FBC24 FLUIDIZED BED CONVERSION CONFERENCE 2022

THE 24TH EDITION OF THE

FLUIDIZED BED CONVERSION CONFERENCE

MAY 8-11 2022

GOTHENBURG SWEDEN

ENERGY A CHALMERS AREA OF ADVANCE

Valmet

Göteborgs Stad

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Dear friends and colleagues,

On behalf of the organizing committee, it is with great pleasure that we finally welcome you to Gothenburg and the 24th International Conference on Fluidized Bed Conversion! As it has now been four years since we last gathered and discussed the latest within fluidization research and development in Seoul, Korea, we will once again meet in person and enjoy a more conventional conference, than what we have been used to during the last years with Covid restrictions.

Besides the opportunity to meet friends and colleagues again, there are some grand challenges where our community can contribute. With respect to achieving sustainable future energy systems, fluidized beds could play an important role. Fluidized bed combustion has long been associated with clean combustion, but perhaps mainly due to the intrinsic benefits to limit pollutants, such as NOx and SOx. However, fluidized bed systems could also play an important role in limiting or even avoiding GHG emissions, both through improved and optimized performance of more conventional fluidized bed systems. Fluidized beds could also be used in a wide range of breakthrough technologies, e.g. chemical- and calcium-looping, carbon capture, poly-generation and recycling systems. Such processes could play a role in not only limiting GHG emissions but even removing such gases from the atmosphere in some cases. During the conference, you will gain insights into the latest in fundamental research for conventional fluidized bed processes, but also research coupled to new or second-generation technologies. During the conference, we will give the attendees plenty of opportunities to explore the different topics, not only through the presentations but through access to full reviewed papers of all presentations and also the possibility to “Meet the presenter” on Monday and Tuesday afternoon.

Chalmers University of Technology has over fifty years of research and development in many aspects related to fluidized beds, with the Chalmers Power Central being the main infrastructure, see page12-13. During the conference, you will get the opportunity to visit this unique boiler but also our fundamental fluidization and chemical-looping lab. Finally, through our main sponsor and collaborator, Valmet, a study trip to a state-of-the-art CHP BFB facility in Borås will be conducted on the last day of the conference. All in all, we hope that the combination of plenary lectures, technical sessions, lab tours and social events will be highly rewarding for you. Finally, May in Gothenburg is usually a very nice and pleasant time of the year and if you have some extra time, this could be a good opportunity to explore the city and its surroundings, including museums, gardens, amusement parks, archipelago and water-ways in addition to a wide range of restaurants and bars. So, on behalf of the organizing committee, we wish you all welcome to Gothenburg and have great time during the FBC24!

Tobias Mattisson, Chairman
Ivana Staničić
Daofeng Mei
Guillermo Martinez Castilla

Schedule

	Sun	Mon	Tue	Wed
08:00 -08:30		Registration	Registration	
08:30 -08:40		Welcome address	General info	General info
08:40 -09:40		**Plenary lecture I** Prof. Bo Leckner Chalmers University of Technology	**Plenary lecture II** Associate Prof. Sonja Enestam Valmet	**Plenary lecture III** Prof. Fabrizio Scala University of Naples Federico II
09:40 -11:00		**Panel Discussion**	**Panel Discussion**	**5A** **5B** **5C** **5D**
11:00 -11:30		Coffee Break	Coffee Break	Coffee Break
11:30 12:30		**1A** **1B** **1C** **1D**	**3A** **3B** **3C** **3D**	**6A** **6B** **6C** **6D**
12:30 -13:00		Lunch 13:00-14:00	Lunch 13:00-14:00	Lunch 12:30-13:30
13:00 -13:30	**Pre-program** Fluidization and new opportunities: an introduction and discussion For students 13:00			
13:30 -14:00				**Closing ceremony** 13:30-14:30
14:00 -14:30		**2A** **2B** **2C** **2D**	**4A** **4B** **4C** **4D**	
14:30 -15:00				**Study visit to Borås Energi Combined Heat and Power BFB** 14:30
15:00 -15:30		**Meet the presenter** Snacks and drinks		
15:30 -16:00		**Poster session 1P** 15:30-17:00 **Lab tour 2** 15:30-17:00		
16:00 -16:30			Coffee Break	
16:30 -17:00			**Meet the presenter** Snacks and drinks	
17:00 -17:30				
17:30 -18:00	**Lab tour 1** 17:30-18:30		**Poster session 2P** 17:00-18:30 **Lab Tour 3** 17:00-18:30	
18:00 -18:30		**Reception by City of Gotheburg at Börsen** 18:00		
18:30 -19:00	**Registration and Reception** 18:30			
19:00 -19:30			**Conference dinner Universeum** 19:00	
19:30 -20:00				

