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12 October 2024

WFC10 Discover the Future of Filtration & Separation

10th World Filtration Congress April 14–18, 2008 Leipzig, Germany

CONGRESS PROCEEDINGS

VOLUME III – G-Sessions

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Venue:
Congress Center Leipzig · Messeallee 1 · 04356 Leipzig · Germany

Congress Secretariat:
Filtech Exhibitions Germany
PO Box 1225 · 40637 Meerbusch – Germany
phone: +49 (0) 2132 93 57 60
fax: +49 (0) 2132 93 57 62
e-mail: Info@wfc10.com
web: www.wfc10.com

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WORLD FILTRATION CONGRESS 2008

SESSION SURVEY

Monday, 14.04.2008

08:00 – 09:00	Registration for Short Courses
09:00 – 18:00	Short Courses
16:00 – 18:00	Registration + Poster Installation

Tuesday, 15.04.2008

08:00 – 10:00	Registration						
10:00 – 11:00	**Opening Ceremony**						
11:00 – 12:00	**Plenary Lecture**						
12:00 – 13:15	Lunch						
13:15 – 14:30	**Invited Lecture 1**		**M 1**	**M 2**	**M 3**	**G 1**	**G 2**
14:30 – 15:00	Coffee Break						
15:00 – 16:15	**L 1**	**L 2**	**L 3**	**Invited Lecture 2**		**G 3**	**G 4**
16:15 – 16:45	Coffee Break						
16:45 – 18:00	**L 4**	**L 5**	**L 6**	**M 4**	**M 5**	**G5**	**G6**
18:00	Welcome Reception in the Exhibition Hall						

Wednesday, 16.04.2008

08:30 – 09:45	**L 7**	**L 8**	**L 9**	**M 6**	**M 7**	**G 7**	**G 8**
09:45 – 10:15	Coffee Break						
10:15 – 11:30	**PL 1**	**PL 2**	**L 10**	**PM 1**	**PM 2**	**PG 1**	**PG 2**
11:30 – 12:15	Poster Session	Poster Session		Poster Session	Poster Session	Poster Session	Poster Session
12:15 – 13:15	Lunch						
13:15 – 14:30	**L 11**	**L 12**	**L 13**	**M 8**	**M 9**	**Invited Lecture 3**	
14:30 – 15:00	Coffee Break						
15:00 – 16:15	**Invited Lecture 4**		**M 10**	**M 11**	**M 12**	**G 9**	**G 10**
16:15 – 16:45	Coffee Break						
16:45 – 18:00	**L 14**	**L 15**	**L 16**	**M 13**	**M 14**	**G 11**	**G 12**

WORLD FILTRATION CONGRESS 2008

SESSION SURVEY

Thursday, 17.04.2008

08:30 – 09:45	L 17	L 18	L 19	M 15	M 16	G 13	G 14
09:45 – 10:15	Coffee Break						
10:15 – 11:30	L 20	L 21	L 22	PM 3	PM 4	PG 3	PG 4
11:30 – 12:15				Poster Session	Poster Session	Poster Session	Poster Session
12:15 – 13:15	Lunch						
13:15 – 14:30	L 23	L 24	L 25	Invited Lecture 5		G 15	G 16
14:30 – 15:00	Coffee Break						
15:00 – 16:15	L 26	L 27	L 28	M 17	M 18	Invited Lecture 6	
16:15 – 16:45	Coffee Break						
16:45 – 18:00	L 29	L 30	L 31	M 19	M 20	G 17	G 18

Friday, 18.04.2008

08:30 – 09:45	L 32	L 133	M 21	M 22	M 23	G 19	G 20
09:45 – 10:15	Coffee Break						
10:15 – 11:30	L 34	L 35	M 24	M 25	M 26	G 21	G 22
11:45 – 12:15	Closing Session						
12:30 – 13:15	Lunch						
13:30– 18:00	Post Congress Plant Tours						

Tuesday – April 15, 2008

Opening Ceremony 10:00-11:00

Plenary Lecture 11:00-12:00

Filtration in the Framework of Globalisation and Technical Innovation, Prof. Richard J. Wakeman, Loughborough University, Great Britain **(I-19)**

Invited Lecture 1 13:15-14:30

Solid-Liquid-Separation by Cake Filtration - State of the Art and Future Expectations, Dr. Harald Anlauf, Karlsruhe University, Germany **(I-21)**

M1 Gas Separation and Pervaporation 13:15-14:30

Gas separation with supported ionic liquid membranes, A. Seeberger*, C. Kern, A. Jess, University of Bayreuth, Germany **(II-40)**

Alternative permeate recovery systems for pervaporation, D. Shanahan*, C. O'Suilleabnain, I. O'Sullivan, Cork Institute of Technology, Ireland **(II-45)**

Concentration and dewatering of ethanol by organophilic and hydrophilic zeolite membranes, M. Weyd*, H. Richter, G. Fischer, P. Puhlfürß, I. Voigt, HITK Hermsdorfer Institute for Technical Ceramics; J. Kühnert, inocermic GmbH, Germany **(II-50)**

M2 Potable Water 13:15-14:30

Safe drinking water for everybody?! Membrane technology from small scale to large scale and vice versa, H. Futselaar*, J. Geluk, L. Broens, Norit Process Technology B.V.; J. Jacobs, Norit Membrane Technology B.V., Netherlands **(II-55)**

Two years experience with Germanys largest two stage ultrafiltration plant for drinking water production (7,000 m³/h), S. Panglisch*, R. Gimbel, IWW Water Center; W. Dautzenberg, WAG Nordeifel mbH, Germany **(II-59)**

Potable water production by membrane processes: Effect of bacterial deformation on microorganisms' removal, N. Lebleu*, C. Causserand, C. Roques, P. Aimar, University of Toulouse, France **(II-64)**

M3 New Fibrous Membranes 13:15-14:30

Functionalized and doped nanofiber filtration media with Ionex and antimicrobial properties, J. Marek*, J. Svobodova, M. Juklickova, Elmarco Ltd.; L. Jelinek, Institute of Chemical Engineering, Czech Republic **(II-69)**

The development of an enhanced surface filtration medium based on short metal fibres for applications in food & beverage, chemical & pharmaceutical industry, I. Schildermanns*; D. Santens, NV Bekaert SA, Belgium **(II-74)**

Commercial applications for Disruptor™ alumina nanofiber filter media, R. Komlenic*, Ahlstrom Filtration Inc.; F. Tepper, Argonide Corp., USA **(II-79)**

G1 Surface Filtration I 13:15-14:30

Assessment of the cleanable dust filtration behaviour of surface treated needle felts by characterisation parameter determined by image analysis, W. Höflinger*, G. Mauschitz, H. Rud, J. Schuberth, Vienna University, Austria **(III-37)**

Characteristics of bag filter pressure drop profiles, M. Koch*; G. Krammer, NTNU University, Norway **(III-42)**

Comparing gas and Liquid filtration of nonwovens transitional capacity and energy consumption, H. Kleizen*, IDEGO, Delft University, Parker Filtration B.V., Netherlands **(III-47)**

G2 Electrostatic Precipitation 13:15-14:30

Charge emission characteristics of a drained DBD electrode apparatus for nano-particle charging and precipitation, M. Wild, J. Meyer*, G. Kasper, Karlsruhe University, Germany **(III-52)**

Separation of oil mists from air flow by a space-charge electrostatic precipitator, A. Bologa*, H. Paur, H. Seifert, K. Woletz, Forschungszentrum Karlsruhe, Germany **(III-57)**

WeLo /MultiTron Premium – The new electrostatic precipitator, M. Sauer-Kunze*, GEA Delbag Lufttechnik GmbH, Germany **(III-62)**

L1 Vacuum and Pressure Cake Filtration Fundamentals I 15:00-16:15

Suspension typology and computer aided characterization of the suspension filterability, I. Nicolaou*, FOS Ltd., Cyprus **(I-37)**

Filter media resistance on continuous solid liquid filters, J. Tichy*, BHS-Sonthofen, Germany **(I-42)**

Experimental design and evaluation of filtration experiments allowing for superposed sedimentation, M. Longerich*, A. Damm, Bayer Technology Services GmbH, Germany **(I-47)**

L2 Sedimentation Fundamentals-Analytical Centrifugation I 15:00-16:15

Acquisition of compression-permeability data of soft and hard colloids based on centrifugation experiments, E. Iritani*, N. Katagiri, K. Aoki, M. Shimamoto, Nagoya University, Japan **(I-51)**

Separation behaviour of suspensions in polymer solutions studied by multisample analytical centrifugation, T. Sobisch*, T. Detloff, D. Lerche, L.U.M. GmbH, Germany **(I-56)**

Application of analytical centrifugation for studying solid-liquid separation in papermaking, H. Liimatainen*, J. Niinimäki, University of Oulu, Finland **(I-61)**

L3 Optimization of Solid-Liquid Separation Processes I 15:00-16:15

A multi-scale approach to solid-liquid separation task: a paradigm shift, T. Sheikhzeinoddin*, P. Sharratt, University of Manchester, Great Britain **(I-66)**

A product-centred approach to a multi-stage task in pharmaceuticals: isolation, T. Sheikhzeinoddin*, P. Sharratt, University of Manchester, Great Britain **(I-71)**

Continuous treatment and scrubbing of bottom ash from thermal waste treatment to produce improved granulate quality, R. Koralewska*, Martin GmbH; R. Grönnert, R. Hausdorf, Hans Huber AG, Germany; G. Zellinger, Kärntner GmbH; H. Gschaider, Binder+Co AG, Austria **(I-76)**

Invited Lecture 2 15:00 - 16:15

Advances relating to Filter Media Developments
Prof. Richard P. Lydon, Clear Edge Group, Great Britain **(II-19)**

G3 Surface Filtration II 15:00 - 16:15

Effects of PPS fibre intermixture on the surface structure and the filtration behaviour of PI needle felts for cleanable dust filters, G. Mauschitz*, J. Schuberth, W. Höflinger, Vienna University, Austria **(III-67)**

Effect of operating parameters on stability of jet pulsed bag filter - an experimental study, M. Saleem*, A. Ijaz, University of the Punjab, Pakistan; G. Krammer, NTNU University, Norway **(III-72)**

Experimental study of cake detachment in cake filtration and electrostatic enhanced cake filtration, H. Xu*, G. Xiong, Q. Yao, Tsinghua University, P.R. China **(III-77)**

G4 Mist and Droplet Separation 15:00 - 16:15

Development of a standardised test method on metalworking fluid mist collector elements, P. Wlaschitz*, W. Höflinger, Vienna University, Austria **(III-82)**

Filtration of liquid aerosols with a horizontal fibrous filter, A. Charvet*, Y. Gonthier, A. Bernis, E. Gonze, University of Savoie, France **(III-87)**

Numerical and experimental investigations on the development of oil droplet separators in crankcase ventilation systems, S. Schütz*, G. Gorbach, A. Zink, K. Kissling, M. Piesche, Stuttgart University, Germany **(III-92)**

