JACOBS DOUWE EGBERTS

John MELROSE Science and Technology Expert

Lisbon Cost-EU meeting 23/03/2017

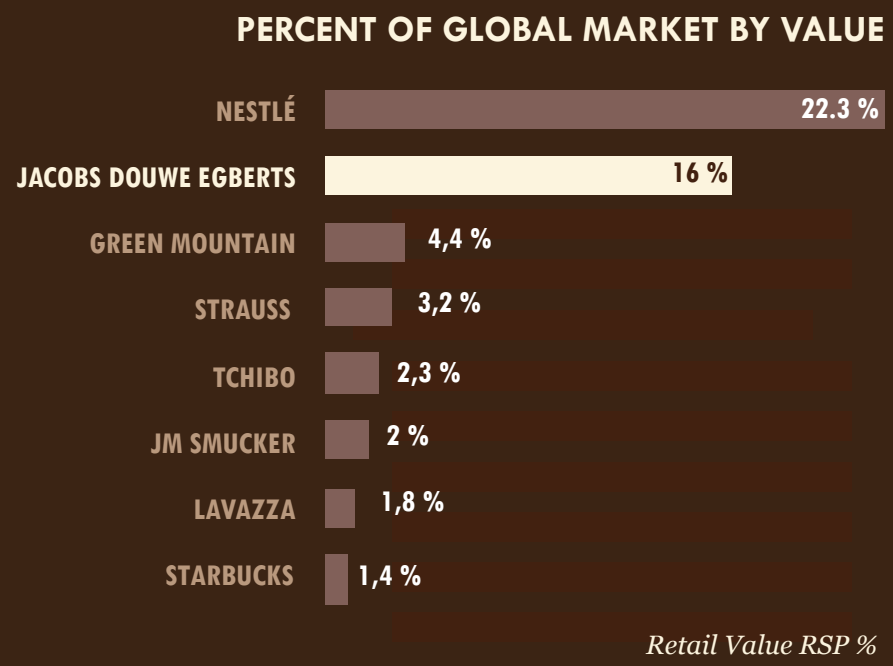
Talk Plan

- Introduction to JDE
- Introduction to myself , as a mathematical modeller
- JDE modelling activities and needs
- Some wider needs for modelling in the food industry
- Food Industry-Academia-Consultant Interactions

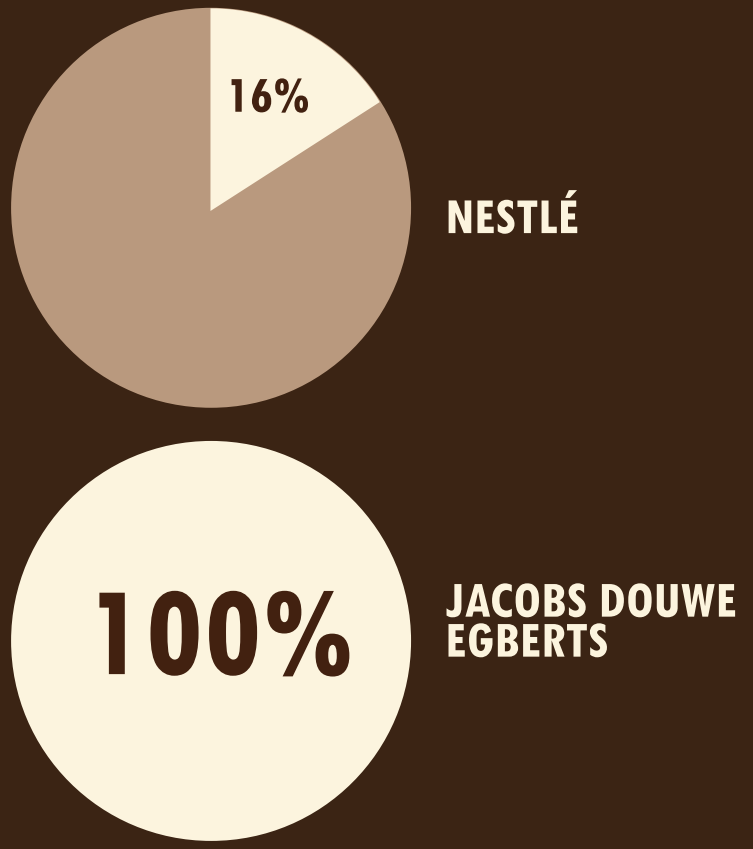
The world's leading pure-play coffee company

COFFEE RETAIL MARKET SHARE:

Source: Euromonitor, 2014



COFFEE AND TEA* AS % OF GROUP SALES:



Source: Euromonitor, 2014
** scope: hot beverages*

Facts & figures

A GLOBAL TEAM OF MORE THAN 12.000 COFFEE CHAMPIONS

OUR BRANDS ARE ENJOYED BY CONSUMERS IN OVER 80 COUNTRIES

#1 OR #2

POSITION IN 18 COUNTRIES ACROSS EUROPE, LATIN AMERICA AND AUSTRALIA

ANNUAL REVENUES OF MORE THAN €5BN

A PORTFOLIO COMPRISING SOME OF THE MOST WELL-KOWN COFFEE BRANDS AROUND THE WORLD

Senseo, Caffè HAG, Piazza d'Oro, Jacques Vabre, L'OR, Prima, Pickwick, Splendid, Marcilla, Tassimo, Jacqmotte, Moccona, Jacobs, Tea forte, Harris, Kenco, Friele, Saimaza, Grand'Mère, Douwe Egberts, Maxwell House, Pilão, Gevalia