Plenary lectures

Prof. Bo Leckner

Bo Leckner graduated at Chalmers University of Technology in 1962, presented his doctor thesis "Radiation in gas fired furnaces" in 1972, and was appointed a professor in 1982. He has been active at Chalmers University since then with the exception of one year spent at the Moscow Energy Institute.

His research work concerns topics related to fluidized bed conversion of solid fuels. Recently, the research has been focused on CO2 reduction involving fluidized bed. Most projects have been carried out at Chalmers University, with a considerable co-operation with external co-workers from all over the world.

Prof. Fabrizio Scala

Fabrizio Scala graduated at University of Naples Federico II in 1995, where he got a PhD in 1999. He was a researcher at the Institute of Research on Combustion of CNR from 2001 until 2014, when he was appointed associate professor at the University of Naples Federico II. From 2020 he is full professor of Chemical Plants. He is Fellow of the Combustion Institute and has been the chair of the Italian Section of the Combustion Institute and associate editor of the journal Fuel Processing Technology.

His activities, both modelling and experimental, are related to the fields of chemical & environmental engineering, and fluidized bed technology. More specifically: combustion, gasification & pyrolysis processes in fluidized bed reactors; carbon capture, utilization, and storage (CCUS) techniques (calcium looping, chemical looping, oxy-combustion, methanation); combustion pollutants abatement (SOx, NOx, Hg).

Associate Prof. Sonja Enestam

Sonja Enestam has been working within the Finnish energy industry since her graduation from Åbo Akademi University in 1995. The main part of her work has been focusing on R&D related to fluidized bed boilers and recovery boilers. She got her Ph.D. in high-temperature corrosion at Åbo Akademi in 2011. Today she is an R&D Manager at Valmet, where her responsibilities are related to technology development for carbon-neutral energy solutions, including combustion, gasification, pyrolysis, and flue gas cleaning.

An essential part of her job is to interact with the research community and implement research results into Valmet's existing and future product portfolio, a task which is supported by her role as associate professor at Åbo Akademi.

Conference information

Registration

Registration to the conference can be done at the registration desk in the main hall on the second floor, Volvofoyer, on **Sunday evening 18.30-20.00** in addition to **Monday and Tuesday morning between 8.00-8.30**. Participants are required to always wear name badges in order to enter the conference area and participate in social activities.

Official language

The conference's **official language is English** and is used to communicate information and for all presentations and printed materials.

Wardrobe

There will be access to an open wardrobe in the Palmstedt room where attendees can leave coats. However, we encourage to take your valuables with you, as the wardrobe will be unattended.

Lunches and Coffee Breaks

Lunches and refreshments during coffee breaks will be provided in the Volvofoyer in the main hall on the second floor.

Presentations

Guidelines for presentation can be found on the website of the conference. The Powerpoint presentations should be uploaded in the room where the presentation will take place, see the detailed program. We encourage all presenters to upload their presentation on the morning of the day of the presentation, between **7.30-8.30 in Scania**, Palmstedt and Ascom/Catella and between **8.00-8.30 in Runan**. Presentations can also be uploaded 20 min. prior to the start of the session, and a representative from the organizing committee will be available in the room during this time. Please bring your presentation on a USB stick. All presentations are 15 min + 5 min for questions. Please adhere to your allocated time for us to keep the schedule and allow for attendees to move between sessions in a good way.