L4 Vacuum and Pressure Cake Filtration Fundamentals II 16:45 - 18:00

Utilization of statistical design of experiments for improving the efficiency of test filtration tasks, A. Häkkinen*, M. Huhtanen, J. Kallas, Lappeenranta University; B. Ekberg, Larox Corp., Finland **(I-81)**

Study on the scalability of pressure filtration in pilot and bench scale test equipment, J. Palmer*, Larox Corp., Finland **(I-86)**

Layout of rotary filters on the basis of laboratory results, E. Ehrfeld*, R. Bott, T. Langeloh, Bokela GmbH, Germany **(I-91)**

L5 Sedimentation Fundamentals-Analytical Centrifugation II 16:45 - 18:00

Theoretical and experimental approach to the settling behaviour of particle-fiber-mixtures, M. Feist*, H. Nirschl, Karlsruhe University; J. Wagner, G. Hirsch, Darmstadt University, Germany **(I-96)**

Equation for fitting dispersed systems gravity & centrifuge settling data, A. Yelshin*, M. Mota, University of Minho, Portugal; I. Yelshyna, Polotsk University, Belarus **(I-101)**

Measurement of settling velocity enhancement by magnetic flocculation using manometric sedimentation centrifugation, M. Stolarski*, C. Eichholz, H. Nirschl, Karlsruhe University, Germany; B. Fuchs, DuPont, USA **(I-106)**

L6 Optimization of Solid-Liquid Separation Processes II 16:45 - 18:00

Life-cycle Cost Analysis for the Selection of the Optimal Equipment for Solid-Liquid Separation, S. Ripperger*, Kaiserslautern University, Germany **(I-111)**

Commercial aspects of solid liquid separations in salt separation applications, D.E. Keller*, KMPT AG, Germany **(I-116)**

Performance increase in solid-liquid separation, D. Steidl*, BHS-Sonthofen; J. Tichy, Consulting Engineer, Germany **(I-121)**

M4 Raw/Sea Water Pre-Treatment 16:45 - 18:00

Seawater intake and pre-filtration with Neodren®, T. Peters*, Consulting for Membrane Technology, Germany; D. Pinto, E. Pinto, Catalana de Perforacions S.A., Spain **(II-83)**

Comparison of options for seawater pre-treatment for SWRO plants, T. Peters*, Consulting for Membrane Technology; O. Schuster, B. von Harten, M. Ulbricht, Membrana GmbH; E. Schmidt, Wuppertal University, Germany; D. Pinto, E. Pinto, Catalana de Perforacions S.A., Spain **(II-88)**

Application of automatic backflushfilter to improve raw water pre-treatment of reverse osmosis desalination plants, B. Schlichter*, P. Mehlem, R. Wnuk, HYDAC Process Technology GmbH, Germany; M. Parker, HYDAC Technology Corp., USA **(II-93)**

M5 New Membranes 16:45 - 18:00

Composite membranes fabricated by plasma polymerization using organic compounds, D.-T. Tran*, L.V. Kim Ba, Hanoi University, Vietnam; S. Mori, M. Suzuki, Tokyo Institute of Technology, Japan **(II-98)**

Functional polymer materials to remove ions in conjunction with ultrafiltration membranes, B. Rivas*, A. Pooley, A. Maureira, E. Peireira, M. del Carmen Aguirre, University of Conception, Chile **(II-103)**

Clean edge micro sealing of filtration modules – the cut&weld method, A. Korz*, K. Herzer, A. Hubrich, Textile Fusion Technologies GmbH, Germany **(II-106)**

G5 Clogging of Candles and Cartridges 16:45 - 18:00

Modelling of the clogging of pleated filter for gas filtration, M. Rebai*, M. Prat, IMFT; M. Meireles, University of Toulouse; P. Schmitz, INSA; R. Baclet, S. Demeulemeester, Mecaplast Group, France **(III-97**

Study of pressure drop and aerosol penetration during clogging of mini-pleated air filters, A. Joubert*, S. Artous, L. Bouilloux, IRSN; S. Calle-Chazelet, D. Thomas, J. Remy, Nancy University, France **(III-102)**

Experimental study on flow through concentric porous filter candle, A. Ijaz*, M. Saleem, University of the Punjab, Pakistan **(III-107)**

G6 Fine Particle Precipitation 16:45 - 18:00

Fine dust precipitation in a Bayer-Reither venturi scrubber, M. Theis*, Bayer Technology Services GmbH; K. Reither, Reither Venturiwäscher GmbH, Germany **(III-112)**

Filtration of silver nanoparticle agglomerates, D.Y.H. Pui*, S.-C- Kim, J. Wang, M. Emery, University of Minnesota, USA **(III-117)**

Enhancement of the thermophoretic aerosol particles deposition efficiency in a turbulent annular flow configuration, B. Sagot*, F. Buron, ESTACA; G. Antonini, University of Compiègne, France **(III-122)**

Wednesday – April 16, 2008

L7 Vacuum and Pressure Cake Filtration Fundamentals III 08:30 - 09:45

Influence of synthetic suspension components on its physical behaviour, P. Ginisty*, N. Ahoyo, IFTS; J. Baudez, Cemagref, France; L. Spinosa, CNR, Italy **(I-126)**

Filtration properties in solvent-water mixtures, S. Neubauer*, U.A. Peuker, Clausthal University, Germany **(I-131)**

The influence of morphology and size on constant pressure filtration for two crystallizing systems, R. Beck*, D. Malthe-Sorenssen, J.-P. Andreassen, NTNU University, Norway; A. Häkkinen, M. Louhi-Kultanen, Lappeenranta University, Finland **(I-136)**

L8 Technical Centrifugal Filtration- Selection and Optimization 08:30 - 09:45

Systematic of filter centrifuges, P. Stelter*, HEINKEL Process Technology GmbH, Germany **(I-141)**

Selection of screen- and filter-centrifuges based on material and filtration properties, U. Esser*, D. Mrotzek, Bayer Technology Services GmbH, Germany **(I-146)**

Computer aided optimization of batch filtering centrifuges, I. Nicolaou*, FOS Ltd., Cyprus **(I-150)**

L9 Filter Media Cleaning 08:30 - 09:45

DEECOM™: A new eco-technology for cleaning metal filters, B. Longworth, J.P. Millington, J. Norris, P. Norris, C. Reid, B&M Longworth Ltd., Great Britain; S.L. Reynolds*, Carolina Filters, Inc., USA **(I-155)**

Process strategies avoiding impurities adhering to woven filter media used in inverting filter centrifuges, S. Stahl*, H. Nirschl, Karlsruhe University, Germany **(I-160)**

Comparison of regeneration methods for ceramic filter media, J. Puranen*, A. Häkkinen, J. Kallas, Lappeenranta University; B. Ekberg, Larox Corp., Finland **(I-165)**

M6 Process/Waste Water Treatment 08:30 - 09:45

Membrane technology for recycling and recovery of resources in industrial water and waste water applications – from lab testings to production experiences, C. Bohner*, EnviroChemie GmbH, Germany **(II-111)**

Field experiences with membrane filtration for reuse of biological wastewater effluents, T. Baum*, S. Theiss, H. Eipper, Pall GmbH, Germany **(II-115)**

Impacts of the influent toxicity on the efficiency of tertiary filtration of wastewater from petroleum industry, S. Heng*, N. Lesage, Q. Su, Total Petrochemicals, France **(II-120)**

M7 Reverse Osmosis 08:30 - 09:45

Investigations of silica scaling on reverse osmosis membranes, G. Braun*, T. Harrer, T.- Götz, Cologne University; W. Hater, C. zum Kolk, C. Dupoiron, BKG Water Solutions - BK Giulini GmbH, Germany **(II-125)**

Reverse osmosis pilot plant studies regarding a novel electrochemical method to control $CaCO_3$ scaling, M. Meinardus*, Grünbeck Wasseraufbereitung GmbH, Germany **(II-130)**

Characeterisation of reverse osmosis (RO) membrane fouling by autopsy – A case study, I. M. El-Azizi*, R. G. Edyvean, Sheffield University, Great Britain **(II-135)**

G7 Depth Filtration & Particle Deposition 08:30 - 09:45

Simulation studies of deposition mechanisms for aerosol particles in fibrous filters including slip flow, A. Wiegmann*, K. Schmidt, S. Rief, L. Cheng, A. Latz, Fraunhofer Institute for Industrial Mathematics ITWM, Germany **(III-127)**

Particle capture by air filter media having truncated log-normal fiber diameter distributions and random spacing of fibers, P. Tronville*, Torino University, Italy; R. Rivers, EQS Inc., USA; Z. Bin, Tongji University, P.R. China **(III-132)**

Comparison of calculated and MRI determined 1-dimensional profiles of deposited particle material in depth filter media with ongoing loading, J. Hoferer*, S. Schollmeier, J. Meyer, G. Kasper, Karlsruhe University, Germany **(III-137)**

G8 Measurement Techniques 08:30 - 09:45

Evaluation of filter test rigs for fractional efficiency measurements according to filter test standards, S. Schütz*, M. Schmidt, L. Mölter, Palas GmbH, Germany **(III-142)**

Real time tunnel ventilation and filter control systems, F. Schneider*, Grimm Aerosol Technik GmbH, Germany **(III-147)**

Dust measuring technology for the monitoring of particulate emissions, H. Födisch*, P. Schengber, Dr. Födisch Umweltmesstechnik AG, Germany **(III-151)**

PL1 – Poster Session 10:15 - 12:15

Deep Bed Filtration for Water and Wastewater

Water depuration by means of fibrous filter medium, A. Budyka*, A. Shepelev, V. Rykunov, K. Lukanina, Karpov Institute of Physical Chemistry, Russia **(I-553)**

Rice hull ash and its filtration and separation applications, W. Li, C. Berthold*, C. Kiser, Q. Richard, Agrilectric Research Company, USA **(I-557)**

Filter Aids - Press Filtration

Influences on the wort flow in the lautering process during beer production, J. Tippmann*, J. Voigt, K. Sommer; Munich University, Germany **(I-562)**

Sedimentation Fundamentals-Analytical Centrifugation

Stability prediction of concentrated suspensions: Comparison of NMR and analytical centrifuge measurements, S. M. Pancera*, N. Nestle, V. Boyko, Y. Liu, BASG AG, Germany **(I-567)**

Centrifugal Sedimentation and Filtration

CFD multiphase flow simulation of a solid bowl centrifuge with radial compartments, X. Romaní Fernández*, H. Nirschl, Karlsruhe University, Germany **(I-572)**

Modelling of centrifugal drainage: effect of filter medium resistance, B. Leger, M. Valat, W. Jomaa, J.-R. Puigali, University Bordeaux 1; S. Couturier, P. Ginisty*, IFTS, France **(I-577)**

Hydrocyclones

Multiphase flow simulation of a hydrocyclone, R.-M. Wu*, C.-Y. Hsu, Tamkang University, Taiwan **(I-582)**

Particle Measurement - Contamination Control

Granulometry and morphology by microscopy and image analysis, O. Huin*, Microvision Instruments SAS, France **(I-586)**

Microbes verification on oxygen consumption rate measurement of biofilm in drinking water, L.-F. Chen*, W.-L. Lai, Shu-Te University, Taiwan **(I-591)**