COMPETENCIES CAREER EXPERIENCE – John Melrose EXPERIENCES

Executive

Director & Ind. Contributor

Stretch

Influencing with authority
Business Acumen
Strategic vision
Change management
External connections

Kraft/Mondeleez/JDE R&D
Banbury
Sept 2009-
Research Principal Coffee

4

Technical & site leadership; building new ways of working
Driving innovation
Focus on one category !
Building its future

Manager & Ind. Contributor

Stretch

Influencing without authority
Business Acumen
Strategic vision

Unilever Corporate Research
2003-2009
Colworth
Science leader Phys & Eng

Build a new body ; define its vision and mission; many cross functional conflicts ; build external scouting
Future technology vision and workshops

3

Unilever R&D
2000-2003
Colworth-Vlarrdingen
Leader Food process modeling

Team across sites; Phys-chemists to engineers; working with manufacturing

Manager & Ind. Contributor

Test, Confirm, Grow

Building Effective teams,
Self Development,
Decision quality,
Customer focus,
Delegation
Drive for Results

University of Cambridge
1992-2000
Cavendish Laboratory ADR
Lead of a Modelling team of (6-8) working on soft materials

2

Industrial partners
Unilever, ICI, Sclumberger
(shear thickening, colloid flow, hair dynamics, aggregation)

Individual Contributor

Learn Fundamentals

Functional Technical
Problem solving
Learning agility
Networking

Standing alone

University Post-Docs
1983-1992
Royal Hollaway, Univ. Surry, Imp Coll.

1

Industrial partners BT, BP, ECC, MOD
(computer simulation, semiconductors, glassy states, fractal patterns, electrochem.)

Phd Physics Univ. of Wales

Managerial and strategic depth
- Multi-team management
- Site leadership & management
-Skills mapping and succession planning
- Creating collaboration space
- Intellectual property

Technical Depth
- Coffee process & science !
- Consumer devices, packaging
- IP
- Sustainability, LCA

4

Managerial and strategic depth
- Function Leadership
- Working cross sites
- handling functional conflicts
- Food manufacturing operations
- Venture capital experience
- Corporate Strategic vision
- Setting a mission for a new unit
- Open innovation & tech scouting
-Technical training
-Coaching & mentoring

Technical Depth
- food microstructure
- ice cream, tea, sauces
- food processing, thermal processing
- microwave cooking
- Detergents skin creams, shampoo

3

People Management
-Running a teams
-Dealing with difficult people
-Managing budgets
-Managing industrial relationships

Technical Depth
- Soft-ware creation management
- creating new frontier physics & techs
- Chem Eng & food Science
- Colloid science, rheology

2

Start up & Technical depth
-How to publish
-Colloid science, rheology
-Computer modeling
-Working with industry

1

Academic modelling:

Monte-Carlo modelling of transport in semi-conductors

Molecular dynamics – glass formation (with David Heyes)

Quantum Monte-Carlo (with Konrad Singer)

Brownian dynamics of colloids – gel formation aging of gels

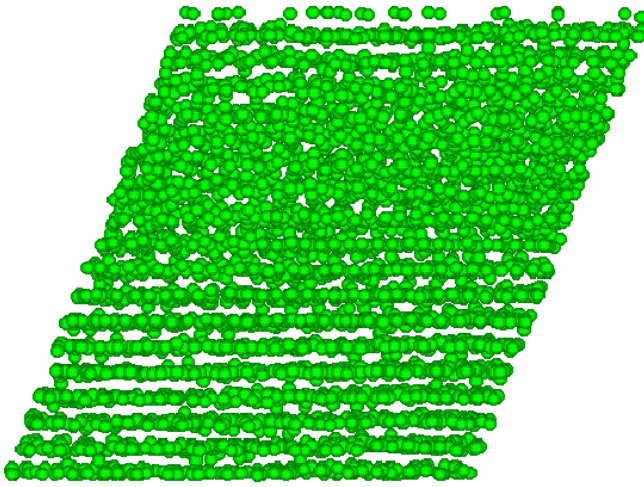
Powder mechanics and jamming (with Robin Ball, Robert Farr)

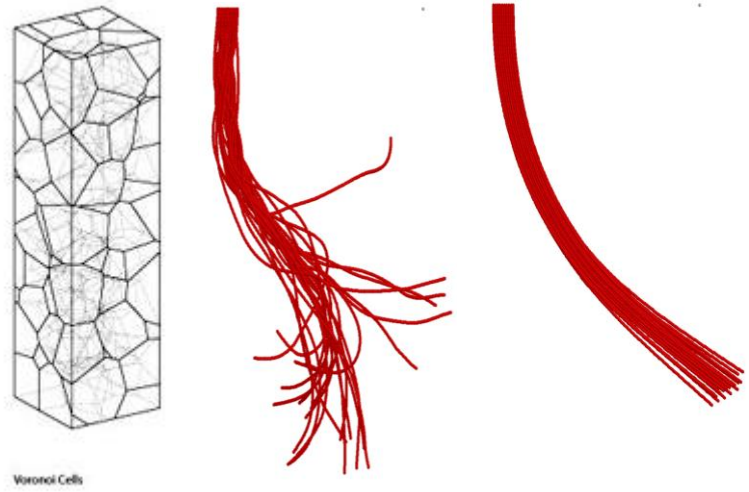
Hydrodynamic interactions and flow of concentrated suspensions (with R Ball)