Plenary lectures and panel discussions

Each day, the technical program starts with a plenary lecture given by three different renowned experts on the field of Fluidized Bed Conversion. The topics covered are of high relevance among the FBC community and are specifically selected to raise interesting discussions among the participants. **The plenary lectures are on Monday, Tuesday and Wednesday from 8.40 to 9.40 in the main hall Runan.**

Following the lectures of Monday and Tuesday, the discussions will be guided by an expert on the field who will invite several panelists to come up on stage and discuss the presented topic. The rest of the audience will be able to post questions online and, if chosen by the moderator, join the discussions from the crowd.

Panel discussion 1, Monday 9th, 9.40-11.00, RunAn: "Fluidization characteristics of circulating fluidized bed boilers"

Panel discussion 2, Tuesday 10th, 9.40-11, RunAn: "Development of fluidized bed technologies and the collaboration of industry and academia – past, present and future"

Getting around Gothenburg

There are three ways to buy tickets for public transport.

i) Västtrafik agents. Here a Västtrafik card can be bought. With a Västtrafik card, you top it up and when there is no more money left on the card. The card is scanned on a machine when boarding the vehicle. It is also possible to buy single tickets at Västtrafik agents for example Pressbyrån, 7-eleven and ICA.

ii) Pay on board. Some vehicles (not all!) sell tickets on board. The range of tickets available to buy or top up on board varies according to which line you are traveling on. Tickets are commonly sold in blue machines located in the middle of the trams which only accept by bank cards.

iii) Västtrafik To Go app. We recommend this option. Buy your ticket wherever and whenever you like with the Västtrafik To Go app. You can buy single tickets or day tickets and travel throughout Västra Götaland. Here you can also search for journeys and plan your trip! Pay by MasterCard or Visa. A single ticket costs 35 SEK and is valid for 90 minutes and you simply buy a new ticket when the old one has run out. You don't need to register to buy a ticket in the app. OBS, the tickets must always be activated before boarding.

Conference information

Meet-the-presenter

For conference participants to be able to discuss the oral presentations more in-depth with the main author, mini-posters of the oral presentations are collected and placed on the big poster boards at the corridor between RunAn and Ledningsrummet. The mini-posters are printed in the size of A3 printer paper. The main author is welcome to present their mini-poster according to the following schedule:

Presenters of sessions 1-3, Monday at 15.00-15.30

Presenters of sessions 4-6, Tuesday at 16.30-17.00

Please make sure you take this opportunity to profile your research!

Posters

For the conference participants to be able to discuss the works of normal poster presentations, posters are collected and placed on the small poster boards at the corridor between RunAn and Ledningsrummet. The normal posters are printed in the size of A1 printer paper. The main author is welcome to present their poster according to the following schedule:

Presenters of all the normal posters, Monday at 15.30-17.00

Presenters of all the normal posters, Tuesday at 17.00-18.30

Lab Tours

Chalmers has been active in research related to fluidization and fluidized bed conversion technologies for almost five decades. During the conference tours will be given to the Chalmers Power Central and the fluidization and chemical-looping (CLC) laboratory. For the lab tours to run smoothly please pay attention to your designated time slot and follow the instructions. You will be allocated a slot during registration. The tours will be given simultaneously as the poster session but there will be plenty of time to attend both.

Please gather on the entrance floor 10 minutes before the start of your lab tour where a representative from the organizing committee will be waiting to guide you to the facility.

Lab Tours - Sun

	The entrance floor		Chalmers Power Central	Fluidization and CLC lab
17:20	**Group A and B**			
		17:30 -18:00	**A**	**B**
		18:05 -18:35	**B**	**A**

Lab Tours - Mon

	The entrance floor		Chalmers Power Central	Fluidization and CLC lab
15:20	**Group C and D**			
		15:30 -16:00	**C**	**D**
16:25	**Group E and F**	16:05 -16:35	**D**	**C**
		16:35 -17:05	**E**	**F**

Lab Tours - Tue

	The entrance floor		Chalmers Power Central	Fluidization and CLC lab
16:50	**Group E and F**			
17:20	**Group G and H**	17:00 -17:30	**F**	**E**
		17:30 -18:00	**G**	**H**
		18:05 -18:35	**H**	**G**

The Chalmers Power Central

Fifty years of industrial scale research

Fluidization research at Chalmers dates back more than 50 years, and the Chalmers Power Central has been the central infrastructure around which much of the research has revolved. The story of the Power Central has even earlier roots, dating back to 1947 when the first boilers were built, although it was only after the oil crisis of the 1970s that the research program really took off with the installation of fluidized bed boilers. Professor Bo Leckner was the driving force behind efforts to find partners who would invest time and money in the fluidized boilers. “One can count publications and scientific citations, but the important thing is if someone reaps the benefit of what we do. Then it’s good. Then we have succeeded”, says Bo Leckner.