Separation Enhancement by Magnetic Forces

Using Magnetic Filtration for Removal of Heavy Metals from Water by Nanomagnetic Extractants, S. M. Alfadul*, King Abdulaziz City for Science Technology, Saudi Arabia; A. W. Apblett, Oklahoma State University, USA **(I-596)**

Separation of pharmaceutical products with reverse micelles, S.H. Mohd-Setapar, R.J. Wakeman, E.S. Tarleton, Loughborough University, Great Britain **(I-601)**

PL2 – Poster Session 10:15 - 12:15

Separation Enhancement by Electric Forces

Electrofiltration of PHB, G. Gözke*, I. Perner-Nochta, C. Posten, Kalrsruhe University, Germany **(I-606)**

Separation Enhancement by Chemical Additives

Charge effects determine the filtration resistance in cake filtration and crossflow filtration experiments, H. Saveyn*, D. Curvers, P. Van der Meeren, Ghent University, Belgium **(I-611)**

Laboratory Vacuum and Pressure Cake Filtration

Miniaturisation of filtration processes - A necessity for the pharmaceutical industry, A. Schreiner*, R. Schneeberger, Novartis Pharma; S. Jerman, ETH Zurich, Switzerland **(I-615)**

Are standards in designing industrial filters for solid liquid filtration wisely and necessary?, J. Tichy*, H.-P. Schmid, BHS-Sonthofen GmbH; S. Ripperger, Kaiserslautern University, Germany **(I-616)**

Filtration Properties in Organic Solvents, S. Neubauer*, U.A. Peuker, Clausthal University, Germany **(I-620)**

Technical Vacuum and Pressure Cake Filtration

Study on parameters affecting belt filtration of a metal precipitate suspension, S. Hirvisaari*, A. Häkkinen, J. Kallas, Lappeenranta University; B. Ekberg, Larox Corp.; A. Rautanen, Tamfelt Corp.; S. Storbacka, OMG, Finland **(I-625)**

Development of an automated online quotation tool, O. Sieking, E. Eenovaara, S. Henttu, Larox Corp., Finland; H. Brezina*, Larox GmbH, Germany **(I-630)**

Technical Vacuum and Pressure Cake Filtration – Media and Components

Easy installation and improved performance with a new filter press cloth design for applications in e.g. waste water, B. Maurer*, R. Gaiser, H. Dür, Sefar AG, Switzerland **(I-633)**

Press Filtration Fundamentals

Mass transfer from porous particles during the pressing of biological materials, M. Petryk, Ternopil University, Ukraine; E. Vorobiev*, University of Compiègne, France **(I-636)**

Slurry Pretreatment by Precipitation and Crystallization

Enhancing phosphogypsum filtration with sorbitan sesquioleate additive: Theory and practice, E.A. Abdel-Aal*, M.M. Rashad, CMRDI, Egypt; H. El-Shall, University of Florida, USA **(I-641)**

Boron recovery from the clay wastes of boron industry by solid-liquid extraction, I. Kipcak*, M. Özdemir, Eskisehir Osmangazi University, Turkey **(I-646)**

Boron recovery from borax sludge using solid-liquid extraction followed by precipitation, I. Kipcak*, M. Özdemir, Eskisehir Osmangazi University, Turkey **(I-651)**

L10 Filter Media Blockage – Initial Stage of Cake Filtration 10:15 - 11:30

Pore fouling behaviors in constant pressure and constant flux filtration of very dilute suspension, E. Iritani*, N. Katagiri, Y. Sugiyama, Nagoya University; K. Yagishita, Sanshin Mfg. Co., Ltd., Japan **(I-170)**

Zeta potential of filter media and its influence on the initial stages of cake filtration, C. Schnitzer*, S. Ripperger, Kaiserslautern University, Germany **(I-175)**

Fouling of filter media: Solubility of oxalate solutions, R. Salmimies*, M. Louhi-Kultanen, A. Häkkinen, J. Kallas, M. Huhtanen, Lappeenranta University; Bjarne Ekberg, Larox Corp., Finland **(I-180)**

PM1 Membrane Fouling 10:15 - 12:15

Resonance pulsed flow in cross flow filtration, C. Pflieger*, D. Lisicki, D. Beckmann, Institute for Bioprocessing and Analytical Measurement Techniques; J. Briesovsky, BB ResoPuls; E. Flindt, T. Reischl, membraPure GmbH; U. Metzler, Dingslebener Privatbrauerei Metzler GmbH, Germany **(II-416)**

Analysis of particle fouling in different kinds of membranes during microfiltration, K.-J. Hwang*, C.-Y. Liao, Tamkang University, Taiwan **(II-421)**

Application of electric field to reduce the fouling in crossflow microfiltration, C.-J. Chuang* , C.-C. Hsiung, Z.-H. Cheng, Chung Yuan University, Taiwan **(II-426)**

Flow Manipulation for Performance Enhancement in Crossflow Filtration, B. Olayiwola*, P. Walzel, Technical University of Dortmund, Germany **(II-431)**

Effect of membrane material-cum-morphology on the dead-end micro-filtration of protein solution during filtration cycles, K.-L. Tung*, S. Wang, D. Nanda, C.-C. Hu, C.-L. Li, Y.-L. Li, Chung Yuan University; J. Huang, Yeu Ming Tai Chemical Industrial Co. Ltd., Taiwan **(II-436)**

Modified UF/NF membranes by LBL polyelectrolytes films for easy handling biofouling, M. Pontié*, E. Joudren, Angers University, France **(II-441)**

Relative effect of osmotic pressure and fouling on flux decline in nanofiltration of whey and skimmed milk, B. Chaufer, H. El Khabbaze, B. Balannec, M. Rabiller-Baudry*, University Rennes 1, France; K. Elkacemi, University Mohamed V-Agdal, Morocco **(II-442)**

Performances of an out-of-basin MBR for treating TFT-LCD wastewater, C.-H. Hsieh*, C.-M. Feng, C. Chou, S. Tan, Topco Scientific Co., Ltd.; C.-Y. Chung, J. C. Liu, Taiwan University, Taiwan **(II-447)**

PM2	Mechanism, Modellling Simulation, Design	10:15 - 12:15

Modelling of the mass transfer in a hollow fiber dialyzer coupled with ultrafiltration operations, C.-D. Ho*, J.-W. Tu, Tamkang University, Taiwan **(II-452)**

Investigation of mass transport in membrane-based separation of aqueous protein mixture, O. Trifunovic*, P. M. Bongers, Unilever, Netherlands **(II-xxx)**

Lattice Boltzmann simulation on flow in porous medium of ceramic filter, Z. Ji*, M. Sun, H. Chen, University of Petroleum Beijing, P.R. China **(II-457)**

CFD simulation of a flat membrane module as a tool to explain fouling distribution, M. Rabiller-Baudry*, B. Balannec, D. Delaunay, University Rennes 1, France; J.M. Gozálvez-Zafrilla, University of Valencia, Spain **(II-462)**

Investigation of dynamic filters using CFD, L. Steinke*, Y. Taamneh, S. Ripperger, Kaiserslautern University, Germany **(II-467)**

Mathematical modeling of the simultaneous absorption of CO2 and H2S in a hollow fiber membrane contactor, J. Fathikalajahi*, P. Keshavarz, S. Ayatollahi, Shiraz University, Iran **(II-477)**

Using fractional factorial design to determine the effect of the operational parameters on water flux in ultrafiltration, W.-L. Lai*, S.-W. Liao, J.-J. Chen, Tajen University; Li-Fu Chen, Shu-Te University, Taiwan **(II-482)**

PG1	Surface Filtration	10:15 - 12:15

Filtration performance characteristics of high temperature pleatead filters which operated in conventional bag filter and Cybag filter, Y.-O. Park*, N. Hasolli, KIER; H.-J. Roh, Chung-Nam University, Korea **(III-362)**

Efficient and economic particulate collection from the flue gas by the advanced hybrid particulate collectors, Y.-O. Park*, N. Hasolli, H.-K. Choi, KIER; Korea **(III-367)**

Particle layer detachment under consideration of transient kinetic effects, Q. Zhang*, E. Schmidt, University of Wuppertal, Germany **(III-372)**

Aspects of nozzle effect on the pulse-jet cleaning of a ceramic filter, J.-H. Choi*, K.-M. Sakong, Gyeongsang University, Korea; H. Chi, Z. Ji, University of Petroleum , P.R. China **(III-378)**

Permeability of ceramic filters for high temperature gas filtration, G.M.C. Silva, E.A. Moreira, M.D.M. Innocentini, J.R. Coury*, University of Sao Carlos; C.R. Rambo, D. Hotza, University of Santa Catarina, Brazil **(III-383)**

Performance evaluation of cellular ceramic membranes for hot aerosol filtration, M.D.M. Innocentini, V.P. Rodrigues, University of Ribeirao Preto; G.M.C. Silva, R.C.O. Romano, J.R. Coury*, University of Sao Carlos; R.G. Pileggi, University of Sao Paulo, Brazil **(III-388)**

Gas filtration: Influence of operational variables on cake formation and detachment in different filter types, M.L. Aguiar*, P.A. Paschoal, University of Sao Carlos, Brazil **(III-393)**

Study on gas-solid filtration using cellulose fiber filtering media, D.F. Torre, M.L. Aguiar*, E.H. Tanabe, University of Sao Carlos, Brazil **(III-398)**

Study of the profundity of particles penetration in different fabric filters, M.L. Aguiar*, E.H. Tanabe, E.J. Ricco, K.B. Rodriguez, University of Sao Carlos, Brazil **(III-403)**

Effects of corona electrified solid particles on the efficiency and pressure drop of a fabric filter, M.V. Rodriguez*, M.A.S. Barrozo, University of Uberlandia; J.R. Coury, University of Sao Carlos, Brazil **(III-408)**

PG2	Solid Gas Separation	10:15 - 12:15

Investigations into the collection of fine dust by plants, D. Bracke*, G. Reznik, H. Mölleken, E. Schmidt, University of Wuppertal, Germany **(III-413)**

Development of a model equation for dust suppression by using a water-spraying system, W. Höflinger*, P. Grundnig, G. Mauschitz, J. Gao, Vienna University, Austria **(III-418)**

Use of water sprays for reduction of airborne dust pollution, U. Klenk*, E. Schmidt, University of Wuppertal, Germany **(III-423)**

Experimental study on the multi-orifice injection of liquid in a venturi scrubber, J.A.S. Goncalves*, V.G. Guerra, J.R. Coury, University of Sao Carlos, Brazil **(III-428)**

Trace heavy metals emission control through enhanced submicrometer range filtration: Experimental determination of performance, C. Gutierrez-Canas*, J.A. Legarreta, University of the Basque Country; Sapin; D.Y.H. Pui, S.-C- Kim, University of Minnesota, USA **(III-433)**

Experimental study of gas-solid two-phase flow in the guide vane cyclone tube, J.-J. Wang*, Y. Guo, Y.-H. Jin, University of Petroleum Dongying, P.R. China **(III-438)**

Personal impactor to measurements aerosol inhalation dose, D.A. Pripachkin*, A.K. Budyka, Karpov Institute of Physical Chemistry; A.G. Tsovyanov, Institute of Biological Physics, Russia **(III-443)**