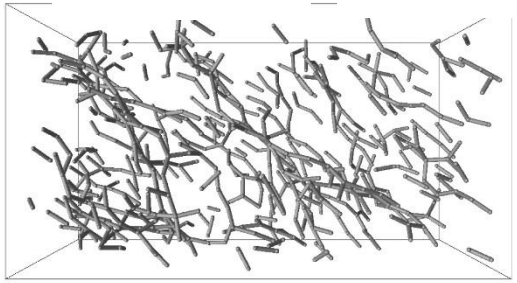
Fibre dynamics with torsion and bend (With Z Ning)

Reconnecting mesh flows and CFD (with R Ball)

FE solution of Flows in packed beds







Industrial modelling work:

Microwave cooking (with John Bows)

Thermal processing of sauces (with Tibo Jurgen)

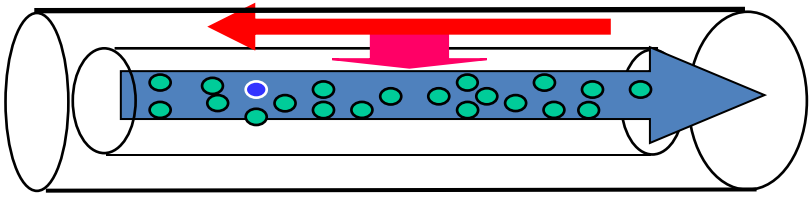
Pipe flows and CIP (with Konstantina Arstrideau)

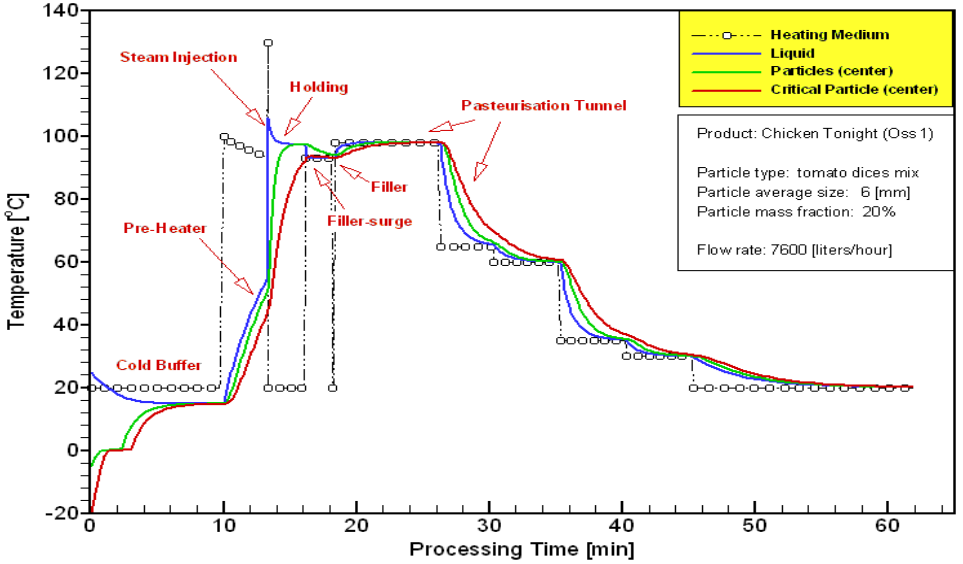
Extraction from packed beds of grains (with Borja Coorochnao)

Coffee Brewer systems

Pack pressures, shelf-life

LCA (with A Stockwell)



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JDE

A track record of innovations

SENSEO PADS MACHINE

COFFEE MACHINES FOR PROFESSIONAL MARKETS

From small office...