Today, the Chalmers Power Central is an advanced research facility focusing on emission control including carbon capture, industrial heating processes, conversion of solid fuels and material recycling, as well as well as on local energy systems. One of the corner stones of the facility is the 12 MW circulating fluidized bed boiler to which a 2-4 MW steam gasifier is attached. This fluidized bed system is highly flexible and allows research at using different bed materials and oxidative conditions as well as with a wide range of feedstocks. In principle, any type of fuel can be fed and converted in the system. This is due to a highly efficient solids handling system as well as be converted and as the emission control system, which meets the requirements for waste incineration.

This has allowed us during decades to provide research in semi-industrial scale. In parallel to the highly flexible fluidized bed boiler, the power central currently includes a new 6 MW flame research boiler, for oil, gas, and powder and a 100 kW oxyfuel pilot with wet or dry flue gas recycling and a lab with analytic equipment as well as small experimental reactors.

During the study visit of the conference you will get a tour in the power central and have a close look at the different research boilers, pilots, experimental setups and analysis equipment installed in the power central, as well as a description of how the experimental work is conducted and the focus of current research.

The power central is part of the campus heating system, which is also connected to the city of Gothenburg’s district heating. So, by a unique contract arrangement between Chalmers University of Technology, Akademiska Hus (campus operator) and Göteborg Energi (local energy company operating the district heating system) the research in the power central can take place during the heating season November to March with the research having priority over the heat production to the campus. If the research creates an excess of heat compared with the need of the campus Göteborg Energy distributes this heat to other part of the town. All in all, this construction makes it possible to conduct research at industrial scale at a marginal cost.

Photo: Bert Leanderssson, Higab

Reception by the City of Gothenburg

At Börsen

On Monday evening of May 9th, the City of Gothenburg would like to welcome you. The welcoming ceremony will be held at Börsen – City of Gothenburg's official building for welcoming visits. Börsen is located in the heart of Gothenburg. It has served as a conference hall for the municipal council but also a place for ceremonious conventions since December 1849. A welcome speech will be given by Lord Mayor of Gothenburg Anneli Rhedin. During the ceremony, a drink and a snack will be served. We encourage the participants to explore restaurants around Gothenburg after the ceremony.

How to get to Börsen

Börsen is a 30-minute walk (2.3km) away from the conference venue. For those that want to walk, the address is Östra Hamngatan 21, 411 10, Göteborg. It is also possible to use public transportation. From Chalmers station take the tram 7 (Bergsjön), 10 (Eketrägatan) or bus 16 (Västra Eriksberg) and exit at Brunnsparken. Walk towards the Gustaf Adolfs Square. Börsen is located north of the statue. Instructions for public transport can be found on the homepage.

Photo: Universeum

Social event and conference dinner

At Universeum

Universeum is the national science centre of Sweden and a powerful arena for education and popular education in science, technology and sustainable development. Their large house in the middle of Gothenburg houses science and experiences about the whole world – from large world oceans and the Amazon rainforest to a chemistry lab, technology lab and space. Universeum gives children and adults the knowledge and power to make the earth a better and more sustainable place to live.

On the evening of Tuesday, May 10th, the participants of FBC-24 are welcome to Universeum for a guided tour around the Science centre followed by an unforgettable dinner experience under the Ocean bottom.

How to get to Universeum:

Universeum is a 14-minute walk (1.2 km) away from the conference venue. For those that want to walk, the address is Södra Vägen 50, 412 54, Göteborg. It is also possible to use public transportation. From Chalmers station take the tram 8 (Angered), or 6 (Kortedala) and exit the next stop at Korsvägen. You will see Universeum right in front of the Liseberg´s ferris wheel.

Instructions for public transport can be found on the homepage.

