Newcastle University
School of Engineering

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pig MONTHLY

process intensification group | http://pig.ncl.ac.uk | www.pinetwork.org

In This Issue

PIN27 MEETING

The 27th Process Intensification Network meeting will be held at Newcastle University on Friday 21st June 2019.

- Offers of talks are welcome – either full-length presentations or 5 minute 'impromptu' talks.
- Posters are welcome – we have a new venue – 'The Boilerhouse' – where space is available for exhibition tables and posters.
- For those arriving on Thursday, we will arrange an evening meal. For anyone staying over for the weekend, a visit to a local Brewery is under consideration for the Friday evening.
- Full joining data will be sent out once the agenda is finalised, but the meeting typically starts at 10.15 am, after registration, and finishes around 3.30 pm, with a subsequent lab tour for those interested.

Please email David Reay on DAReay@aol.com or Adam Harvey on Adam.Harvey@newcastle.ac.uk if you would like to give a talk (full or impromptu).

Upcoming Conferences

- **ChemEngDayUK** (8-9 April 2019, Heriot-Watt University, Edinburgh, UK). Programme
- **4th Green and Sustainable Chemistry Conference** (5-8 May 2019, Dresden, Germany). Programme
- **International Symposium on Green Chemistry, ISGC2019** (13-17 May 2019, La Rochelle, France). Programme
- **2nd International Process Intensification Conference (IPIC^2)** (27-29 May 2019, Leuven, Belgium). Programme
- **13th International Workshop on Polymer Reaction Engineering** (11-14 June 2019, Hamburg, Germany). Programme
- **European Symposium on Computer Aided Process Engineering (ESCAPE-29)** (16-19 June 2019, Eindhoven, The Netherlands). Programme
- **9th International Conference on Algal Biomass, Biofuels & Bioproducts** (17-19 June, Boulder, CO, USA). Early registration deadline: 5th Apr 2019 | Programme
- **IChemE Catalysis SIG: Reactors, Scale-Up and Separations** (12 Sep 2019, London, UK). Early registration deadline: 2nd Aug 2019 | Programme
- **12th European Congress of Chemical Engineering** (15-19 Sep 2019, Florence, Italy). Early registration deadline: 15th July 2019
- **2019 AIChE Annual Meeting** (10-15 Nov 2019, Orlando, Florida, US). Abstract Deadline: 12th April 2019
- **Advances in Process Automation and Control** (18-20 Nov 2019, Manchester, UK). Early registration deadline: 24th May 2019

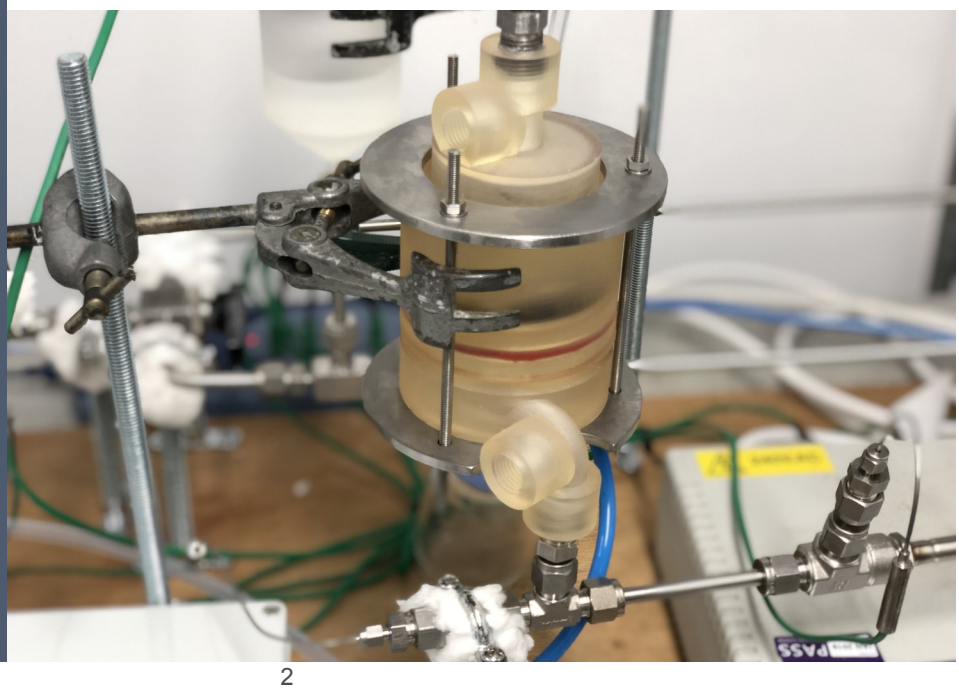
Announcements

- Prof Ian Wilson (Department of Chemical Engineering, Cambridge) will be visiting the PI group/School of Engineering on Wednesday 8th May. Prof Wilson's interests primarily lie in the study of soft solids and surfaces, with applications including the food, pharma and chemical industries. As part of the visit, he will be delivering a talk at 14:30 on the day covering the general themes of fluid dynamics and surface cleaning. The venue for this talk will be confirmed closer to the time.