...to large events

TASSIMO INTELLIGENT BREWER

MILK BASED PADS

PORTIONED ESPRESSO

First to launch in grocery retail

WHOLEBEANS INSTANT

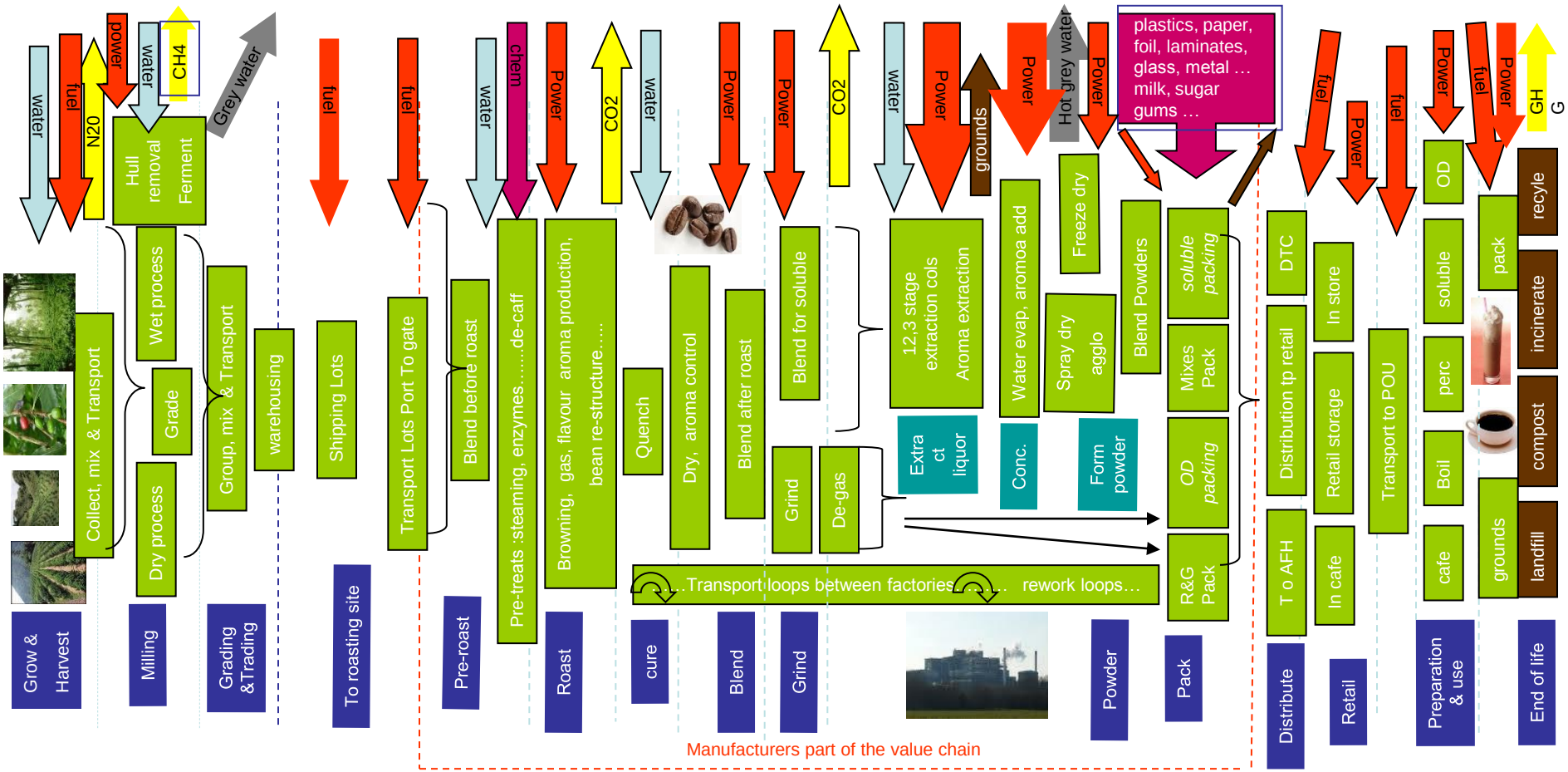
LIQUID TECHNOLOGY

- Pure, liquid coffee concentrate
- High quality coffee
- Barista standard
- Delicate product
- Proprietary technology

CONSUMER TASTE PROFILE MAPPING

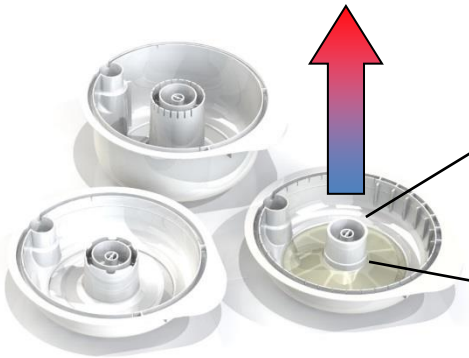
FULL BEVERAGE RANGE

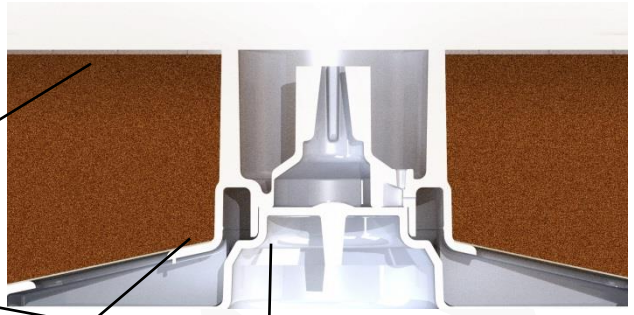
Coffee Value chain



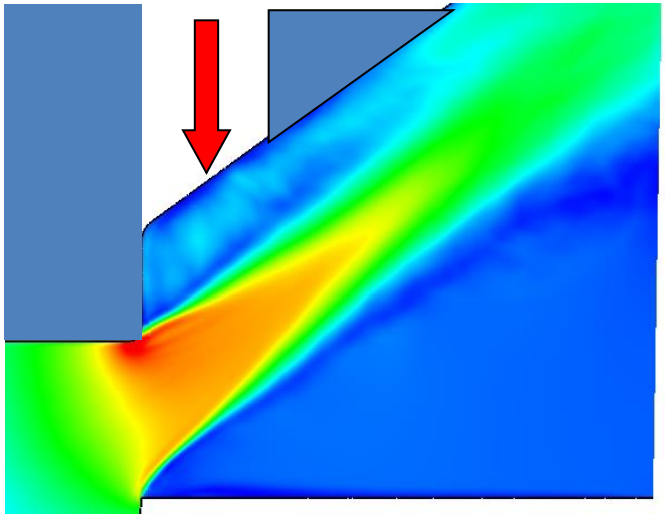
We have build a suite of tools for CO_2 LCA in Gabi (Amy Stockwell)

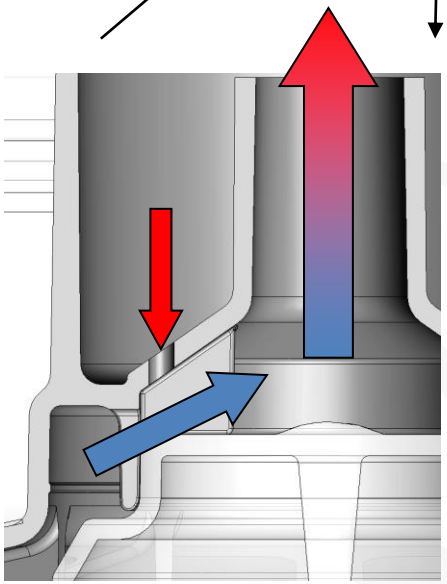
Example of CFD modelling : Tassimo Disks