L11	Technical Vacuum and Pressure Cake Filtration	13:15 - 14:30

Optimizing industrial filters at Pyhäsalmi mine in Finland, P. Rantala*, S. Lähteenmäki, Helsinki University, Finland **(I-185)**

Advanced filtration of PTA (Pure Terephthalic Acid): Separation, washing and demoisturing in a single process unit with the hi-bar filtration R. Bott*, T. Langeloh, M. Schiessl, Bokela GmbH, Germany **(I-190)**

The multi-purpose rotary drum filter, T. Langeloh*, R. Bott, Bokela GmbH, Germany **(I-195)**

L12 Technical Centrifugal Sedimentation for Ultrafine Particles 13:15 - 14:30

Centrifugal separation in biopharmaceutical processing, W.-F. Leung*, The Hong Kong Polytechnic University, Hong Kong **(I-200)**

A case study - from lab-scale testing to industrial scale processing using a disk stack centrifuge, B. Fuchs*, A. Trasatti, S. Reddell, T. Pryor, DuPont Engineering, USA **(I-205)**

Fine solids separation within biodiesel process, M. Kopf*, G. Bergjohann, Pieralisi Deutschland GmbH, Germany **(I-210)**

L13 Filter Media Characterization – Porometry – Integrity Testing I 13:15 - 14:30

Homogeneity of commercial filter cartridges, K. Gupta*, A. Jena, Pourous Materials, Inc., USA **(I-215)**

Bubble point and pore size distribution measurements of filter papers, wovens and nonwovens using a pore size meter PSM 165, S. Große*, A. Rudolph, Topas GmbH, Germany **(I-220)**

Filter media pore size comparison between porometry and glass bead challenge testing, G. Rideal*, Whitehouse Scientific Ltd., Great Britain; E. Mayer, DuPont Engineering, USA **(I-225)**

M8 Produced Water Treatment 13:15 - 14:30

Feasibility of using ceramic ultra- and nanofiltration membranes for efficient treatment of produced water, P. Czermak*, M. Ebrahimi, K. Shams Ashaghi, University of Giessen-Friedberg; P. Mund, Atech Innovations GmbH, Germany **(II-140)**

Crossflow microfiltration of oil from synthetic produced water, Y.H.D. Alanezi*, R.J. Wakeman, R.G. Holdich, Loughborough University, Great Britain **(II-145)**

Preparation of nano-sized particles modified PVDF/Al_2O_3/TiO_2 ultrafiltration membrane and study on its performances for oilfield wastewater treatment, S.-L. Yu*, Q. Zhao, H. Lu, J. Yang, D. Wang, Harbin Institute of Technology, P.R. China **(II-150)**

M9 Nanofiltration 13:15 - 14:30

Nanofiltration: A method for solute removal from non-aqueous solvents, E.S. Tarleton*, Loughborough University, Great Britain **(II-155)**

Organophilic nanofiltration by polymeric membranes, T. Beeskow*, GMT Membrantechnik GmbH; J. Stegger, Borsig Membrane Technology GmbH, Germany **(II-160)**

Pre-oxidation effect on TOC removal in surface water treatment by nanofiltration, G.H.R. Nabi Bidhendi*, A.Torabian, H. Etemadi, A.A. Ghadimkhani, Tehran University, Iran **(II-165)**

Invited Lecture 3 13:15 - 14:30

Gas Cleaning Technology, Prof. Gernot Krammer NTNU - University of Science and Technology, Norway **(III-19)**

Invited Lecture 4 13:15 - 14:30

Solid-Liquid-Separation by Deep Bed Filtration, Prof. Rolf Gimbel University of Duisburg Essen, Germany **(I-29)**

M10 Characterisation by SAXS 15:00- 16:15

Modifying a small-angle X-ray scattering-camera for a time-reduced characterisation of nanoparticles, V. Goertz*, H. Nirschl, Karlsruhe University, R. Wengeler, BASF AG, Germany **(II-170)**

Spatial and temporal in-situ evolution of concentration profile probed by SAXS during ultrafiltration of casein micelles, C. David, F. Pignon*, A. Magnin, University of Grenoble; M. Sztucki, European Synchrotron Radiation Facility; G. Gésan-Guiziou, INRA Agrocampus Rennes, France **(II-175)**

In-situ characterization of anisotropic colloids deposition by SAXS during crossflow ultrafiltration, F. Pignon*, C. David, A. Magnin, University of Grenoble; M. Sztucki, European Synchrotron Radiation Facility, France **(II-180)**

M11 Dynamic Filtration 15:00- 16:15

Rotation filtration with ceramic membrane discs: presentation of industrial and municipal applications, C. Münch*, F. Koppe, Kerafol GmbH, Germany **(II-185)**

Dynamic cross-flow filtration of biological suspensions, e.g. bakers yeast, S. Neubauer*, U.A. Peuker, Clausthal University, Germany **(II-190)**

Classification using dynamic filtration, Y. Taamneh*, S. Ripperger, Kaiserslautern University, Germany **(II-195)**

M12 Dairy Products I 15:00 - 16:15

Impact of physico-chemical feed properties on deposit layer formation and filtration in the microfiltration of milk proteins, W. Kühnl*, A. Piry, A. Tolkach, U. Kulozik, Munich University; T. Grein, S. Ripperger, Kaiserslautern University, Germany **(II-200)**

Effect of physico-chemical changes on critical hydrodynamic conditions and protein transmission during microfiltration (0.1 µm) of skimmed milk, G. Gésan-Guiziou*, F. Garnier, F. Rousseau, INRA Agrocampus Rennes; A. Jimenez, SOREDAB SAS, France **(II-204)**

Role of physico-chemical environment on limiting and critical fluxes in ultrafiltration, nanofiltration and reverse osmosis of modified skim milks, M. Rabiller-Baudry*, H. Bouzid, L. Paugam, University Rennes 1, France **(II-209)**

G9 Depth Filtration & Nanofibre Layers 15:00 - 16:15

Experimental investigation on air filtration of submicron particulates by nanofiber filter, W.-F. Leung*, C.-H. Hung, The Hong Kong Polytechnic University, Hong Kong **(III-156)**

Investigation of filters with a single nanofiber layer on a substrate, J. Wang*, D.Y.H. Pui, S.C. Kim, University of Minnesota, USA **(III-161)**

Filtration properties of cellulose filter media with polymer nanofiber layer, M. Maly*, S. Petrik, J. Duchoslav, L. Plistil, Elmarco Ltd.; J. Hruza, University of Liberec, Czech Republic **(III-166)**

G10 Hot Gas Cleaning 15:00 - 16:15

Predicting the long term filtration behaviour on the basis of cycle times measured over a limited number of filtration cycles: Problems and approaches in high temperature gas filtration, N. Döring*, J. Meyer, G. Kasper, Karlsruhe University, Germany **(III-171)**

Blow back system for hot gas filter installations using sintered metal fibre filter elements, I. Schildermans*, V. Kuijken, S. Vandendijk, A. Aust, NV Bekaert SA, Belgium **(III-176)**

High temperature granular bed filtration of biomass gasification gas, D. Stanghelle*, A. Norheim, O.K. Sonju, J. Hustad, NTNU University, Norway **(III-181)**

L14 Large Scale Treatment of Water and Wastewater 16:45 - 18:00

Large scale experiences in wastewater filtration: A practical insight, M. Barjenbruch*, Berlin University, Germany **(I-230)**

Experience from world's largest sea water filtration plant for oil reservoir injection, M.H. Al-Ghamdi*, N.P. Isaias, Saudi Aramco, Saudi Arabia **(I-235)**

The impact of wastewater quality on receiving water bodies in Eastern Cape, South Africa, A.N. Osode, University of Fort Hare; M. Sibewu; M.N.B., Tshwane University, South Africa **(I-240)**

L15 Centrifugal Filtration Fundamentals 16:45 - 18:00

Advances in mathematical models and numerical methods for gravity and centrifugal sedimentation and filtration of polydisperse suspensions, R. Bürger*, University of Conception; A. Garcia, University del Norte, Chile **(I-245)**

Steam enhanced centrifugation of compressible products, U.A. Peuker*, Clausthal University, Germany **(I-250)**

Purification of particulate solids on centrifuges, F. Ruslim*, H. Nirschl, W. Stahl, Karlsruhe University, Germany; P. Carvin, Rhodia, France **(I-255)**

L16 Filter Media Characterization Porometry – Integrity Testing II 16:45 - 18:00

A study of the mechanism of wet and dry filtration using NIST traceable glass microspheres, G.R. Rideal*, E.A. Roberts, A. Stewart, J. Storey, Whitehouse Scientific Ltd., Great Britain **(I-260)**

Monitoring of cleanliness level in hydraulic and lube fluids using the mesh blockage technique, H. Karl*, Pall GmbH, Germany; M.J. Day, Pall Europe Ltd., Great Britain **(I-265)**

Filterability of mineral based gear lubrication oils, K. Farooq*, Pall Corporation, USA **(I-270)**

M13 Dynamic Filtration II 16:45 - 18:00

Dynamic cross flow microfiltration of viscous suspensions, S. Mirza*, Somicon AG, Switzerland; R. Bott, E. Ehrfeld, Bokela GmbH, Germany **(II-214)**

Dynamic cross-flow filtration with ceramic filter membranes, B. Hegnauer*, KMPT AG, Germany **(II-219)**

Influence of different parameters on membrane flux and nutrient retention of digester effluent filtrate in a single-shaft-disk-filter, R. Maas*, V. Bagehorn, E. Friedrich, H. Friedrich, Fraunhofer Institute for Ceramic Technologies & Systems IKTS, Germany **(II-224)**

M14 Dairy Products II 16:45 - 18:00

Microfiltration for the reduction of microorganisms in complex food systems: Effect of operating conditions and ingredient interactions, V. Kaufmann*, V. Schmidt, S. Scherer, U. Kulozik, Munich University, Germany **(II-229)**

Effect of membrane length, membrane resistances and process conditions on the fractionation of milk proteins by microfiltration, A. Piry*, W. Kühnl, A. Tolkach, U. Kulozik, Munich University, T. Grein, S. Ripperger, Kaiserslautern University, Germany; A. Heino, University of Helsinki, Finland **(II-233)**

Membrane adsorption chromatography – A novel hybrid technology for the separation of high value bioactive molecules such as glycosylated peptides, M. Kreuß*, U. Kulozik, Munich University, Germany **(II-238)**

G11 Depth Filtration & Modelling 16:45 - 18:00

Simulation of dust filtration in consideration of the incident flow using a coupling of analytical filtration models with CFD code, P. Kopf*, M. Piesche, Stuttgart University, Germany **(III-186)**

Initial collection efficiency of neutral aerosol particles in bipolarly charged fibrous filters, A. Podgorski*, Warsaw University, Poland; A. Balazy, Cummins Filtration, Inc., USA **(III-191)**

Nonsteady-state performance of mechanical fibrous filters, A. Balazy*, Cummins Filtration, Inc., USA; A. Podgorski, Warsaw University, Poland **(III-196)**