Photo: Borås Energi och Miljö

Field trip to a state-of-the-art BFB-CHP plant

On Wednesday, 11th of May, Valmet will sponsor a study visit to the Sobacken CHP-BFB plant in Borås, a city approx. 60 km from Gothenburg.

The CHP plant at Sobacken replaces the old biofuel-fired boilers at Ryaverket, with a boiler output of 120 MW thermal and 40 MW from flue gas condensation and air humidification. The turbine provides about 43 MW of electricity at full load. The plant is completely biofuel fired and the boiler is of the bubbling fluidized bed (BFB) type. The boiler, flue gas condenser and flue gas cleaning were designed and supplied by Valmet, while the turbine was supplied by TGM Kanis Turbinen and the fuel handling system by BMH Technology. Visit the conference´s website for more information about the development of the plant.

During the study visit you will be able to get information about the plant from the plant technical experts with focus on the state-of-the-art aspects.

Monday

	Runan	Palmstedt	Scania	Catella/Ascom
08:40 -09:40	**Plenary I** **Prof. Bo Leckner** Chair: Prof. Raffaella Ocone Fluidization characteristics of circulating fluidized bed boilers			
09:40 -11:00	**Panel discussion**			
11:00 -11:30	**Coffee break**			
11:30 -13:10	**1A** Modelling/CFD/Advanced diagnostics	**1B** Gasification and pyrolysis	**1C** High temperature looping cycles	**1D** FBC in China - Novel processes and concepts (Hybrid)
13:00 -14:00	**Lunch**			
14:00 -15:00	**2A** Fluidized bed design and operation	**2B** Fundmentals: particles and fluidization	**2C** Novel processes and concepts	**2D** Combustion
15:00 -15:30	**Meet the presenter**			
15:30 -17:00	**Poster session 1p & Lab tour 2**			

Tuesday

	Runan	Palmstedt	Scania	Catella/Ascom
08:40 -09:40	**Plenary II** **Associate Prof. Sonja Enestam** Chair: Prof. Pavleta Knutsson Development of fluidized bed technologies and the collaboration of industry and academia – past, present and future			
09:40 -11:00	**Panel discussion**			
11:00 -11:30	**Coffee break**			
11:30 -13:00	**3A** Modelling/CFD/Advanced diagnostics	**3B** Gasification and pyrolysis	**3C** High temperature looping cycles	**3D** FBC in China/korea - Design adn Modelling (Hybrid)
13:00 -14:00	**Lunch**			
14:00 -16:00	**4A** Fluidized bed design and operation	**4B** Fundmentals: particles and fluidization	**4C** Novel processes and concepts	**4D** Ash and spent solids
16:00 -16:30	**Coffee break**			
16:30 -17:00	**Meet the presenter**			
17:00 -18:30	**Poster session 2P & Lab tour 3**			

Wednesday

	Runan	Palmstedt	Scania	Catella/Ascom
08:40 -09:40	**Plenary III** **Prof. Fabrizio Scala** Chair: Prof. Alberto Gomez Barea CO2 capture and utilization processes involving fluidized beds			
09:30 -11:00	**5A** Modelling/CFD/Advanced diagnostics	**5B** Gasification and pyrolysis	**5C** High temperature looping cycles	**5D** FBC in China - Novel processes and concepts (Hybrid)
11:00 -11:30	**Coffee break**			
11:30 -12:30	**6A** Emissions and CO2 capture	**6B** Fundmentals: particles and fluidization	**6C** Novel processes and concepts	**6D** FBC in China - Gasification and Novel processes (Hybrid)
12:30 -13:30	**Lunch**			
13:30 -14:30	**Closing ceremony**			