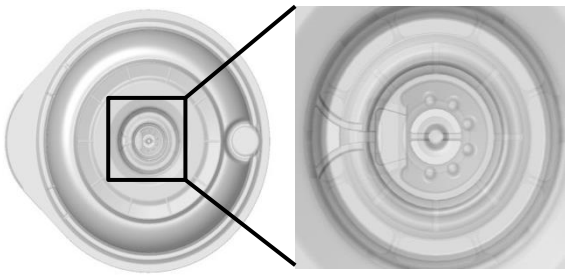


CFD modelling used to design the air inductor

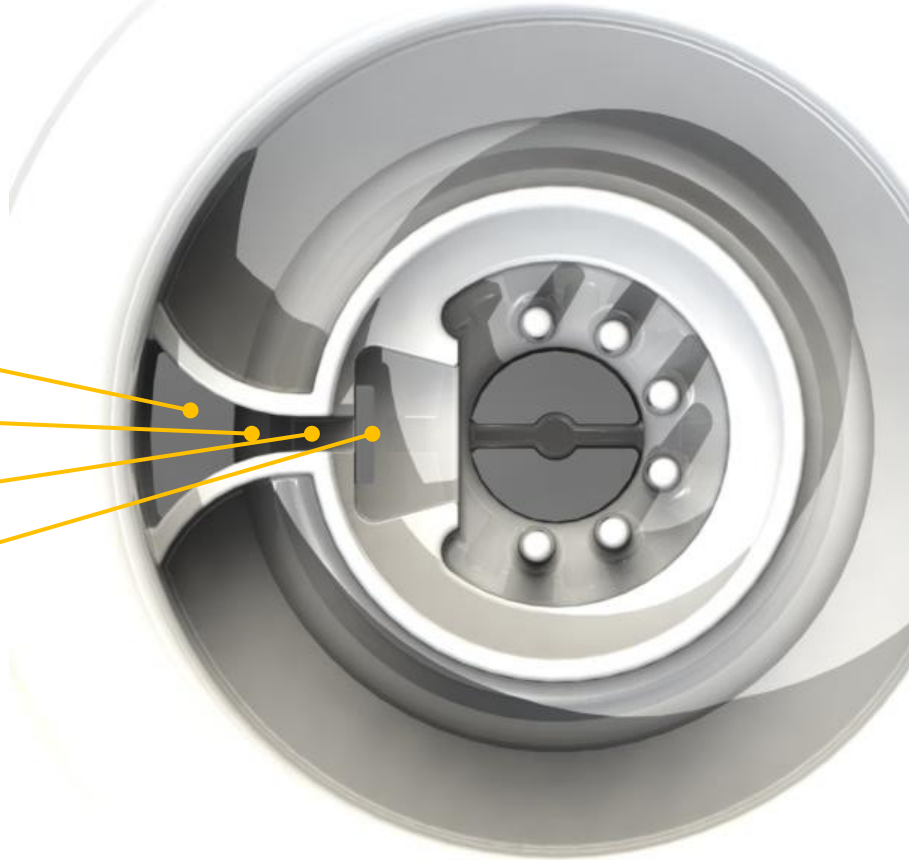




Design Features Inside a T-Disc



Inner Component Underside Close-up

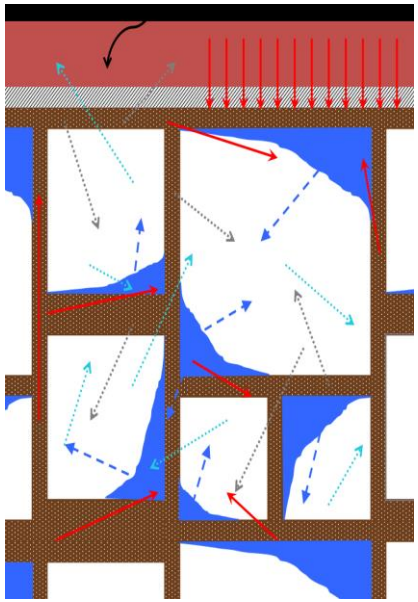


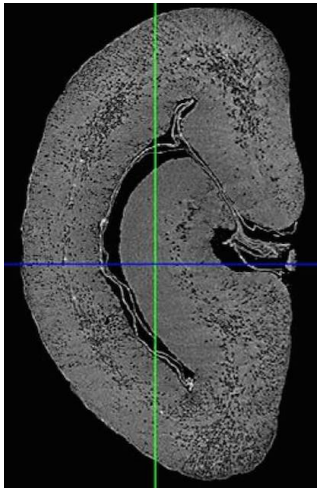
Coffee Roasting – physical modelling giving of phenomena which are hard to measure