G12 Industrial (Hot) Gas Cleaning 16:45 - 18:00

Star-BagsTM – Application of an advanced filter media construction for greater filtration efficiency and production capacity, M.J. Neate*, Albany International Pty Ltd, P.R. China; B. Currwell, Albany International Pty Ltd, Australia **(III-201)**

Backpulse cleaned filtration system for the retention of alumina particles in NOx-gas streams, I. Schildermans*, H. Verbauwhede, S. Vandendijk, NV Bekaert SA, Belgium **(III-206)**

Recent advances in particulate filtration technologies for coal gasification based power generation plants, S.D. Sharma*, D. Chase, M. Dolan, A. Ilyusheckin, K. McLennan, T. Nguyen, CSIRO Energy Technology, Australia **(III-211)**

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L17 Deep Bed Filtration – Modelling, Test and Simulation I 08:30 - 09:45

Basic model for suspension transport in porous media (for petroleum and environmental engineering), A. Shapiro*, University of Denmark DTU, Denmark; P. Bedrikovetsky, University of Rio de Janeiro/Petrobras, Brazil **(I-275)**

Optimization of non-woven metallic filter media based on probability model, S. Ishikawa*, Kansai Wire Netting Co., Ltd.; A. Shimosaka, Y. Shirakawa, J. Hidaka, Doshisha University, Japan **(I-280)**

On coupled micro- and macro simulation for filtration processes, Z. Lakdawala*, O. Iliev, A. Wiegmann, Fraunhofer Institute for Industrial Mathematics ITWM, Germany **(I-285)**

L18 Technical Vacuum and Pressure Cake Filtration – Media & Components 08:30 - 09:45

Sefar hybrid technology (SHT) - A new approach to extend durability of filter fabrics, K.-U. Hömann*, C. Maurer, Sefar AG, Switzerland **(I-290)**

Latest developments in woven filter media for gypsum dewatering in modern FGD, A. Aust*, O. Steffen, C. Gurtner, C. Maurer, Sefar AG, Switzerland **(I-291)**

Pigments getting finer and finer - A new answer to this challenge, C. Maurer*, Sefar AG, Switzerland **(II-296)**

L19 Separation Enhancement by Electric Forces 08:30 - 09:45

Comparative analysis of electro-osmotic dewatering and electroforced sedimentaion, M.S. Jami,* Islamic University Malaysia; Malaysia; M. Iwata, Suzuka National College, Japan **(I-301)**

Electrohydrodynamic transport in nanoporous filter cakes, B. Schäfer*, H. Nirschl, Karlsruhe University, Germany **(I-306)**

Solid-liquid expression enhancement from plant tissues by pulsed electric fields, E. Vorobiev*, N. Grimia, N. Lebovka, University of Compiègne; J. Vaxelaire, ENSGTI, France **(I-311)**

M15 Modelling of Membrane Processes 08:30 - 09:45

Modelling and optimization of multi-stage membrane filtration processes, Z. Kovacs*, W. Samhaber, University of Linz, Austria **(II-241)**

Dynamical modelling and optimization of wastewater filtration process by submerged membrane bioreactors, C. Albasi*, A. Zarragoitia, S. Schetrite, U. Jauregui, University of Toulouse, France **(II-246**

Modelling the separation of protein solutions by means of cross-flow filtration, T. Grein*, S. Ripperger, Kaiserslautern University; A. Piry, W. Kühnl, U. Kulozik, Munich University, Germany **(II-251)**

M16 Membrane Fouling 08:30 - 09:45

Determining fouling parameters from microfiltration tests, W.-F. Leung, The Hong Kong Polytechnic University, Hong Kong **(II-256)**

Core-shell particles as model compound for studying fouling, M.L. Christensen*, M.B.O. Andersen, T.B. Nielsen, K. Keiding, Aalborg University, Denmark **(II-261)**

Characterization of fouling membrane in different integrated microfiltration systems, X.-J. Yan, S.-L. Yu*, S.-T. Fu, X. Yang, Y.-T. An, Harbin Institute of Technology, P.R. China **(II-266)**

G13 Particles and Filter Tests 08:30 - 09:45

Filter test with soot generation from 7.5 nm up to 200 nm and a mass concentration from 100 mg/h up to 3 g/h, G. Lindenthal*, Consulting for Particle Technology; M. Schmidt, L. Mölter, Palas GmbH, Germany **(III-216)**

The influence of test aerosol parameters on the filtration efficiency of electret filters, I.L. Tuinman*, C. van Gulijk, TNO Defense Security and Safety, Netherlands **(III-221)**

Separation behaviour of airborne particles and bioaerosols on particulate respirators and respirator filter media, T. Voigt*, S. Ripperger, Kaiserslautern University; G. Helmke, B. Ahlert, Fulda University, K.W. Müller, BGN, Germany **(III-226)**

G14 Fibrous Filter 08:30 - 09:45

Experimental investigations concerning the origin of particle penetration during dust filtration with nonwoven filter media, T. Häusle*, H. Rieger, H. Sauter, Mahle Filtersysteme GmbH, Germany **(III-231)**

Collection of nanoparticles on fibrous media: Filtration efficiency and clogging effect, G. Mouret*, D. Thomas, S. Calle-Chazelet, Nancy University; D. Bemer, INRS, France **(III-236)**

Air filtration performance of fine to nano size fibrous materials formed from polymeric film stretch, K.-J. Choi*, AAF International, USA **(III-241)**

L20 Deep Bed Filtration – Modelling, Test and Simulation II 10:15 - 11:30

On new challenges for CFD simulation in filtration, O. Iliev*, Z. Lakdawala, Fraunhofer Institute for Industrial Mathematics ITWM; M. Dedering, W. Stausberg, IBS Filtran, Germany; R. Ciegis, V. Starikovicius, Vilnius University, Lithuania **(I-316)**

Importance of the CFD simulations for the design of efficient filters, W. Stausberg*, M. Dedering, IBS Filtran; O. Iliev, Z. Lakdawala, P. Popov, Fraunhofer Institute for Industrial Mathematics ITWM, Germany **(I-321)**

Setting a new milestone in filter media design: Simulating performance according multipass test based on 3D fiber structures, M.J. Lehmann*, H. Banzhaf, G.-M. Klein, M. Durst, Mann+Hummel GmbH; S. Rief, A. Wiegmann, Fraunhofer Institute for Industrial Mathematics ITWM, Germany **(I-326)**

L21 Press Filtration Fundamentals I 10:15 - 11:30

Describing the shear and compressive behavior of fine particulate filter cakes using characteristic solids volume fractions, A. Erk*, BASF AG, W. Stahl, H. Anlauf, Karlsruhe University, Germany **(I-331)**

Dewatering and flow behaviour of fine limestone particle packings, T. Mladenchev*, J. Tomas, University of Magdeburg, Germany **(I-336)**

Dewatering and fluidity behaviour of kaolin suspensions in the presence of a dispersant, O. Larue*, E. Vorobiev, University of Compiègne; M. Loginov, Nikolai Lebovka, Institute of Biocolloidal Chemistry, Ukraine **(I-341)**

L22 Separation Enhancement by Magnetic Forces 10:15 - 11:30

Existing and potential applications of magnetic fields in particle technology, C. Eichholz, M. Stolarski, H. Nirschl, Karlsruhe University, Germany; K. Keller*, Solae/Dupont, USA **(I-346)**

Magnetic filtration processes in selective bio separation, H. Nirschl*, M. Stolarski, C. Eichholz, Karlsruhe University, Germany **(I-351)**

Continuous selective high gradient magnetic bio separation using novel rotating matrix centrifugation, M. Stolarski*, C. Eichholz, H. Nirschl, Karlsruhe University, Germany; K. Keller, Solae; B. Fuchs, DuPont, USA **(I-356)**

PM3 Inorganic/Ceramic Membranes 10:15 - 12:15

Feasibility of ceramic ultra- and nanofiltration membranes for removal of endotoxins, P. Czermak*, M. Ebrahimi, University of Giessen-Friedberg; G. Catapano, University of Calabria, Italy **(II-487)**

Two stage integrated ceramic membrane reactor system for the continuous enzymatic synthesis of oligosaccharides, M. Ebrahimi*, L. Placido, L. Engel, K. Shams Ashagi, University of Giessen-Friedberg, Germany; P. Czermak, Kansas State University, USA **(II-492)**

MEMBRALOX® IC A new range of high compactness ceramic Crossflow filtration membranes, J. Guibaud*, P. Chanaud, J.M. Cayrey V. Lasserre, Pall Exekia, France **(II-497)**

Goat milk fractionation and protein concentration by ceramic and polymeric membranes, B. Cancino*, C. Astudillo, Pontificia Universidad Catolica de Valparaiso, Chile **(II-500)**

Filtration of BSA and ß-cyclodextrin solutions by using inorganic membrane, T.-W. Cheng*, K.-W. Lin, Y.-L. Chiu, Tamkang University, Taiwan **(II-505)**

Preparation of nano-sized alumina modified ultrafiltration membrane and its antifouling research , S.-L. Yu*, D. G. Wang, Y. Lu, W. X. SHi, H. Lv, Harbin Institute of Technology, P.R. China **(II-510)**

Adhesion of particles on ceramic membranes, T. Quadt*, E. Schmidt, University of Wuppertal, Germany **(II-515)**

PM4 Special Membranes and Complex Systems 10:15 - 12:15

Enhanced membrane separation process for biogas upgrading – Operating experiences of feeding biomethane into the Austrian gas grid, M. Harasek*, A. Makaruk, M. Miltener, R. Schlager, Vienna University, Austria **(II-520)**

Investigation of He/CO_2 selectivity in palladium composite membranes, M. Dogan*, O. Altinisik, G. Dogu, Gazi University, Turkey **(II-525)**

Ionic liquid recovery from aqueous solutions by cross-flow nanofiltration, J.F. Fernández*, E. Chilyumova, D. Waterkamp, J. Thöming, University of Bremen, Germany **(II-528)**

Linseed oil extraction by high voltage electrical discharges followed by separation oil-in-water emulsions by dynamic microfiltration, J.-L. Lanoisellé, L. Li, L. Ding, X. Liao, E. Vorobiev*, University of Compiègne, France **(II-533)**

Chromatography membrane reactor system (CMCRS) for the continuous synthesis of galactosyl-oligosaccharides, L. Engel*, M. Ebrahimi, K. Schams, P. Czermak, University of Giessen-Friedberg, Germany **(II-538)**

Homogeneous catalysts recycling by nanofiltration: one step further to the sustainable production, T. Renouard*, A. Keraani, M. Rabiller-Baudry, C. Fischmeister, University Rennes 1, France **(II-543)**

Nanofiltration membrane performances in concentrated and diluted phosphoric acid media, H. Diallo*, B. Chaufer, M. Rabiller-Baudry, University Rennes 1, France **(II-548)**

The effect of feed solution pH on membrane microstructure and performance: An inside understanding by PALS analysis and molecular dynamic simulation, K.-S. Chang*, K.-L. Tung, D. Nanda, J.Y.-C. Jean, Chung Yuan University, Taiwan **(II-553)**