Monday

1A Modelling/CFD/Advanced diagnostics 11:30 -13:10

11.30 -11.50	**Advanced X-ray imaging techniques for the investigation of single particle devolatilization in fluidized bed reactors**	Stefano Iannello[1], Alex Sebastiani[1], Domenico Macrì[1], Zachariah Bond[2], Alessandro Antonio Papa[3], Andrea Di Carlo[3], Massimiliano Materazzi[1]	**1.**Department of Chemical Engineering, University College London, London WC1E 7JE, UK. **2.**Department of Chemical Engineering and Biotechnology, University of Cambridge, Cambridge CB30AS, UK. **3.**Department of Industrial Engineering and Information and Economy, Università degli Studi dell'Aquila, Monteluco di Roio, 67100 L'Aquila, Italy
11.50 -12.10	**New model development for liquid bridges and coefficient of restitution for wet particles in fluidisation**	Leina Hua[1], Raffaella Ocone[2], Ning Yang[1,3]	**1.**State Key Laboratory of Multiphase Complex Systems, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China **2.** Institute of Geoenergy Engineering, Heriot-Watt University, Edinburgh EH144AS, UK **3.**School of Chemical Engineering, University of Chinese Academy of Sciences, Beijing 100049, China
12.10 -12.30	**Comparison of two measurement methods of horizontal solids flow in a bubbling fluidized bed**	Munavara Farha[1], Diana Carolina Guío-Pérez[1], Jesper Aronsson[2], David Pallarès[1], Filip Johnsson[1]	**1.**Chalmers University of Technology, Hörsalsvägen 7B, 412 96 Gothenburg, Sweden **2.**BioShare AB, Steffens Väg 431, 655 92 Karlstad, Sweden
12.30 -12.50	**Coupling of Spectral Thermal Radiation Model with a Comprehensive System Model for Co-Combustion of Biomass in Bubbling Fluidized Bed**	Mehmet Soner Yasar[1], Nevin Selçuk[1], Gorkem Kulah[1]	**1.**Department of Chemical Engineering, Middle East Technical University, Universiteler Mahallesi, Dumlupinar Bulvari No:1, Cankaya, Ankara, 06800, Turkey
12.50 -13.10	**Development and numerical investigation of a DDPM-KTGF model for modeling flow hydrodynamics and heat transfer phenomena in a bubbling calciner reactor**	Georgios Kanellis[1,3], Myrto Zeneli[1,2], Nikolaos Nikolopoulos[1], Jukka Konttinen[3]	**1.**Centre for Research and Technology Hellas,Chemical Process & Energy Resources Institute (CERTH/CPERI), Thessaloniki, Greece **2.**Laboratory of Steam Boilers and Thermal Plants, National Technical University of Athens, 9 Heroon Polytechniou Street, 15780 Zografou, Greece **3.**Faculty of Engineering and Natural Sciences, Tampere University, P.O. Box 541, FI-33101,Tampere, Finland

1B Gasification and pyrolysis 11:30-13:10

11.30 -11.50	**Analysis of sorption-enhanced gasification process for the production of biomass-based synthetic natural gas with a dual fluidised bed model**	Antti Pitkäoja[1], Kari Myöhänen[1], Jouni Ritvanen[1]	**1.**LUT School of Energy Systems, Lappeenranta-Lahti University of Technology, Yliopistonkatu 34, PO. Box 20, FI-53851 Lappeenranta, Finland
11.50 -12.10	**Development of an empirical method for determining macro-kinetics of pyrolysis of biogenic and waste derived fuels in a SEG environment**	Felix Mangold[1], Max Schmid[1], Günter Scheffknecht[1]	**1.**University of Stuttgart, Institute of Combustion and Power Plant Technology - IFK, Pfaffenwaldring 23, D-70569 Stuttgart, Germany
12.10 -12.30	**Dual Fluidized Bed gasification of Tall Oil Pitch**	Isabel Cañete Vela[1], Judith González-Arias[1], Teresa Berdugo Vilches[1], Chahat Mandviwala[1], Tharun Roshan Kumar[1], Renesteban Forero[1], Martin Seeman[1], Henrik Thunman[1]	**1.**Department of Space, Earth and Environment (SEE), Division of Energy Technology, Chalmers University of Technology, 412 96 Gothenburg, Sweden
12.30 -12.50	**Solid Flux Measurement in Chemical Looping Gasification Based on Solid Samples**	Falko Marx[1], Paul Dieringer[1], Jochen Ströhle[1], Bernd Epple[1]	**1.**Institute for Energy Systems & Technology, Technische Universität Darmstadt, Otto-Berndt-Str. 2, 64287 Darmstadt, Germany
12.50 -13.10	**Gasification of high ash Indian coal in indigenous 1.5 TPD oxygen-enriched air-blown pressurized fluidized bed gasification (PFBG) pilot plant facility**	Vishal Chauhan[1], Prakash D. Chavan[1], Rupesh K. Singh[1], Sujan Saha[1], Sudipta Datta[1], Nilesh D. Dhaigude[1], Gajanan Sahu[1], Pradeep K. Singh[1]	**1.**Gasification and Catalysis Research Group, CSIR-Central Institute of Mining and Fuel Research (CIMFR), Dhanbad, Jharkhand-826001, India