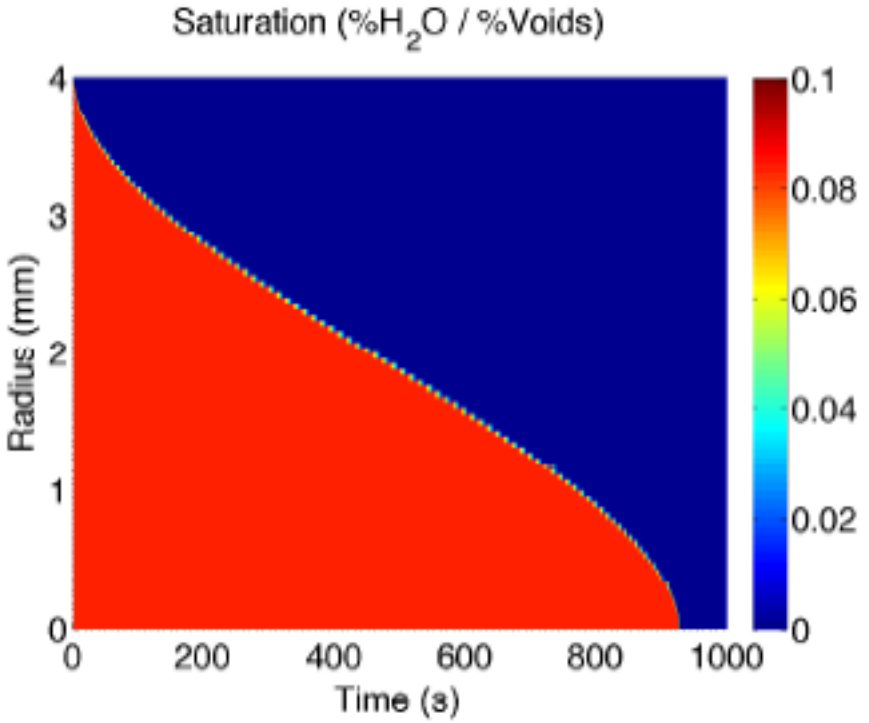
A heat and mass transfer study of coffee bean roasting

Nabil T. Fadai, Ian Hewitt, John Melrose, Colin P. Please, Alexandra Schulman, Robert A. Van Gordera, Mathematical Institute, University of Oxford & Jacobs Douwe Egberts R&D UK Ltd, Banbury

International Journal of Heat and Mass Transfer 104 (2017) 787–799







Modelling – Maps in reduced variables

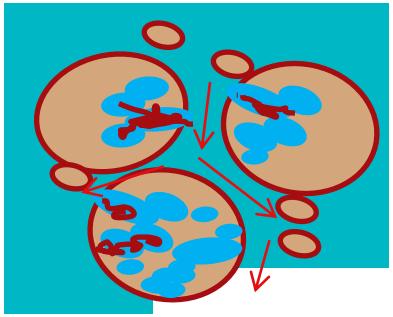
THE PRINCIPLES OF COFFEE EXTRACTION FROM PACKED BEDS IN ON-DEMAND COFFEE SYSTEMS

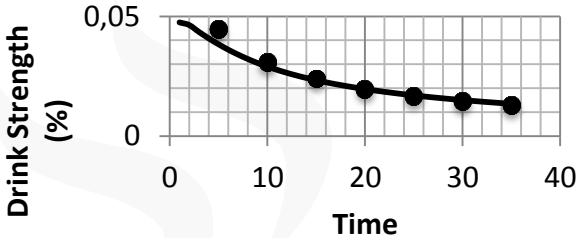
MELROSE, John*, CORROCHANO Borja** and BAKALIS, Serafim* Mondelēz International Banbury;

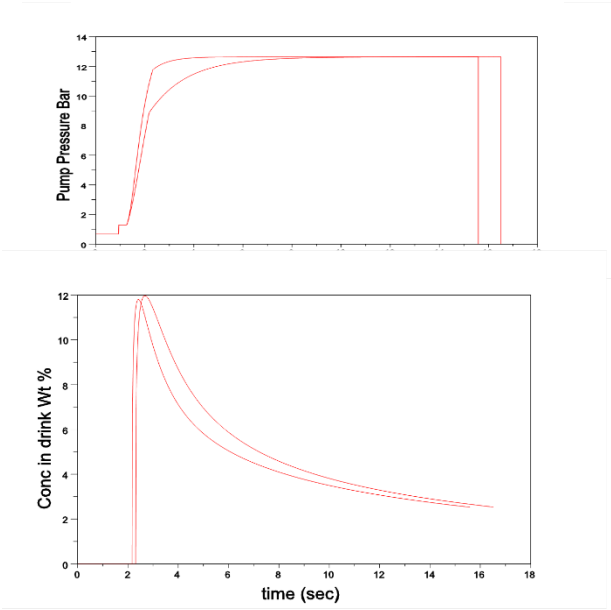
Department of Chemical Eng. University of Birmingham. ASIC Conference 2014 Colombia

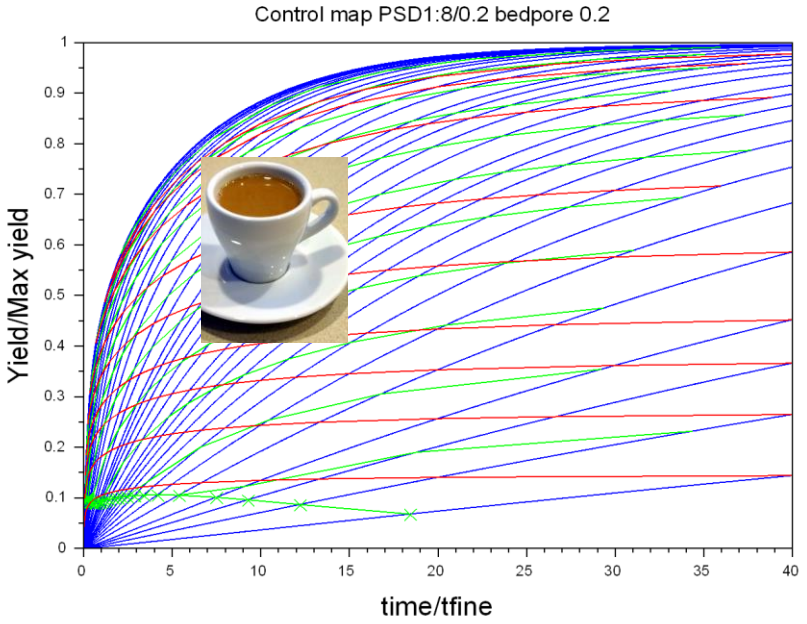
$$\frac{\partial C}{\partial t} + v(z)\frac{\partial C}{\partial z} + \frac{3(1-\varepsilon)}{\varepsilon R} j(C_R^P - C, D, z) = 0$$

$$J(t) = \frac{3(1-\varepsilon)}{\varepsilon}\left[\frac{j_{fine}(t)\vartheta_{fine}}{R_{fine}} + \frac{j_{coarse}(t)(1-\vartheta_{fine})}{R_{coarse}}\right]$$









