 – Delft University of Technology (Neth.): Professor in Transport Phenomena

1977 – 1988 Royal Dutch/Shell Laboratory, Amsterdam (Shell Research B.V.)

1984 – 1985 Shell Oil, Westhollow Research Center, Houston, TX, USA

My recent research output reflects a substantial reduction in research activities due to cancer (2004-2006), managerial tasks (among which Head of Department, 2002-2012), and my transition in 2013 to the University of Limerick where I am building a new active research group. In 2017, I am expecting to have at least 6 journal papers published.

## INNOVATION/COMMERCIALISATION ACTIVITY

### Industrial Collaborations:

- My career started with Shell where I studied various engineering problems; at the occasion of my transition to Delft University (1988), Shell provided me with a start-up grant to an amount of some €225,000 – at that moment the largest Shell grant ever.
- In my Delft period, I worked with many companies, Shell in the first place, but also DSM, Exxon, Hoogovens (now Tata Steel), Huntsman, Dow Chemical, AkzoNobel, Siemens, ASM Int'l, Philips, DuPont, Van Tongeren, Stork, Coberco, Witmetaal, Scholten Lijmen, Wheelabrator, TNO, Toftejorg, Sontex, Primix, Sabic, Bostik, FrieslandCampina, and several other companies, either in the context of research foundation funded PhD research projects or via company supported MSc student and PDEng trainee projects
- My research funding in the period 1990-2010 comprised
  - 3 of my 31 PhD students were financed by EU Framework Programs
  - 9 by the various Dutch research foundations (FOM, NWO, STW)
  - 2 by the Dutch research organization TNO
  - 3 by the Dutch Ministry of Economic Affairs (innovation programs)
  - 5 from central innovation budgets of Delft University of Technology
- Now, at the University of Limerick, I am carrying out projects with dairy companies in the frameworks of the Dairy Process Technology Centre DPTC, with 4 pharmaceutical companies within the Pharmaceutical Manufacturing Technology Centre PMTC, in the context of the SSPC MOMEnTUM Spoke with Johnson & Johnson and with Rusal, and with Aerogen via an Enterprise Ireland project.

**Patents Granted:**

- Apparatus for the separation of solids from a mixture of solids and fluid (Twin Drum Separator) T5225, 10 March 1988. European Patent Application filed 3 March 1989, #89200556.2 (GB 8805755), also USA (together with 5 other persons).
- Improved Swirl Tube Separator, T5059, 22 September 1988; European Patent Application filed 21 September 1989, #89202391.2 (GB 8822348), also USA (together with C.J.M. De Kort).
- Apparatus for separating solid particles from a fluid, T5217, 22 September 1988; European Patent Application filed 21 September 1989, #89202388.8 (GB 8822350), also USA.

**Other Innovation/Commercialisation Activities:**

- In 2001, as the Scientific Director of the Netherlands Research School OSPT, I published the Green Manifesto, calling for innovative research programs for more sustainable processes in chemical industry.
- As a member of the Executive Committee of the Dutch Institute for Sustainable Process Technology (ISPT), I played an active role in promoting and supporting innovation in process industries.
- I was involved in the Delft PDEng (Professional Doctorate in Engineering) program: a 2yr full-time post-graduate program educating design engineers; among other things, I supervised some 12 - 15 of these students during their 2<sup>nd</sup> year design project carried out within companies.
- In Limerick, I am involved in several networks with companies located in Ireland (including the Dairy Process Technology Centre, DPTC, and the Pharmaceutical Manufacturing Technology Centre, PMTC ) and I am a Funded Investigator to SSPC, the industry focused Synthesis & Solid State Pharmaceutical Centre at UL.