Monday

1C High temperature looping cycles 11:30-13:10

11.30 -11.50	**Investigations on a Volatiles Distributor for Improving the Cross-sectional Gas Distribution in Fluidized Beds**	Xiaoyun Li[1], Anders Lyngfelt[1], Carl Linderholm[1], Tobias Mattisson[1]	**1.**Department of Space, Earth and Environment, Chalmers University of Technology, Hörsalsvägen 7b, 412 96 Gothenburg, Sweden
11.50 -12.10	**Operation of a 300 kWth Indirectly Heated Carbonate Looping Pilot Plant for CO2 Capture from Lime Industry**	Carina Hofmann[1], Martin Greco-Coppi[1], Jochen Ströhle[1], Bernd Epple[1]	**1.**Technical University of Darmstadt, Institute for Energy Systems and Technology, 64206 Darmstadt, Germany
12.10 -12.30	**Comparison of low-cost and synthetic oxygen carriers for the Biomass Chemical Looping Gasification process**	Iván Samprón[1], Oscar Condori[1], Luis F. de Diego[1], Francisco García-Labiano[1], M.T. Izquierdo[1], Juan Adánez[1]	**1.**Instituto de Carboquímica (ICB-CSIC), Miguel Luesma Castán, 4, Zaragoza, 50018, Spain
12.30 -12.50	**An Industrial-Scale Boiler for Chemical-Looping Combustion – Design and Downstream Gas Treatment**	Anders Lyngfelt[1], Klas Andersson[1]	**1.**Chalmers University of Technology, 412 96 Göteborg, Sweden
12.50 -13.10	**Trace element behavior in fluidized bed applications utilizing oxygen carriers**	Ivana Staničić[1], Rainer Backman[2], Magnus Rydén[1], Tobias Mattisson[1]	**1.**Department of Space, Earth and Environment, Division of Energy Technology, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden **2.**Department of Applied Physics and Electronics, Thermochemical Energy Conversion Laboratory, Umeå University, SE-901 87, Umeå, Sweden

1D FBC in China - Novel processes and concepts (Hybrid) 11:30-13:10

11.30 -11.50	**Influence of Particle Size on the Cluster Characteristics of Bed Material in a Circulating Fluidized Bed**	Chengliang Han[1], Lilin Hu[1], Tianxing Song[2], Yang Zhang[1], Hairui Yang[1], Suxia Ma[2], Hai Zhang[1]	**1.**Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing, China. **2.**Department of Thermal Engineering, Taiyuan University of Technology, Taiyuan, Shanxi, China.
11.50 -12.10	**Experimental investigation on the hydrodynamic characteristics of the circulating fluidized bed whole loop under load regulation**	Boyu Deng[1], Man Zhang[1], Yi Zhang[2], Hao Kong[1], Tuo Zhou[1], Hairui Yang[1]	**1.**Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China. **2.**China Electric Power Planning & Engineering Institute, Beijing 100120, China.
12.10 -12.30	**Experimental study of 0.3 MWth coal-fired circulating fluidized bed combustion by using ilmenite ore as active bed material**	Lin Li[1], Guang Sun[1], Yuanqiang Duan[1], Yueming Wang[1], Chun Zhu[1], Zhenkun Sun[1], Lunbo Duan[1]	**1.**Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, School of Energy and Environment, Southeast University, Sipailou 2#, Nanjing, China
12.30 -12.50	**Reliability verification of fast-reaction thermogravimetric analysis**	Yupeng Feng[1], Ruiqi Bai[1], Yajie Jia[1], Xinhua Yang[1], Tuo Zhou[1], Zhong Huang[1], Man Zhang, Hairui Yang[1]	**1.**State Key Laboratory of Power System and Generation Equipment, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China
12.50 -13.10	**Experimental Research on Pyrometallurgical Recovery of Iron from Red Mud**	Hao Kong[1], Shuangming Zhang[1], Xinhua Yang[1], Tuo Zhou[1], Man Zhang[1], Hairui Yang[1]	**1.**Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China