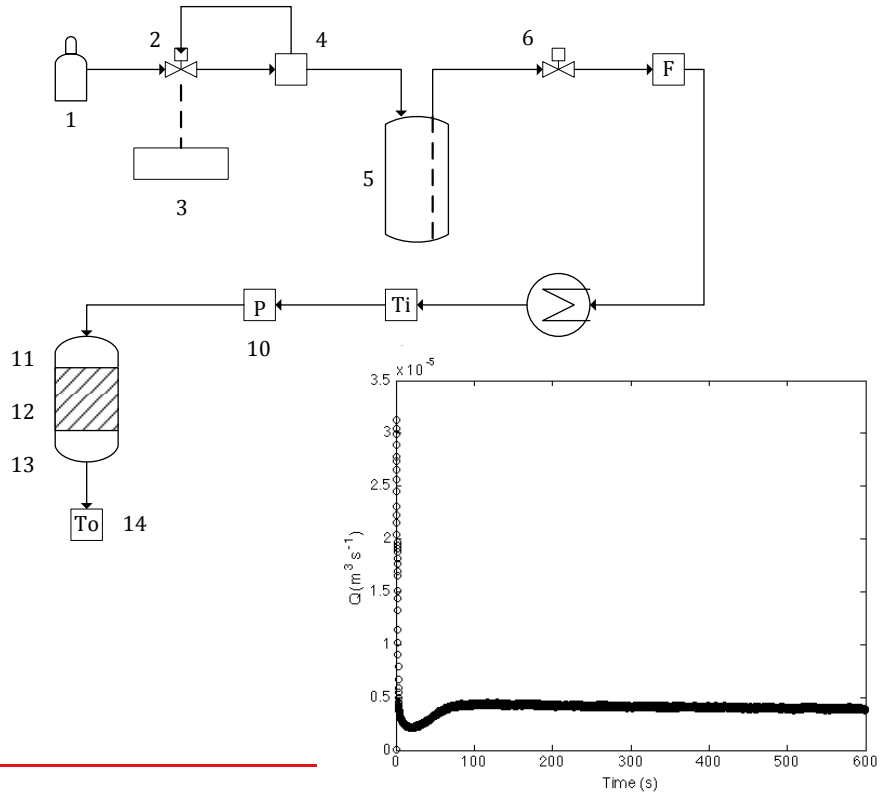
Coffee bed permeability

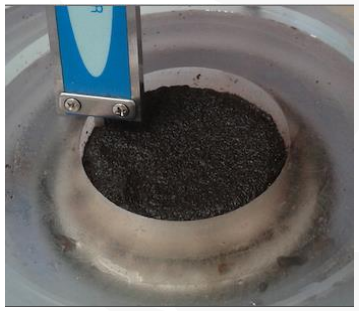
A new methodology to estimate the steady-state permeability of roast and ground coffee in packed beds

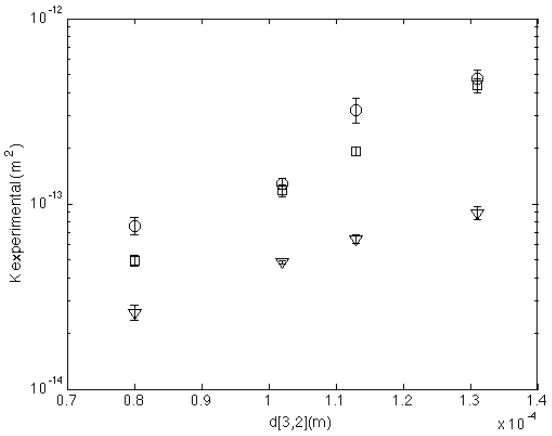
B.R. Corrochano[a, b,], J.R. Melrose[b], A.C. Bentley[b], P.J. Fryer[a], S. Bakalis[a]

- [a] Centre for Formulation Engineering, Department of Chemical Engineering, University of Birmingham
- [b] Mondelēz International, Coffee Global Centre of Excellence, Banbury

Jol of Food Engineering 150, 106-116 (2015)







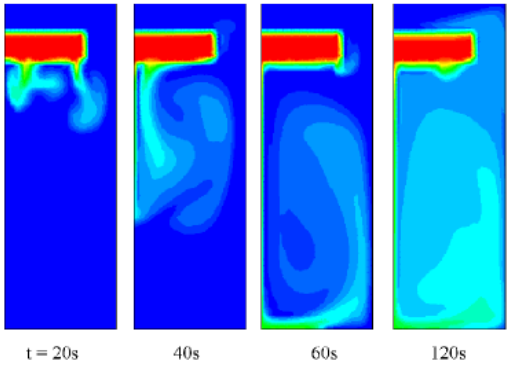
Coffee Modelling Challenges - Physical

- Spray drying of milk powders
- Freeze drying (energy minimisation)
- Powders in processing (flow, attrition, dosing, jamming..)
- Roasting both at the many bean roaster level and bean level,
- Malliard reaction models…
- Modelling of grinding
- Foam generation and foam physics
- Transport in interactive porous media
- Flow thru coffee beds, dynamic bed permeability under pressure