**KEY ACHIEVEMENTS (RESEARCH AND IMPACT)**

1. One of major generic topics over the years was ‘dispersed multiphase flows’ involving research on bubble columns, aerated stirred vessels and fluidized beds. My focus was on exploring, describing and measuring the role of coherent vertical-flow structures in multiphase systems. In 2000, the Dutch Research Foundation for Fundamental Physics (FOM) awarded 1 assistant professor position plus 4 PhD positions *via* its ‘Dispersed Multi-phase Flow’ Program (k€ 1200) to my group. My current experimental research in Limerick, with PhD student, Corné Muilwijk, is an extension of that research.
2. Over the years, I made significant contributions to advancing the use of Computational Fluid Dynamics techniques in the field of industrial mixing: RANS simulations since 1990; LES since 1996; DNS since 2004/2012; CFD for aerated stirred vessels (1992); population balances for aerated stirred vessel (2002); with a kernel for agglomeration (2001). As a result, in 2011, the North American Mixing Forum (NAMF) selected my 1999-paper with J.J. Derksen in the AIChE Journal, entitled ‘Large eddy simulations on the flow driven by a Rushton turbine’ (see publication #48) as one of the 21 most influential contributions to the field of mixing (since 1940)
3. In 2001, I was appointed Director of the TU Delft Multidisciplinary Research Initiative ‘Mastering the Molecules in Manufacturing (M3)’ in which several research groups from several Delft Faculties participated; M3 comprised a large number of professors, PhD students and postdocs. My own research share in M3 was the supervision of 4 PhD

students.

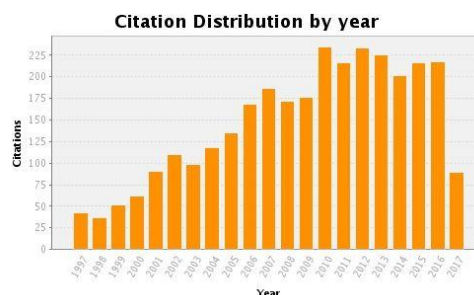
4. In 2011, I was bestowed with the 'Leermeesterprijs 2011', the Annual Master Teacher Award for Excellence in Research & Teaching at Delft University of Technology, because of the excellent quality of my research and the establishment of a 'school' in the field of transport phenomena having attracted large numbers of MSc and PhD students
5. In 2013, I was selected as Bernal Chair of Fluid Mechanics at the University of Limerick, Ireland - with a start-up fund of €500,000.

## PUBLICATIONS

Total No. of Publications: 243 (ResearchGate)	Senior Author Publications: 221	h-Index: 30 (ISI)	Total no. of citations: >3000	Source of citation data: ISI Web of Science	
Journal Articles: 120 (ISI)	Reviews: 10 to 15	Book Chapters: 3	Books: 3	Conference associated publications: 94	Other: 23