Removing natural organic matters from raw water using PACl coagulation & membrane filtration, D.-J. Lee, B.N. Tsai, J.Y. Lai, National Taiwan University, Taiwan **(II-558)**

A MEMS-based wet-wet differential pressure sensor for aggressive media with integrated temperature sensor, G. Drews*, Grundfos GmbH, Germany **(II-560)**

PG3 Depth Filtration 10:15 - 12:15

Improved CFD modeling of fibrous media for air cleaning applications, P. Tronville*, Torino University, Italy; R. Rivers, EQS, Inc, USA; Z. Bin, Tongji University, P.R. China **(III-448)**

Influence of unevenness of porous structure of filtration papers on distributing of stream in pores, A.G. Denysenko*, Kharkiv University, Ukraine **(III-453)**

Dispersion of aerosol particles in inhomogeneous fibrous filter media, A. Podgorski*, A. Jackiewicz, Warsaw University, Poland; A. Balazy, Cummins Filtration, Inc., USA **(III-456)**

Deposition of charged submicron aerosol particles in fibrous filters, V.A. Kirsch*, Frumkin Institute of Physical Chemistry; A.K. Budyka, Karpov Institute of Physical Chemistry, Russia **(III-461)**

Orthogonal test and regression analysis on granular bed filter, H.-M. Fu*, X. Su, Z. Lo, X. Zhou, Donghua University, P.R. China **(III-466)**

Hot Cleaning of Fuel Gas from Biomass Gasification, S. Thomas*, A. Herrmann, E. Schotte, Fraunhofer Institute for Factory Operation and Automation, Germany **(III-471)**

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High porosity sinters TiO 2-xNx as an active carrier used in DPF Filter, J. Merkisz*, P. Fuc, Poznan University; D. Oblakowska, Crakow University, Poland **(III-479)**

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L23 Deep Bed Filtration – Modelling, Test and Simulation III 13:15 - 14:30

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Transitional capacity and particle removal efficiency connecting novel performance parameters of nonwovens, H. Kleizen*, IDEGO, Delft University, Parker Filtration B.V., Netherlands **(I-366)**

Dynamic filter efficiency. The effect of filter performance on fluid cleanliness in dynamic operating systems, C. Juhasz*, Scientific Services, Inc., USA **(I-371)**

L24 Press Filtration Fundamentals II 13:15 - 14:30

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Pore pressure measurement during cake filtration, E. Chantoiseau*, P. Arlabosse, Mining University d'Albi-Carmaux, France **(I-381)**

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G15 Filter Test Systems 13:15 - 14:30

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Practice-relevant lifetime of cleanable filter media, M. Schmidt*, L. Mölter, Palas GmbH, Germany **(III-250)**

Investigation of the filtration behaviour of an artificial filtration test rig in comparison to an industrial filter unit – Differences and possibilities of scale up, G. Gasparin*, Evonik Fibres GmbH, Austria **(III-255)**

G16 Special Filter Media 13:15 - 14:30

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The study of the PSU filtrater medium, J.-D. Wang*, China North Vehicle Research Institute, P.R. China **(II-265)**

Design of seamless sintered metal powder filter elements, R. Röhlig*, GKN Sinter Metals Filters GmbH, Germany **(II-268)**

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A novel fibrous filter for particle removal and coalescence applications, D.G. Griffiths*, C. Flinn, Fibra Ltd., Great Britain **(I-405)**

Effect of particle size on particle capture performance of polypropylene non-woven fibrous filter, T. Oshita*, Yamashin-Filter Corp.; K. Nakamura, K. Matsumoto, Yokohama University, Japan **(I-410)**

Modification of diatomaceous earth-based depth filters with nanosized basic or amphoteric metal oxides to promote virus removal from water, B. Michen*, M. Wegmann, T. Graule, Swiss Federal Laboratories for Materials Testing and Research, Switzerland; C.G. Aneziris, Freiberg University, Germany **(I-415)**

L27 Technical Mechanical-Thermal Press Filtration 15:00 - 16:15

Thermally assisted press-filtration processes - An overview, S. Couturier*, IFTS, France; U.A. Peuker, Clausthal University, Germany **(I-420)**

Hot filter presses - Industrial and international experiences with Rollfit®, A. Reisser*, Reisser Eilers & Partner AG, Switzerland **(I-425)**

Hot filter press - Filtration, washing & thermal drying in a filter press, D. Mrotzek*, U. Esser, M. Longerich, Bayer Technology Services GmbH, Germany **(I-429)**

L28 Separation Enhancement by Chemical Additives II 15:00 - 16:15

Cationic polymer desorption kinetics from sludge, H. Saveyn*, P. Van der Meeren, Ghent University, Netherlands; S.K. Dentel, University of Delaware, USA **(I-434)**

Sludge floccation: From laboratory to wastewater treatment plant, P. Ginisty*, C. Peuchot, IFTS, France **(I-439)**

Interaction of polyelectrolyte with sewage sludge and lignite in conditioning of flocculated sludge, K.B. Thapa*, E. Qi, A.F.A. Hoadley, A. Stevens, Monash University, Australia **(I-444)**

M17 Separation of Complex Systems 15:00 - 16:15

Novel yeast & oil drop microfiltration equipment, M.T. Stillwell*, W. Sumritwatchasai, R.G. Holdich, S.R. Kosvintsev, Loughborough University, Great Britain **(II-271)**

The effect of pH on the separation of manure nutrients with reverse osmosis membranes, L. Masse*, D.I. Massé, Agriculture and Agri-Food Canada; Y. Pellerin, Technologies Osmosys, Canada **(II-276)**

Influence of extractant molar volume on the alkali metal membrane extraction in closed system, Z. Albaraka*, D. Trebouet, M. Burgard, Strasbourg University, France; J.M. Loureiro, University of Porto, Portugal **(II-281)**

M18 Membrane Characterisation 15:00 - 16:15

High sensitivity binary gas integrity test for parvovirus retentive filters provides enhanced virus retention assurance, S. Giglia*, M. Krishnan, Millipore Corp., USA **(II-286)**

Characterization of the 3D pore morphology and connectivity of polymeric membranes by nanotransmission X-ray microscope, T.-T. Wu*, K.-L. Tung, C.-C. Chien, C.-Y. Lin, Chung Yuan University, Y.-F. Song, G.-C. Yin, Y.-M. Chen, National Synchrotron Radiation Research Center, Taiwan **(II-291)**

Development and characterization of new inorganic supports based on natural moroccan phosphate for microfiltration and ultrafiltration membranes, I. Barrouk; S. Alami Younssi; A. Elbizane, FSTM Mohammedia, A. Kabbabi*, J. Maghnouji, CERPHOS, Morroco; M. Persin; A. Larbot, University of Montpellier, France **(II-295)**

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Simulation of Particle Separation Processes
Prof. Uwe Janoske, University of Cooperative Education Mosbach, Germany **(III-29)**

L29 Adsorption-Absorption in Deep Bed Filtration for Water & Wastewater 16:45 - 18:00

Removal of xeno-estrogenic pollutants by an yeast saccharomyces cerevisiae strain from water, A. Ghirisan*, S. Dragan, C. Cimpoiu, V. Micluas, University Cluj-Napoca; C. Roman, Research Institute for Analytical Instrumentation, Romania **(I-449)**

Deep bed filtration optimization: Study of physical fouling and chemical saturation of permeable reactive barriers at pilot scale, P. Ginisty*, IFTS; A. Esnault-Filet, Soletanche Bachy, France **(I-454)**

Use of wood fiber filter for advanced treatment of municipal wastewater, M.-Y. Oh*, M.-Y. Kim, Y.-K. Kim, Kangwon University, Korea **(I-459)**

L30 Particle Measurement – Contamination Control 16:45 - 18:00

A review of methods and techniques available for particle sizing and/or counting in liquid contamination control, C. Peuchot*, S. Couturier, IFTS, France **(I-464)**

Advances in laboratory performance evaluation of hydraulic filter elements - Application to the study of aircraft hydraulic filter elements, P. Madhavan, L. Bensch, Pall Corporation; X. Tao*, Southwest Research Institute, USA **(I-469)**

Measurement of water separation efficiency of diesel fuel filters, C. Peuchot*, N. Petillon, IFTS, France **(I-474)**

L31 Separation Enhancement by Chemical Additives III 16:45 - 18:00

Industrial wastewater treatment utilizing zeta potential measurements, S. Emeish*, Al-Balqa' Applied University, Jordan **(I-479)**

Artificial neural networks for on-line control of coagulation in drinking water treatment, H.-J. Mälzer*, A. Nahrstedt, S. Panglisch, IWW Water Center; S. Strugholtz, University of Duisburg-Essen; J. Gebhardt, aquatune – Dr. Gebhardt & Co. GmbH; W. Zach, Stadtwerke Düren, Germany **(I-484)**

Classification of manganese-doped zinc sulfide nanoparticles by size, Y. Mori*, Y. Arao, H. Ishizuka, Doshisha University, Japan **(I-489)**

M19 Membrane Modules Modelling (CFD) 16:45 - 18:00

Computational fluid flow of porous SiC ceramic filtering modules and optimization of the channel edge form geometry, S. Alexopoulos*, G. Breitbach, B. Hoffschmidt, Aachen University, Germany; P. Stobbe, Stobbe Tech Ceramics A/S, Denmark **(II-300)**

CFD studies for flow and concentration profiles in feed channels of spiral-wound membrane modules, M. Shakaib*, S.M.F. Hasani, M. Mahmood, NED University Karachi, Pakistan **(II-305)**

Modelling the two phase flow in a pilot submerged Membrane bioreactor, E. Nguyen Cong Duc*, B. Lesjean, Berlin Center of Competence for Water; Germany; C. Levrecq, Anjou Recherche, France **(II-310)**

M20 Submerged Membranes 16:45 - 18:00

The effect of the kind of the sludge solids containing in the excess activated sludge on the filtration characteristics of hollow fiber microfiltration, K. Kawasaki*, A. Matsuda, H. Tanimoto, R. Nagasaki, Ehime University; D. Omori, Daiki Axis Co., Japan **(II-315)**

Membrane separation processes assisted by in situ streaming potentials measurement in low pressure MF/UF immersed membranes, M. Pontié*, Angers University, France **(II-320)**

Treatment of wastewater using microfiltration submerged membranes, S. Bou-Hamad*, A. Al-Safar, A. Al-Sariafi, Kuwait Institute for Scientific Research, Kuwait **(II-325)**

G17 Filter Media Fabrication 16:45 - 18:00

New hot melt technology to bond and separate filter media, M. Puffe*, Nordson Deutschland GmbH, Germany **(III-273)**

Nanofibers by centrifuge spinning to improve filter media, M. Dauner*, A. Ullrich, ITV Denkendorf; F. Reiter, Reiter Oberflächentechnik GmbH, Germany **(III-278)**

Nanofibrous material FP for radioactive aerosol monitoring, A.K. Budyka*, I.U. Filatov, Y.N. Filatov, V.G. Mamagulashvili, Karpov Institute of Physical Chemistry; Y.N. Martynyuk, JSC NPP Doza, Russia **(III-283)**