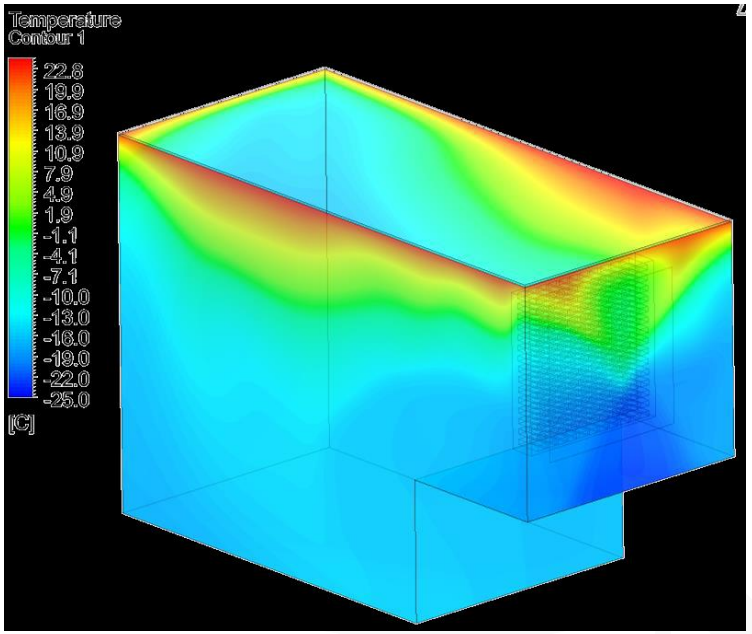
Other Coffee Modelling Challenges

- Chemometrics (GCMS data….)
- Legacy data/meta-data/molecules thru the value chain
- Sensory and chemistry
- Consumer networks
- Modelling the coffee value chain, LCA flex blending vs cost
- Modelling of climate impact on coffee agronomy
(see P Laderach et al Predicted Impact of Climate Change on Coffee Supply Chains)
- Coffee agronomy and social impacts (see ASIC conferences)

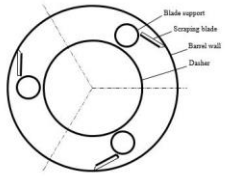
Examples from others IOP Pepsico (John Bows) and Unilever (Robert Farr)

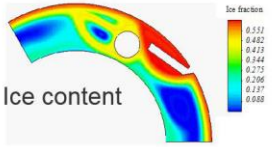


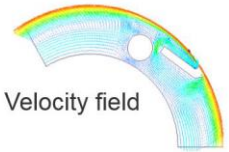
G. Lian and C. Astill, "Computer simulation of the hydrodynamics of teabag infusion" Trans IChemEC, 80 (2002) 155

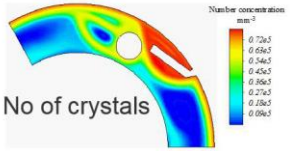


W.G.M. Agterofet al. "Prediction of emulsion particle sizes using a computational fluid dynamics approach", Colloids and Surfaces B 31 (2003) 141









CFD simulations of ice cream cabinets, to improve designs and reduce energy usage (thus carbon emissions) in the supply chain

Images & simulations from A. Mudaliar

UK Knowledge Transfer Network (KTN), Technology Strategy Board, and the Food and Drink Federation

The Health of physics in food manufacturing (UK Institute of Physics)
https://www.iop.org/publications/iop/2016/file_68330.pdf

Some other areas…..

Food is often a complex multiphase, metastable , colloid structure, manufactured thru a series of phase and structural transformations/manipulations, stable thur the supply chain, but present the right consumer experience - modelling this is a challenge

e.g. Ice cream, heat sensitive: emulsion + crystals + foam + surface active ingredients volume… a holy grail ambient stable ice-cream !

Powders and dispersions at high phase volume occur in many food products and strongly affect properties

Energy, water and waste minimization: cutting waste, energy efficiency, CFD of complex fluids in processing (complex evolving microstructures in large scale flows)

Ageing phenomena

Shelf life predication and stability under fluctuating conditions

Safety processing prediction of Fo

Value chain: managing fluctuations in the raw materials quality and cost.

Industry-Academia-Consultant Interactions

- You can bring wider benefits: bringing clarity on hypothesis and/or problem statement, starting with the basic principles and models, governing equations developing reduced variables, breaking the problem down, estimating what is important..
- You bring and transfer learnings and techniques from other problems, areas..

But…..

- You need understand their data how its was measured, dig into it
- You will need parameters, they might not have..
- What they say is the problem may not be the key problem
- Do they really think modelling replaces experiment..
- There is a low physics know-how in the food industry esp, there can be large knowledge and skills gaps, low quantitative and mathematical/modelling abilities/perception
- Software open source vs packages (we use Comsol and Matlab, but I often also use open source software, scilab, stats guys use R),
- Are you also delivering a model tool and interface, if so is it robust ?

Industry-Academia-Consultant Interactions

IP arrangements and negotiation, unless you already have the invention under IP no royalties please ! IP frameworks..

Align Expectations, esp. publication rights and intentions

Is it research, knowledge building or a development barrier ?
Short term, or long term strategic ?
Are the whole internal team truly on board with using the external ?

Start small (interns, consultancy) then move to longer term.. strategic partnerships or not ?

Workshops, a good example: The Oxford Centre for Industrial and Applied Mathematics (OCIAM)

We currently have 2 UK doctorial training centre students (Birmingham and Oxford); we take in circa 16 interns per year from food science and Chem Eng depts,(prefer 1 year); we have had EU Food Masters program students

Thank you for listening