ilass EUROPE 2005

Proceedings of the 20th Annual Conference on Liquid Atomization and Spray Systems

Organized by the Institute for Liquid Atomization and Spray Systems-Europe

and the Laboratoire de Combustion \& Systèmes Réactifs (LCSR-CNRS)

5th-7th September 2005 ORLÉANS, France

Edited by: Christian CHAUVEAU \& Joël PAGE
# CONTENTS

**PREFACE**

**SCIENTIFIC COMMITTEE** iv

**KEYNOTES LECTURES**

The future of atomization and sprays: *N. Chigier* 1

Fuel Atomisation A key process for Aero Engine Combustor design: *M. Cazalens, C. Berat* 8

Single and Multiple Water Drop Impacts onto Heated Metallic Surfaces: *M. Marengo, G.E. Cossali, M. Santini* 9

Stochastic modelling of sprays and flames: *B. Naud, D. Roekaerts* 10

**PAPERS**

**Application**

Experimental, theoretical and numerical investigations of paste flows in a pressure-swirl atomiser: *S. Li, Y. Ding, A. Bayly* 11

Experimental and CFD Analysis of High Pressure Pulsed Water-Jet: *A. Aziz, U. Gaertner* 17

Solid-Liquid Separation in Suspension Sprays: *B. Mulhem, U. Fritsching* 23

Influence of Geometrical and Operational Parameters on the Behavior of Twin-fluid Nozzles with an Internal Mixing Chamber: *J. Barroso, E. Lincheta, F. Barreras, A. Lozano* 29


Effect of the fluid properties and the geometry of the atomizer on the spray characteristics of a developed air assisted internal mixing atomizer: *E. Pantouflas, N. Zarzalis* 41

Atomization of non-Newtonian Liquids using High-Speed Rotary Bell Atomizers: *J. Domnick, M. Thieme* 43

Industrial application of CFD to fuel injector nozzle design: *G. Corbinelli, B. Prosperi, J. Hêlie, G. Unterweger* 49

Combustion efficiency: a comparison between fuel oil and waste oil: *V. Laboni, G. Langella, C. Laterza, C. Mongiello, A. Petriccione* 51

**Measurement techniques**


Fluorescence Spectroscopy of Kerosene Vapour: Application to Gas Turbines: B. Rossow, M. Orain, F. Grisch

Fluorobenzene and Fluorotoluene with Triethylamine as Exciplex Tracers for Two-Phase Visualization in Gasoline-like Fuel Sprays: F. Persson, S. Hemdal, M. Andersson

A Fibre Sensor based Frequency Analysis of Surface Waves at Hollow Cone Nozzles: D. Feggeler, F. Landwehr, P. Walzel, F. Weichert, H. Müller

Preliminary investigation by high speed imaging to estimate hollow cone spray fluctuations: A. Amoresano, T. Marchione

Maximum Entropy Reconstruction and Experimental Validation of Local Drop Size Distributions of Palm Oil Based Biodiesel Sprays: P. Yongyingskathavorn, P. Vallikul, B. Fungtammasan, C. Dumouchel

Simultaneous global size and velocity measurement of droplets and sprays: G. Pan, J. Shakal, W. Lai, R. Calabria, P. Massoli

Processing of rainbow signals from individual droplets: S. Saengkaew, Y. Biscos, N. Garcia, T. Charinpanitkul, H. Vanisri, G. Lavergne, G. Gouesbet, L. Méès, G. Gréhan

Modelling

The Application of Gamma and Beta Number Size Distributions to the Modelling of Sprays: A.P. Watkins

Modelling of Turbulence in the context of an Eulerian Approach for simulating two-phase flow in internal combustion engines: B. Truchot, A. Benkenida, J. Magnaudet

Joint velocity-scalar PDF modeling of turbulent spray flows: H.-W. Ge, E. Gutheil

Modelling of Electrostatic Sprays using the Moments Approach to Spray Simulation: N. Emekwuru, A.P. Watkins

Modeling the Evaporation of Multicomponent Diesel Fuel under Engine Conditions: D. Stegemann, G.P. Merker