G18 Combined Processes 16:45 - 18:00

Adsorptive removal of nitrogen oxides in cabin air filters, U. Sager*, A. Görgülü, F. Schmidt, University Duisburg-Essen, Germany **(III-288)**

The removal of ozone and nitrogen oxides by HVAC filters, A. Ginestet*, D. Pugnet, CETIAT, France **(III-293)**

Experimental investigation of diesel exhaust particles loading on high performance mechanical air filters, W. Poon*, E. Fischer, W. L. Gore & Associates, Inc., USA; M. Schroeter, W. L. Gore & Associates GmbH, Germany **(III-298)**

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L32 Precoat Filtration-Body Feed Filtration-Filter Aids 08:30 - 09:45

New filter system for kieselguhr-free filtration of beer - Concept and practical results, A. Zeller*, A. Schwarz, C. Forte, H. Evers, KHS AG, Germany **(I-494)**

Framework for selecting thin-cake candle filter technology for removing solid contaminant fines from recirculating acid gas scrubbing fluid streams, B.A. Perlmutter*, G.E. Schlager, BHS-Filtration Inc., USA **(I-499)**

Rice hull ash for water treatment, W. Li, C. Berthold*, C. Kiser, Q. Richard, Agrilectric Research Company, USA **(I-504)**

M21 New Separation Concepts 08:30 - 09:45

Pulsed flow microfiltration with a spiral wound membrane, R.G. Holdich, S.R. Kosvintsev, S. Zhdanov, M. Stillwell*, Loughborough University, Great Britain **(II-330)**

Al2O3 microporous membranes prepared on wet substrate by plasma spray coating technology, C.-C. Hsiung*, K.-L. Tung, C.-J. Chuang, T.-C. Ling; Chung Yuan University, Taiwan **(II-335)**

Development of a novel high performance continuous cake-less filtration system, T. Mori*, T. Katsuoka, B. Ochirkhuyag, J. Tsubaki, Nagoya University; T. Sugimoto, Chuo Kakohki Co. Ltd., Japan **(II-340)**

M22 Micro Sieves 08:30 - 09:45

Stainless steel micro sieves produced by "on-the-fly" laser perforation for fermentation sludge treatment, M. Baumeister*, K. Dickmann, Laser Center Münster LFM; D. Richter, pro-net, Germany **(II-345)**

Microsieves – Low filter area, high performance, A. Damm*, Bayer Technology Services GmbH, Germany; B. Brocades, Fluxxion B.V., Belgium **(II-350)**

Micro filtration with silicon nitride micro sieves and high frequency back pulsing, C.N. Koh*, T. Wintgens, T. Melin, Aachen University, Germany; F. Pronk, B. Brocades, Fluxxion B.V., Belgium **(II-354)**

M23 Membrane Bio Reactor I 08:30 - 09:45

Containerized MBR plants for wastewater treatment, S. Richter*, U. Brüß, A3 Water Solutions GmbH, Germany **(II-359)**

Ceramic membrane bio reactor for industrial waste water treatment a case study, J. Guibaud*, S. Paranthoen, A. Balaire, Pall Corp, France **(II-364)**

AirLift MBR: large-scale side-stream system for municipal waste water treatment, H. Futselaar*, L. Broens, Norit Process Technology B.V.; R. Rosberg, Norit X-Flow B.V.; J. Jacobs, Norit Membrane Technology B.V., Netherlands **(II-367)**

G19 Filter Classification and Standardisation 08:30 - 09:45

Developments in the standardization of methods of measuring the performance of air filters, P. Tronville*, Torino University, Italy; J. Dyment, Great Britain **(III-303)**

Which filter class is requested in a typical HVAC system?, T. Carlsson*, Scandfilter AB, Sweden **(III-308)**

Energy-efficiency-classification of air filters, M. Mayer*, T. Caesar, J. Klaus, Freudenberg Vliesstoffe KG, Germany **(III-313)**

G20 Simulation of Diesel Particulate Filters 08:30 - 09:45

Simulation of ceramic DPF media, soot deposition and pressure drop evolution, S. Rief*, D. Kehrwald, K. Schmidt, A. Wiegmann*, Fraunhofer Institute for Industrial Mathematics ITWM, Germany **(III-318)**

Numerical investigations of diesel particulate filter systems with 2D and 3D simulation models, T. Deuschle*, M. Piesche, Stuttgart University, Germany **(III-323)**

Computational fluid dynamics simulation of soot filtration in wall-flow diesel particulate traps for automotive applications, S. Bensaid*, D. Marchisio, D. Fino, G. Saracco, V. Specchia, Torino University, Italy **(III-328)**

L34 Water Separation from Biodiesel by Filtration and Coalescence 10:15 - 11:30

The Effects of biodiesel fuels of water separation performance in diesel fuel, S. Hutzler*, G.B. Bessee, Southwest Research Institute, USA **(I-524)**

The Effects of diesel fuel additives on water separation performance, S. Hutzler*, G.B. Bessee, Southwest Research Institute, USA **(I-529)**

Factors of influence in water separation from biodiesel-ultra low sulfur diesel blends, C. M. Stanfel*, Ahlstrom Engine Filtration LLC, USA **(I-534)**

L35 Gravity Sedimentation/ Flotation 10:15 - 11:30

BayFlotech – Make things clearer, D. Ulrich*, Bayer Technology Services GmbH, Germany **(I-539)**

Fine particles separation in recovered paper suspensions, G. Hirsch*; J. Wagner; S. Schabel, Darmstadt University; M. Feist, Karlsruhe University, Germany **(I-544)**

Removal of arsenic from wastewaters by batch airlift electrocoagulation, H.K. Hansen*, P. Nunez, C. Jil, G. Technical University Federico Sta. Maria, Chile **(I-548)**

M24 Special Membrane Applications 10:15 - 11:30

Nanofiltration operation as a sustainable water defluoridation operation dedicated to large scale pilot plants for the future, M. Pontié*, H. Dach, Angers University, J. Leparc, Veolia Water, France; A. Lhassani, University of Fes, Morocco **(II-372)**

Properties of downward and upward ultrafiltration of nanoparticle suspensions, Y. Mukai*, S. Shida, E. Iritani, Nagoya University, Japan **(II-377)**

Experimental study on the desalination of polymer-flooding oil-extraction wastewater with UF-EDR combined system, S.-L. Yu*, J. Xu, X. Zuo, D. Wang, J. Liu, H. Lu, Harbin Institute of Technology, P.R. China **(II-382)**

M25 Product Processing 10:15 - 11:30

Influence of membrane polymer on adsorptive fouling in microfiltration of wine, O. Schuster*, W. Ansorge, B. von Harten, Membrana GmbH; M. Ulbricht, University Duisburg-Essen, Germany **(II-387)**

Application of binary packing for polysaccharides separation by hydrodynamic chromatography, A. Yelshin*, M. Mota, J.A. Teixeira, A. Yelshin, University of Minho; R. Diash, University of Bragança, Portugal **(II-392)**

Improved virus retention assurance using novel high productivity parvovirus retentive filters, G. Tkacik*, M. Krishnan, Millipore Corp., USA; G. Kern, Millipore SAS, France **(II-397)**

M26 Membrane Bio Reactor II 10:15 - 11:30

Development and operation of a submerged flat sheet membrane system for wastewater treatment in MBR, W. Lamparter*, S. Krause, U. Meyer-Blumenroth, R. Voigt, Microdyn-Nadir GmbH, Germany **(II-401)**

Mechanism of enhanced biological nitrogen and phosphorus removal in ICAS-MBR System, Y. Wang, S.-L. Yu*, F. Zhao, D. Wang, Harbin Institute of Technology, P.R. China **(II-406)**

Effect of cyclophosphamide and its main metabolites on the performance of a membrane bioreactor, C. Albasi*, L.F. Delgado, V. Faucet-Marquis, A. Leszkowicz, University of Toulouse; M. Audran, Lapeyronie Hospital, M. Castegnaro, CDS, France **(II-411)**

G21 Filter Element Production 10:15 - 11:30a

HYCOKNIT® - High efficient cleanable filter media for process gas filtration, E. Schmalz*, STFI e.V.; W.P. Frenzel, ILK GmbH, Germany **(III-333)**

Low pressure plasma coatings allows to produce in an economical, environmental friendly way, M. Pauwels*, Europlasma N.V., Belgium **(III-338)**

High efficient cleanable depth filter media for process gas filtration and a inno-vative all-purpose compact filter apparatus, E. Schmalz*, STFI e.V., Germany **(III-343)**

G22 Simulation of Particle Separation 10:15 - 11:30

Flow phenomena in mechanical separation technology, C. Seyfert*, N. Sautter, S. Schütz, M. Piesche, Stuttgart University, Germany **(III-348)**

CFD numerical flow simulation of particulate-laden and bulk solid flows - A state of the art, M. Lotfey*, ANSYS Fluent Deutschland GmbH, Germany **(III-353)**

The design of electrostatic precipitators by use of physical models, P. Tronville*, Torino University; G. Bacchiega, R. Sala, IRS s.r.l.; I. Gallimberti, Padova University; F. Zatti, Area Impianti .s.p.a., Italy **(III-357)**

Closing Session 11:45

Announcement of the Host of the next WFC.

Additional Paper

Effect filter performance under various contaminants, X. Tao*, Southwest Research Institute; P. Madhavan, L. Bensch, Pall Corporation, USA

The Programme lists countries and regions and is subject to amendments. Errors and obmissions excepted.

DEVELOPMENTS IN THE STANDARDIZATION OF METHODS OF MEASURING THE PERFORMANCE OF AIR FILTERS

Paolo Tronville*, Politecnico di Torino, C.so Duca degli Abruzzi 24 - 10129 Turin, Italy
John Dyment, Strone Cottage, Achnamara, Lochgilphead, Argyll, PA31 8PS, UK

ABSTRACT

The diversity of air filter products and their applications means that many factors need consideration in assessing their performance. The applications considered here are principally “habitability” filters, i.e. filters for general ventilation and air conditioning together with high efficiency (HEPA) filters, which are used for special ventilation applications where a significantly higher degree of cleanliness is required.
During the 20th century a number of countries developed their own national standardised procedures for this purpose. Because of the differences between these methods the quality of products manufactured in different countries could not readily be compared. In 2005 the International Standards Organization (ISO) activated technical committee TC142 and tasked it with producing a set of new ISO standards. The new standards will provide a platform to facilitate world-wide trading of filter products. This paper informs air filtration industry and professionals of ISO air filtration standards that are in process and of new applications that could be covered.

KEYWORDS

Air cleaning, Air filters, Filter test, Fractional efficiency, Testing procedures

Introduction

“Few branches of engineering can have had quite such a wealth of physical and mathematical talent expended gratuitously upon their problems in the spare time of the practitioners and in the face of lack of enthusiasm, if not active opposition, from the developers and users of filters.” This comment from C.N .Davies (1), himself one of the great theoreticians in this field, illustrates the complexity of the filtration process. As evidence this reference quotes more than 150 earlier references to advances in the many theories of the mechanisms of (air) filtration current at that time. Nowadays developers take a more enlightened approach but empiricism still dominates the development of test methods.
This paper is concerned with the standardization of methods of determining the performance of air filters, media and systems as currently addressed by the international community. The International Standards Organization (ISO) Technical Committee142 "Cleaning equipment for air and other gases" covers this area apart from a few restricted applications, i.e. mobility industry and respiratory protection.