### Selected senior author publications (\*Senior author publications)

- Zarghami, A, and H.E.A. Van den Akker\* (2017), Thermohydrodynamics of an evaporating droplet studied using a multiphase lattice Boltzmann method, Phys. Rev. E 95, 043310 (JIF 2015: 2.252)
- Ashorynejad, H.R., K. Javaherdeh, and H.E.A. Van den Akker\* (2016), The effect of pulsating pressure on the performance of a PEM fuel cell with a wavy cathode surface, Int. J. Hydrogen Energy 41, 14239-14251 (JIF 2015: 3.205; Citations = 3).
- Zarghami A, N. Looije and H.E.A. Van den Akker\* (2015), Assessment of interaction potential in simulating non-isothermal multiphase systems by means of lattice Boltzmann modelling, Phys. Rev. E 92, 023307 (JIF 2015: 2.252; Citations = 5).
- Kamali M.R. and H.E.A. Van den Akker\* (2013), Simulating Gas-Liquid Flows by Means of a Pseudo-potential Lattice Boltzmann Method, Ind. Eng. Chem. Research 52, 11365-11377 (JIF 2015: 2.567; Citations = 5).
- Gillissen J.J.J. and H.E.A. Van den Akker\* (2012), Direct Numerical Simulation of the turbulent flow in a baffled tank driven by a Rushton turbine, AIChE Journal 58, 3878-3890 (JIF 2015: 2.98; Citations = 10).
- Heus T., G. Van Dijk, H.J.J. Jonker and H.E.A. Van den Akker\* (2008), Mixing in shallow cumulus clouds studied by Lagrangian particle tracking, J. Atmos. Sci. 65, 2581-2597 (JIF 2015: 3.578; Citations = 45).
- Venneker B.C.H., J.J. Derksen and H.E.A. Van den Akker\* (2010), Turbulent flow of shear-thinning liquids in stirred tanks-The effects of Reynolds number and flow index, Chem. Eng. Res. Des. 88, **827-843** (JIF 2015: 2.525; Citations: 20).
- Van den Akker\* H.E.A. (2010), Toward A Truly Multi-scale Computational Strategy For Simulating Turbulent Two-Phase Flow Processes, Ind. Eng. Chem. Research 49, 10780-10797 (JIF 2015: 2.567; Citations = 16).
- Ten Cate A., E. Van Vliet, J.J. Derksen and H.E.A. Van den Akker\* (2006), Application of spectral forcing in lattice-Boltzmann simulations of homogeneous turbulence, Comp. & Fluids 35, 1239-1251 (JIF 2015: 1.891; Citations = 23).
- Hoekstra, A.J., J.J. Derksen and H.E.A. Van den Akker\* (1999) An experimental and numerical study of turbulent swirling flow in gas cyclones, Chem. Eng. Sci. 54 (13-14), 2055-2065 (JIF 2015: 2.75; Citations=188)2055-2065 (JIF 2015: 2.75; Citations=188).



### Other Publications

- Kamali M.R., J.J.J. Gillissen, H.E.A. Van den Akker and S. Sundaresan (2013) Lattice-Boltzmann-based two-phase thermal model for simulating phase change, Phys Rev. E 88, 033302 (JIF 2015: 2.252; Citations = 13).