Further Validation of the EOLE Code For Diesel Direct Injection Modelling: R. Marcer

Modeling of the break-up of deformable particles in developed turbulent flow: A. Sarimeseli, G. Kelbaliyev

Model equation for slip velocity and assessment of its performance: N. Beheshti, A.A. Burluka

Stochastic simulation of primary air-blast atomization along with LES computation of gaseous phase; first results: J. Jouanguy, M. Gorokhovski

Improving the design of fan spray atomizers through Computational Fluid Dynamics Techniques: A. Rivas, G. Sánchez, A. Estévez, J.C. Ramos

Nonlinear breakup of a three-dimensional axisymmetric, shear-thinning liquid filament: V. Dravid, C. Corvalan, P.E. Sojka
Modelling of Droplet Transport, Dispersion and Evaporation: J.M.M. Barata, A.M.M. Mandes

Advanced evaporation models for gasoline and diesel spray investigations: S. Rakowski, M. Fischer, G. Stiesch, G.P. Merker

Numerical analysis of swirl number effect on fuel oil mild combustion: S. Giammartini, G. Langella, C. Laterza, C. Mongiello, A. Petriccione

Numerical Simulation of Sprays by the Direct Quadrature Method of Moments: J. Madsen, T. Solberg, B.H. Hjertager


Numerical simulations of ambient-turbulence effects on diesel-like sprays: T. Jakubik, M. Jicha

Prediction of the near-field spray issued via a pressure-swirl atomiser: A.J. Heather, G. Wigley, H.K. Versteeg

The Eulerian-Lagrangian Spray Atomization Model – Contribution to the mean liquid/gas interface transport equation: P.-A. Beau, R. Lebas, F.-X. Demoulin


**Fundamental**

Flow patterns and liquid holdup in two-phase air-water flow with low flow rates: S.U. Onbasioglu

Application of an acoustic forcing on an air-blasted liquid sheet: C. Siegler, A. Lozano, F. Barreras

New Electron Injection Technique for Generating Electro Spray: T. Funakawa, W. Balachandran

Experimental study of injection of charges in a liquid jet. Discussion about the dominant effect in the atomization of an electrified jet: L. Priol, P. Baudel, C. Louste, H. Romat

Spray Characteristics produced by Conventional and Electrostatic Pressure–Swirl Nozzles: G.N. Laryea, S.Y. No

Numerical Simulations of breakup behavior of liquid droplets: E. Lavante (von), K. Henning, D. Beermann, P. Walzel, G. Schaldach

Laser-Induced Evaporation of a Single Droplets – An Experimental and Computational Investigation: D. Urzica, I. Düwel, C. Schulz, E. Gutheil

Effects of acoustic modulations on a spray flame: C. Pichard, D. Durox, S. Ducruix

Unsteadiness of effervescent atomizer generated sprays: J. Jedelsky, M. Jicha

Characterization of cavitation in transparent nozzles depending on the nozzle geometry: H. Chaves, Ch. Ludwig

Hydrodynamics in Orifice-Nozzles and the Jet-Breakup of Superheated Liquids: M. Rossmeissl, K.-E. Wirth
An Experimental Study of Super-critical Fluid Jets: *G.W.P. Zeaton, L.C. Crook, D.R. Guildenbecher, P.E. Sojka*

Experimental and theoretical study of n-alkanes droplet vaporization. Application to droplets suspended and impacting on hot solid plates: *C. Morin, L. Le Moyne, C. Chauveau, I. Gökalp*

Droplet-Droplet and Droplet-Vapour Interaction in an evaporating monodispersed spray: *S. Horender, M. Sommerfeld*


Experimental studies on the vaporization of a three-dimensional droplet network: *F. Halter, C. Chauveau, C. Mounaim-Rousselle, I. Gökalp*

**Automotive**

Influence of the Nozzle Geometry on the Cavitation and on the Spray Development in Diesel Injection: *R. Saliba, J.C. Champoussin*