The standardization process

There is an increasing need for standardization. System designers need filter performance data in order to match designs to requirements. Some foreknowledge of dust characteristics likely to be encountered in service is of course desirable although this may not be available. Additionally, information on through-life costs of the various options is helpful. Standardized performance test methods enable suitable options to be identified and to some extent enable comparisons to be made of the costs of the available options.

An ISO standard is desirable even when manufacturer's data is available because the users/purchasers of air filter equipment are rarely aware of the complexities involved in making the optimum choice for any particular application. In present times need for unbiased comparative performance data for filter products on a global basis seems obvious. At present several national and regional standard methods of assessing filter performance currently exist, for example the Far East, Europe and US all differ, and it is not easy for users to compare results obtained by these different methods.
Within ISO TC142 there are a number of working groups of specialists working to achieve global commonality in the methods of testing certain classes of filter media and cleaning devices.
Apart from the differences in test methods that exist in the world today there are also differences in classifying filter types according to the test results. Both of these differences constitute barriers to trade. Achieving international agreement, or consensus on the global scale is not a rapid process, as all parties involved have to be prepared to some extent to accept modification or change to their current practices. Under ISO rules there are definite time limits: once started the process must proceed within these limits (which have a limited degree of flexibility), or will fail.

Current work being developed inside ISO/TC142
The FDIS (Final Draft International Standard) 21220 "Particulate air filters for general ventilation - Determination of the filtration performance" is currently the most advanced ISO/TC142 work item (i.e. project) and its publication is expected during 2008. This document covers performance test methods for filters used in general ventilation. This area covers filtration of air for supply to inhabited (enclosed spaces) premises, work areas, public buildings where forced ventilation equipment is installed. This document is now at the final draft stage before formal voting. The principal participants in this project include China, Europe, Japan and USA.
The problem of classification has been bypassed for the time being by removing it from the standard, on the basis that it is more important at this stage to agree on a test method within the allotted timescale.
The adoption of an ISO standard is voluntary and subsequent to the publication from the ISO Central Secretariat. Hence, it will be possible to adopt different classification schemes according to different market needs. Harmonization of filter classification could be treated by the different ISO members as a separate work item in the future.
The problems in achieving consensus during the standardization process in this case are listed here below.
a) Preconditioning procedure
It is well known that filter media composed of polymer fibres may carry an electrostatic charge that enhances their initial efficiency. It is also known that in most applications the charge may become less effective within a comparatively short period of service, so that the effective efficiency at that time is also reduced. Eventually the build up of deposited dust may increase the efficiency back to its original value and possibly exceed it. The existence of this phenomenon raises questions about the validity of the test procedure in circumstances where the test results do not enable it to be identified. To remedy this situation a “preconditioning” procedure has been introduced whereby the electrostatic charge of a few samples of the filter medium is completely inhibited. The efficiency of the medium samples is measured before and after the preconditioning process, and the result quoted in the test report as an illustration or guide to the extent to which electric forces contribute

to the initial efficiency.
Manufacturers of these media and manufacturers of filter products employing them, while agreeing that some way of acknowledging the phenomenon is required, are not in general agreement of the method currently adopted, asserting that total removal of the charge is not realistic and gives a false impression of product performance. None of the available alternatives has so far been found acceptable.

b) Choice of Test Dust

In the area of general ventilation filters the test dust will ideally be selected to relate to dusts found in in-service conditions. It goes without saying that it is not possible to fulfil such a requirement. One dust may suit some applications but different ones would be needed for different situations. Indeed so far it is only in the case of coarse filters that it is possible to use the same test dust both for loading and for measuring efficiency. Two classes of filters (F Class, i.e. Fine, and G Class, i.e. Coarse) come within the scope of the proposed ISO standard. In the current European practice for both classes has been to use ASHRAE test dust (i.e. the dust specified in ASHRAE Standard 52.1-1992) for loading and 0.4 µm droplets of DEHS (Di-Ethyl-Hexyl-Sebacate) produced by a Laskin nozzle for measurement of efficiency by particle size.
The ISO/FDIS 21220 requires to use ISO 12103-A2 fine test dust for loading fine filters with untreated DEHS droplets for fractional efficiency testing in the 0.3-1.2 µm size range. Coarse filters must be loaded instead with ASHRAE dust with neutralized KCl particles for fractional efficiency testing in the 1.0-5.5 µm size range. ASHRAE dust is constituted largely of ISO 12103-A2 fine test dust (72% by mass) but with added proportions of carbon black and cotton fibres to match the composition of the aerosol entering air handling systems (2). Problems have been encountered obtaining consistent quality material from more than a single source of ASHRAE dust. It may be argued that ASHRAE dust is more akin to industrial pollution than ISO 12103-A2 dust which is perhaps more reminiscent of dry (desert) conditions; in fact it is the original Arizona (silica) road dust refined to give consistent properties. A third possibility under examination for future revisions is the Japanese JIS 11 test dust.

The NWIP (New Work Item Proposal) 29464 "Cleaning equipment for air and other gases – Terminology" was approved in June 2007 and its publication is expected by 2010. Such terminology reference document is being developed alongside the current standards projects. It is intended to assist in the drafting of the new documents as well as in their interpretation after publication. Existing anomalies between different sources will be addressed. It is based on the existing EN14799 terminology document as well as other ISO documents.

The NWIP 29463 "Performance testing and classification of high efficiency filter and filter media for removing particles in air" was approved in May 2007 and its publication is expected by 2011. The target date for the first Committee Draft is May 2008; the registration as Draft International Standard (DIS) is expected by May 2009.
This new standard is planned to include a reference method based on EN1822, IEST Recommended Practices (RP) and other existing documents. Once the reference method and classification system is accepted, national bodies will be in a position to relate it to their own test methods and classification systems. It is also planned to include tests other than efficiency tests, e.g. strength tests on media and environmental tests for filter products. As in the case of general ventilation filters a new classification system may have to await agreement on the details of the

reference test method. This method is likely to be based on testing with particles sized for maximum penetration (MPPS) through the filters being tested. It is expected that existing national methods will remain in place for a while at least as changes in practice are normally spurred on principally by market demand.
One method likely to remain in view for a considerable time is the “sodium flame test”.
This method of testing utilizes a polydisperse sodium chloride aerosol as a challenge; the concentration of particles in the air samples is determined by flame photometry; thus the efficiency is measured in terms of mass rather than particle counts. The earliest references to this test date from 1941 (unpublished UK government report cited by Green & Lane (3)). Subsequent developments led to the use of photomultipliers, giving a sensitivity of around 1 part in 10^5. The equipment was upscaled for use in testing ventilation filters and was published as a national UK standard as BS 3928:1965, (revised in 1969). Dorman (4) gives further details of the development and characteristics of the method. This standard is still retained today mainly to meet the requirements of the UK nuclear industry, although EN1822 is normally used to meet the needs of other industries and markets. There are said to be upwards of 50 such test-rigs in the People’s Republic of China. The authors understand that further developments increasing the sensitivity still further have recently been made in China, although details are not at present available.
Another topic to be addressed in the future is related to the procedures for in-situ performance testing of HEPA and ULPA filter installations (other than those covered by ISO 14644-3). Such systems cover mainly exhaust air filtration systems used typically in the nuclear industry and other industries handling highly toxic materials. Apart from normal operational considerations regulatory authorities frequently require periodic evidence of the effectiveness of these exhaust systems as part of a licensing procedure. Systems supplying ultraclean process air, e.g. to biological or semiconductor processing, may also fall into this category.

The PWI (Preliminary Work Item) 29462 "In situ testing procedure for general ventilation filters" was established at the end of 2006 and is expected to start a 3 years development track around the middle of 2008. This proposed ISO standard describes a procedure of measuring the performance of general ventilation air cleaning devices in their end use installed configuration. The performance measurements include removal efficiency by particle size (ambient air particles of 0.3 to 5.0 μm) and the resistance to airflow. The procedure for test include the definition and reporting of the system airflow. ASHRAE Guideline 26P and Eurovent Recommendation 4/10 will serve as base documents. This could be an important development because, as is noted above, one of the problems encountered in performance testing of ventilation filters is the variability of dusts encountered in service. Knowledge of the performance behaviour of installed filters can give valuable guidance both to users and suppliers of filter products.

The PWI 29461 "Air intake filter systems for rotary machinery" was established at the end of 2006 and was successively divided in two different parts:

- Part 1: Test methods and classification for static filter elements
- Part 2: Test methods and classification for cleanable (pulse jet) filter systems

Like PWI 29462, this document is expected to start a 3 years development track around the middle of 2008. These standards cover methods on how to test air filters and air filter intake systems for rotary machinery, like gas turbines, compressors and

for stationary internal combustion engines. The test air flow rate is in the range of 0.25 m^3/s (900 m^3/h) up to 1.67 m^3/s (6000 m^3/h). Parameters to be evaluated include fractional particle removal efficiency (0.3-1.2 μm for fine filters and 1.0-5.5 μm for coarse filters), airflow resistance (energy consumption), loading characteristics.
These proposed international standards apply to air filters having an initial efficiency of less than 99.98% with respect to 0.4 μm particles. Other issues that could be addressed in the future include integrity testing of filter elements and in-situ testing of air intake filter systems.
After some meetings and discussions the PWI 10121 about gas-phase air cleaning is mature and the NWIP "Gas-phase air cleaning media and devices for general ventilation" is about to start. Part 1 of the proposed standard will cover the most common types of sorptive devices. Part 2 will cover the sorptive medium such as activated carbon, silica gel, activated alumina, molecular sieves, specialist adsorptive fibre based products as well as the sorptive capacity of traditional fibres, particulates and granules. A number of proposed base documents exist (ASHRAE 145.1P and 145.2P) but problems in standardization relate to the large numbers of potential contaminants and of media to deal with them.

Future work within ISO/TC142 scope

Other technologies and application could be included in the work program of the renovated ISO/TC142, pending the availability of experts volunteering to work on these topics. These include: UV devices and lamps (a task group was already formed in January 2006), electrostatic precipitators and industrial air cleaners. A new task group ("Performance testing of dust collectors") has already been formed to study how to tackle problems related to industrial applications of air cleaning equipment.
Sustainability is a relevant issue also for air cleaning technologies. Hence, a PWI dealing with "Quality Factor, Life Cycle Cost, Life Cycle Assessment, Safety of the materials which make up the filter product" was established during the last plenary meeting in Beijing (November 2007).

How ISO operates and how to contribute to the work

ISO technical committees are staffed by experts from manufacturers, research organizations and users working on a voluntary basis. Anyone with relevant expertise wishing to volunteer can do so through their national standardization body. Apart from ISO standards, ISO deliverables also include Technical Specifications (TS) and Technical Reports (TR). One of these latter products may be appropriate when a document is not able to be accepted as a full standard, e.g. because of insufficient support in voting, when the work can be rounded off for possible use later on.

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