12. Mousazadeh, F., H.E.A. Van den Akker and R.F. Mudde (2013), Direct numerical simulation of an exothermic gas-phase reaction in a packed bed with random particle distribution, *Chem. Eng. Sci.* 100, 259-265 (JIF 2015: 2.75; Citations: 6).
13. Mousazadeh F., H.E.A. Van den Akker and R.F. Mudde (2012), Eulerian simulation of heat transfer in a trickle bed reactor with constant wall temperature, *Chem. Eng. J.* 207-208, 675-682 (JIF 2015: 5.31; Citations = 8).
14. Kamali M.R., S. Sundaresan, H.E.A. Van den Akker\* and J.J.J. Gillissen (2012), A multi-component two-phase lattice-Boltzmann method applied to a 1-D Fischer-Tropsch reactor, *Chem. Eng. J.* 207-208, 587-595 (JIF 2015: 5.31; Citations = 19).
15. Kamali M.R., J.J.J. Gillissen and H.E.A. Van den Akker (2011), Contact line motion without slip in lattice Boltzmann simulations, *Chem. Eng. Sci.* 66, 3452-3458 (JIF 2015: 2.75; Citations: 7).
16. Gillissen J. J. J., S. Sundaresan and H.E.A. Van den Akker\* (2011), A lattice Boltzmann study on the drag force in bubble swarms, *J. Fluid Mech.* 679, 101-121 (JIF 2015: 2.514; Citations = 8)
17. Vellema J., N.G.M. Hunfeld, H.E.A. Van den Akker and J.H. Ter Horst (2011), Avoiding crystal-ization of lorazepam during infusion, *Eur. J. Pharm. Sci.* 44, 621-626 (JIF 2015: 3.773; Citations: 4).
18. Vervloet D., M.R. Kamali, J.J.J. Gillissen, J. Nijenhuis, H.E.A. Van den Akker, F. Kapteijn and J.R. Van Ommen (2009), Intensification of co-current gas-liquid reactors using structured catalytic packings: A multi-scale approach, *Catalysis Today* 147, S138-S143 (JIF 2015: 4.312; Citations: 21).
19. Heus T., C.F.J. Pols, H.J.J. Jonker, H.E.A. Van den Akker and D.H. Lenschow (2009), Observational validation of the compensating mass flux through the shell around cumulus clouds, *Quart. J. Roy. Meteor. Soc.* 135, Issue 638, Part A, 101-112 (JIF 2015: 3.669; Citations: 22).
20. Heus T., H.J.J. Jonker, H.E.A. Van den Akker\*, E.J. Griffith, M. Koutek and F.H. Post (2009), A statistical approach to the life cycle analysis of cumulus clouds selected in a virtual reality environment, *J. Geophys. Res. – Atmospheres* 114, Paper D06208 (JIF 2015: 3.318; Citations: 23).
21. Mudde R.F., W.K. Hartevelde and H.E.A. Van den Akker\* (2009), Uniform Flow in Bubble Columns, *Ind. Eng. Chem. Research* 48, 148-158 (JIF 2015: 2.567; Citations 31)
22. Derksen J.J., S. Sundaresan and H.E.A. Van den Akker\* (2008), Two-way coupled large-eddy simulations of the gas-solid flow in cyclone separators, *AIChE Journal* 54, 872-885 (JIF 2015: 2.98; Citations = 38).
23. Rohde M., J.J. Derksen and H.E.A. Van den Akker\* (2008), An applicability study of advanced lattice-Boltzmann techniques for moving, no-slip boundaries and local grid refinement, *Computers & Fluids* 37, 1238-1252 (JIF 2015: 1.891; Citations: 9).
24. Derksen J.J., H.E.A. Van den Akker\* (2007), Multi-scale simulations of stirred liquid-liquid dispersions, *Chem. Eng. Res. Des.* 85, 697-702 (JIF2015: 2.525; Citations 12)
25. Derksen J.J., K. Kontomaris, J.B. McLaughlin and H.E.A. Van den Akker\* (2007), Large-eddy simulation of single-phase flow dynamics and mixing in an industrial crystallizer, *Chem. Eng. Res. Des.* 85, 169-179 (JIF 2015: 2.525; Citations: 15).
26. Van Vliet E., J.J. Derksen, H.E.A. Van den Akker\* and R.O. Fox (2007), Numerical study on the turbulent reacting flow in the vicinity of the injector of an LDPE tubular reactor, *Chem. Eng. Sci.* 62, 2435-2444 (JIF 2015: 2.75; Citations = 3).
27. Derksen J.J., S. Sundaresan and H.E.A. Van den Akker\* (2006), Simulation of mass-loading effects in gas-solids cyclone separators, *Powder Technol.* 163, 59-68 (JIF 2015: 2.759; Citations: 54).
28. Hartmann H., J.J. Derksen and H.E.A. Van den Akker\* (2006), Numerical solution of