Spatial Structure of Clustering in GDI Sprays: *F. Moukaideche, D.A. Greenhalgh*

Optimisation by numerical simulation of multiple injection strategies for Diesel Particulate Filters regeneration: *M. Costa*

Optical Investigation of Multiple Injection of Synthetic Fuels for HCCI Operation: *T. Delebinski, M. Fischer, S. Pöttker, G.P. Merker*


Experimental investigation of the influence of fuel pressure on the fuel distribution and liquid penetration of a high-pressure gasoline multi-hole direct injection injector spray: *P. Dahlander, I. Denbratt*

Investigation into primary break up of conical liquid sheets produced by a pressure swirl gasoline direct injector: *P. Stansfield, G. Wigley, G. Pitcher, H. Nuglisch, J. Jedelsky*


**Characterization**

Laser Doppler measurements of nozzle flow and optical characterisation of the generated spray: *M. Stahl, M. Gnirß, N. Damaschke, C. Tropea*

Experimental Investigation on Oil Atomization Processes in Car Engines: *M. Lecompte, C. Dumouchel*

Numerical simulation and experimental investigation of droplet size distribution in non-reactive turbulent spray flows: *I. Düwel, H. Kronemayer, C. Schulz, H.-W. Ge, E. Gutheil*

Effect of Swirl Combinations on Spray Dispersion Characteristics of a Multi-Swirler Airblast Atomizer: *K. Matsuura, Y. Kurosawa*

Transition of Spatial Inhomogeneity of Spray: *M. Kuramochi, K. Kuno, N. Tokuoka*
A Scaling Study of the Atomization of a Two-Phase Industrial Nozzle: Effect of Surface Tension and Viscosity on Mean Drop Size Profiles: C.E. Ejim, B.A. Fleck, A. Amirfazli

Spray Characteristics of a Novel Multi Orifice Electrostatic Atomizer: J. Allen, P. Ravenhill, J.S. Shrimpton

Characterization of spray transport and spray/wall interactions using the IPI technique: N. Damaschke, D. Kalantari, I.V. Roisman, C. Tropea

Structure of a Flashing Spray under Varying Ambient Air Pressure Conditions: A.K. Jasuja

Effect of the inflow conditions on the entrainment of sprays from air assisted internal mixing atomizers for use in high temperature air combustion: M. Odinius, H. Bockhorn

**Drop-Wall Interaction**

Generation, Positioning, and Measurement of a Droplet on a Flat Glass Surface: N. Roth, F. Maichle, J. Urban, B. Weigand

Effects of wall effusivity on secondary droplet atomisation from single and multiple drop impact onto heated surfaces: G.E. Cossali, M. Marengo, M. Santini

The thermal interaction of pulsed sprays with hot surfaces – application to Port-Fuel Gasoline Injection systems: J. Carvalho, M.R.O. Panão, A.L. Moreira

Experimental study of spray impact onto rigid walls: D. Kalantari, C. Tropea

Liquid flow produced by spray impact onto a curved rigid wall: I. Mustafić, T. Gambaryan-Roisman, I.V. Roisman, P. Stephan, C. Tropea


The combined effects of surface topography and heat transfer on droplet/wall interaction mechanisms: A.S. Moita, A.L. Moreira

**Gas turbine**


Planar Liquid Sheet Breakup of Pre-and Nonprefilming Airblast Atomisers at Elevated Ambient Air Pressures: U. Bhayaraju, F. Giuliani, C. Hassa

Experimental and numerical investigation on a liquid jet injected in a high pressure channel: A. Bellofiore, P. Martino (di), R. Ragucci, A. Cavaliere
Poster Session

Dispersion and vaporization of fuel polydispersed droplets in intense isotropic turbulence: M. Cochet, M. Marchal, G. Couteau, R. Bazile

Ultrafast X-radiography of High-Pressure High-Speed Diesel Sprays: S.-K. Cheong, C. Powell, X. Liu, J. Wang, K. Im, M.-C. Lai, M.W. Tate, A. Ercan, D. Schuette, S. Gruner


INDEX OF AUTHORS