- The UK National Heat Transfer Committee will be running a one-day workshop on: "Heat Transfer Research, Education and Practice in the UK" on 25th April 2019 at the Roundhouse in Derby, UK. The objective of the workshop is to bring together Academia with Industry to discuss current status, needs and outlook for the Heat Transfer field in the UK. The workshop is supported by the Institution of Mechanical Engineers, the Institution of Chemical Engineers, the Heat Transfer Society and will be co-located with the Thermal Engineering Show. More details can be found here.

Bench-Scale Carbon Capture

As part of an EPSRC collaboration with Heriot Watt and Sheffield Universities, the PI group has also started working with the Torftech Group to develop a small-scale toroidal fluidized bed (Torbed®) reactor for screening adsorbent materials for carbon capture. Recently, a novel 50 mm diameter unit, believed to be the smallest of its kind, has been successfully fabricated through additive manufacturing in-house using a high-temperature polymer, enabling sorbents to be screened at over 200°C and 3 bar . The use of this polymer has also enabled rapid design iterations and the integration of standard NPT fittings. Although substantially smaller than typical industrial Torbed units, the 'correct' swirling flow formulation is preserved at this small scale. Preliminary data will be presented shortly at ChemEngDay and IPIC^2.



PIG News

- Congratulations to Ahmed Al-Hatrooshi who passed his PhD viva on Friday 29th March with minor corrections. His thesis was titled: *"A Marine Waste Biorefinery"*
- Congratulations to Mohamad Faiz Gunam Resul who passed his PhD viva on Tuesday 26th March with minor corrections. His thesis was titled: *"Process development for the continuous epoxidation of renewable terpenes using "mesoscale" 3D-printed oscillatory baffled reactors"*
- The PIG would like to welcome new visiting PhD student Munazza Maqbool who will be working with Sharon and Adam for the next 6 months
- Congratulations to Dr Chris O'Malley who is one of 2019's shortlisted candidates in The Education Awards (TEA) in the category of "Outstanding Contribution to Employability"
- As part of a "Forestry Innovation Fund" project, Prof Harvey visited a very impressive highly automated batch charcoal plant in Germany on 18th/19th March. The plant is able to produce a range of products from basic barbeque charcoal through pet food grade to pharmaceutical grade. Some more 'novel' examples of their charcoal producing capabilities are highlighted in the two images below.

Carbonised clog anyone? Or how about some carbonised pastries on a carbonised platter?

- On the 28th January, Prof Harvey hosted the final meeting of the Biopharmaceutical and Bioprocessing Technology Centre, which was an EPSRC Engineering Doctorate Centre that took in its first cohort of students in 2008. The meeting as an "Impact Event" and focused on the impact of the center on both the companies and students involved. Further details can be read here. Images below:

New Publications

- L.S. Al-Saadi, A. Alegria, V.C. Eze, A.P. Harvey. Rapid screening of an acid-catalyzed triglyceride transesterification in a mesoscale reactor. Chemical Engineering and Technology 42(3) (2019) 539 -548
- X. Dai, Y. Du, J. Yang, D. Wang, J. Gu, Y. Li, S. Wang, B.B. Xu, J. Kong. Recoverable and self-healing electromagnetic wave absorbing nanocomposites. Composites Science and Technology 174 (2019) 27-32
- R. Feng, N. Ramchandani, N.M. Salih, X.Y.E. Lim, S.W.B. Tan, L.Y. Lee, S. Khean Teoh, P.N. Sharratt, K. Boodhoo. Process intensification strategies and sustainability analysis for amidation processing in the pharmaceutical industry. Ind. Eng. Chem. Res. 58(11) (2019) 4656-4666
- A. Hernandez-Garcia, S.B. Velasquez-Orta, E. Novelo, I. Yanez-Noguez, I. Monje-Ramirez, M.T. Orta Ledesma. Wastewater-leachate treatment by microalgae: Biomass, carbohydrate and lipid production. Ecotoxicology and Environmental Safety 174 (2019) 435-444
- M. Idrees, L. Liu, S. Batool, H. Luo, J. Liang, B.B. Xu, S. Wang, J. Kong. Cobalt-doping enhancing electrochemical performance of silicon/carbon nanocomposite as highly efficient anode materials in Lithium-ion batteries. ES Energy & Environment (2019) DOI: 10.30919/es8d798
- A. Laybourn, A.M. Lopez-Fernandez, I. Thomas-Hillman, J. Katrib, W. Lewis, C. Dodds, A.P. Harvey, S.W. Kingman. Combining continuous flow oscillatory baffled reactors and microwave heating: Process intensification and accelerated synthesis of metal-organic frameworks. Chemical Engineering Journal 356 (2019) 170-177
- P. Livotov, A.P.C. Sekaran, R. Law, D. Reay. Systematic Innovation in Processing Engineering: Linking TRIZ and Process Intensification. *In:* Advances in Systematic Creativity, pp. 27-44 (2019)
- J.R. McDonough, R. Law, D.A. Reay, V. Zivkovic. Fluidization in small-scale gas-solid 3D-printed fluidized beds. Chemical Engineering Science 200 (2019) 294-309
- I. Nava Bravo, S.B. Velasquez-Orta, R. Cuevas-Garcia, I. Monje-Ramirez, A. Harvey, M.T. Orta Ledesma. Bio-crude oil production using catalytic hydrothermal liquefaction (HTL) from native microalgae harvested by ozone-flotation. Fuel 241 (2019) 255-263
- F. Saleem, K. Zhang, A.P. Harvey. Decomposition of benzene as a tar analogue in CO_2 and H_2 carrier gases, using a non-thermal plasma. Chemical Engineering Journal 360 (2019) 714-720
- F. Saleem, K. Zhang, A.P. Harvey. Plasma-assisted decomposition of a biomass gasification tar analogue into lower hydrocarbons in a synthetic product gas using a dielectric barrier discharge reactor. Fuel 235 (2019) 1412-1419
- F. Saleem, K. Zhang, A.P. Harvey. Removal of toluene as a tar analogue in a N_2 carrier gas using a non-thermal plasma dielectric barrier discharge reactor. Energy and Fuels 33(1) (2019) 389-396
- F. Saleem, K. Zhang, A.P. Harvey. Temperature dependence of non-thermal plasma assisted hydrocracking of toluene to lower hydrocarbons in a dielectric barrier discharge reactor. Chemical Engineering Journal 356 (2019) 1062-1069
- S. Sana, K. Boodhoo, V. Zivkovic. Production of starch nanoparticles through solvent-antisolvent precipitation in a spinning disc reactor. Green Processing and Synthesis 8 (2019) 510-518
- S.B. Velasquez-Orta, O. Heidrich, D.W. Graham. Energy use and carbon emissions across a English wastewater network. Institute of Water Journal 3 (2019) 17-23
- C. Wang, B.B. Xu, J.G. Terry, S. Smith, A.J. Walton, S. Wang, H. Lv, Y. Li. Flexible, strain gated logic transducer arrays enabled by initializing surface instability on elastic bilayers. APL Materials 7 (2019) 031509
- S. Wang, W. Lee, C. Li, B. Kuan, N. Burke, J. Patel. Pyrolysis of natural gas—An investigation of effects of process variables and reactor materials on the product gas compositions. Chemical Engineering & Technology (2019) DOI: 10.1002/ceat.201800267
- Y. Xu, Y. Zhang, S. Wang, J. Xu, C. Yang. Conformation-induced separation of 3-Chloropropene from 1-Chloropropane through nanoporous monolayer graphenes. Physical Chemistry Chemical Physics (2019) DOI: 10.1039/C9CP00137A
- J. Zhao, U. Gulan, T. Horie, N. Ohmura, J. Han, C. Yang, J. Kong, S. Wang, B.B. Xu. Advances in Biological Liquid Crystals. Small (2019) DOI: 10.1002/smll.201900019

Recent PIG Seminars

- **Dr James Hendry** | 11th Jan
  "Rotating Packed Beds for Carbon Capture"
- **Prayoon Enmak** | 18th Jan
  "Intensification of the Harvesting of Microalgae "
- **Phuet Prasertcharoensuk** | 25th Jan
  "Gasification of waste wood for H_2 production
- **Dr Jonathan McDonough** | 1st Feb
  "Micromixing in oscillatory baffled flows "
- **Sahr Sana** | 8th Feb
  "Solvent-antisolvent precipitation of starch nanoparticles in a spinning disc reactor "
- **Long Duong** | 15th Feb
  "Catalytic intensification of the pyrolysis of lignocellulosic biomass "
- **Salihu Musa** | 22nd Feb
  "Methanol concentration as a means to produce algal biodiesel in a foam column "
- **Akmal Bin Abdul Rahim** | 1st Mar
  "Intensification of Epoxidation of Vegetable Oil "
- **Jeremiah Corrigan** | 8th Mar
  "Nonlinear Modelling of the Chemical Durability of High Level Nuclear Waste Glass "
- **James Hockaday** | 15th Mar
  "Copper uptake by the microalgae *Chlorella vulgaris* "
- **Abdul Rehman** | 22nd Mar
  "Synthesis of limonene and styrene carbonate via CO_2 cycloaddition "
- **Chris Dixon** | 29h Mar
  "Identification of Reaction Networks using MILP "

Other Information

- Full contact details and research profiles for the PI group members can be found at the website: *http://pig.ncl.ac.uk*
- For enquires about collaborations or PhD study, see the website: *http://pig.ncl.ac.uk*
- If anyone would like to contribute any articles, or if anyone has any ideas regarding the newsletter please contact Jonathan McDonough: jonathan.mcdonough@ncl.ac.uk