- a dissolution process in a stirred tank reactor, Chem. Eng. Sci. 61, 3025-3032 (JIF 2015: 2.75; Citations = 24).
29. Hartmann H., J.J. Derksen , H.E.A. Van den Akker\* (2006), Mixing times in a turbulent stirred tank using LES, AIChE Journal 52, 3696-3706 (JIF 2015: 2.98; Citations = 43).
  30. Rohde M., D. Kandhai, J.J. Derksen and H.E.A. Van den Akker\* (2006), A generic, mass conservative local grid refinement technique for lattice-Boltzmann schemes, Int. J. Numer. Meth. Fluids 51(4) 439-468 (JIF 2015: 1.447; Citations = 35).
  31. Van den Akker\* H.E.A. (2006), The details of turbulent mixing processes and their simulation, Advances in Chemical Engineering 31, Ed. G.B. Marin, Elsevier, pp. 151-229 ISBN: 978-0-12-008531-6; (Citations = 30).
  32. Van Vliet, E., J.J. Derksen and H.E.A. Van den Akker\* (2005), Turbulent mixing in a tubular reactor: Assessment of an FDF/LES approach, AIChE Journal 51 (3), 725-739. (JIF 2015: 2.980; Citations= 23) .
  33. Hartmann, H., J.J. Derksen, C. Montavon, J. Pearson, I.S. Hamill and H.E.A. Van den Akker\* (2004) Assessment of large eddy and RANS stirred tank simulations by means of LDA, Chem. Eng. Sci. 59, (12), 2419-2432 (JIF 2015: 2.75; Citations= 95).
  34. Van Wageningen, W.F.C., D. Kandhai, R.F. Mudde and H.E.A. Van den Akker\* (2004) Dynamic flow in a Kenics static mixer: An assessment of various CFD methods, AIChE Journal, 50 (8), 1684-1696 (JIF 2015: 2.980; Citations= 27).
  35. Ten Cate, A., J.J. Derksen, L.M. Portela and H.E.A. Van den Akker (2004) Fully resolved simulations of colliding monodisperse spheres in forced isotropic turbulence, Journal of Fluid Mechanics (519), 233-271 (JIF 2015: 2.514; Citations= 108).
  36. Hartmann, H., J.J. Derksen and H.E.A. Van den Akker\* (2004) Macroinstability uncovered in a Rushton turbine stirred tank by means of LES, AIChE Journal, 50 (10), 2383-2393 (JIF 2015: 2.980; Citations=42).
  37. Van Wageningen, W.F.C., R.F. Mudde, H.E.A. Van den Akker\* (2004) Numerical simulation of growing Cu particles in a Kenics static mixer reactor, reducing Cu<sup>2+</sup> by carbohydrates, Chem. Eng. Sci. 59 (22-23), 5193-5200 (JIF 2015: 2.75; Citations=6).
  38. Van Vliet, E., S.M. Van Bergen, J.J. Derksen, L.M. Portela and H.E.A. Van den Akker\* (2004) Time-resolved, 3D, laser-induced fluorescence measurements of fine-structure passive scalar mixing in a tubular reactor, Experiments in Fluids 37 (1), 1-21 (JIF 2015: 1.57; Citations=13).
  39. Hollander, E.D., J.J. Derksen, H.M.J. Kramer, G.M. Van Rosmalen and H.E.A. Van den Akker\* (2003) A numerical study on orthokinetic agglomeration in stirred tanks, Powder Technology 130 (1-3), 169-173 *Special Issue (SI)* (JIF 2015: 2.759; Citations=8).
  40. Sobera, M.P., C.R. Kleijn, H.E.A. Van den Akker and P. Brasser (2003) Convective heat and mass transfer to a cylinder sheathed by a porous layer, AIChE Journal 49 (12), 3018-3028 (JIF 2015: 2.980; Citations=30).
  41. Harteveld, W.K., R.F. Mudde and H.E.A. Van den Akker\* (2003) Dynamics of a bubble column: Influence of gas distribution on coherent structures, Canadian Journal of Chemical Engineering 81 (3-4), 389-394 (JIF 2015: 1.066; Citations=25).
  42. Kandhai, D., J.J. Derksen and H.E.A. Van den Akker\*(2003) Interphase drag coefficients in gas-solid flows, AIChE Journal 49 (4), 1060-1065 (JIF 2015: 2.980; Citations 28).
  43. Oey, R.S., R.F. Mudde and H.E.A. Van den Akker\* (2003) Numerical simulations of an oscillating internal-loop airlift reactor, Canadian Journal of Chemical Engineering 81(3-4), 684-691 (JIF 2015: 1.066; Citations=18).
  44. Oey, R.S., R.F. Mudde, H.E.A. Van den Akker\* (2003) Sensitivity study on interfacial closure laws in two-fluid bubbly flow simulations, AIChE Journal 49 (7), 1621-1636 (JIF 2015: 2.980; Citations=47).