Monday

2A Fluidized bed design and operation 14:00 - 15:00

14.00 -14.20	**Assessment of Fuel and Load Flexibility in a Circulating Fluidized Bed Pilot Plant**	Jochen Ströhle[1], Alexander Kuhn[1], Jens Peters[1], Mikko Salo[2], Jenö Kovács[2], Vesna Barišić[2], Bernd Epple[1]	**1.** Technical University of Darmstadt, Institute for Energy Systems and Technology, Otto-Berndt-Str.2, 64287 Darmstadt, Germany. **2.** Sumitomo SHI FW Energia Oy, Relanderinkatu 2, 78200 Varkaus, Finland
14.20 -14.40	**Evaluation of bed-to-tube heat transfer in a fluidized bed heat exchanger in 75 MWth CFB boiler for municipal solid waste fuels**	Viktor Stenberg[1], Magnus Rydén[2], Fredrik Lind[2]	**1.** CIT Industriell Energi AB. **2.** Division of Energy Technology - Department of Space, Earth and Environment, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden
14.40 -15.00	**Experimental Investigation of CaO/Ca(OH)2 for Thermochemical Energy Storage – Commissioning of a 0.5 kWh Experimental Set-Up**	Leander Morgenstern[1], Elija Talebi [1], Stephan Gleis[1], Florian Kerscher[1], Hartmut Spliethoff[1]	**1.** Chair of Energy Systems, Technical University of Munich, Boltzmannstr. 15, 85748 Garching b. München, Germany

2B Fundmentals: particles and fluidization 14:00-15:00

14.00 -14.20	**Agglomeration tendencies for three different bed materials in a laboratory-scale bubbling fluidized bed**	Maria Zevenhoven[1], Frida Tropp[1,2], Patrik Yrjas[1], Henrik Leion[2]	**1.** Johan Gadolin Process Chemistry Center, Åbo Finland **2.** Division of Energy and Material, Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Göteborg 412 58, Sweden
14.20 -14.40	**Binary mixtures of biomass and inert components in fluidized beds: experimental and neutral network exploration**	Paola Brachi[1], Riccardo Chirone[1], Roberto Chirone[2], Antonio Coppola[1], Vincenzo Del Duca[1], Michele Miccio[3], Giovanna Ruoppolo[1]	**1.** Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili – Consiglio Nazionale delle Ricerche, Piazzale V. Tecchio 80, 80125 Napoli, Italy **2.** Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale (DICMaPI) Università degli Studi di Napoli Federico II, Piazzale V. Tecchio 80, 80125 Napoli, Italy **3.** Dipartimento di Ingegneria Industriale (DIIN), Università degli Studi di Salerno, via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy
14.40 -15.00	**CFD-DEM investigation on the (de-)fluidization behavior of combusted iron fines in a fluidized bed**	X. Liu[1], N.G. Deen[1,2], Y. Tang[1,2]	**1.** Power and Flow Group, Department of Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands **2.** Eindhoven Institute for Renewable Energy Systems (EIRES), Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

Monday

2C Novel processes and concepts 14:00-15:00

14.00 -14.20	**Minimum fluidization velocity of combusted iron fines using H2 and N2 in a lab-scale fluidized bed**	C.J.M. Hessels[1], D.W.J. Lelivelt[1], G. Finotello[1,2], Y. Tang[1,2], N.G. Deen[1,2]	**1.** Power and Flow Group, Department of Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands **2.** Eindhoven Institute of Renewable Energy Systems (EIRES), P.O. Box 513, 5600 MB Eindhoven, The Netherlands
14.20 -14.40	**Effect of Multiple Storage Cycles on Heat Transfer in Bubbling Fluidized Beds for Thermochemical Energy Storage**	Elija Talebi[1], Leander Morgenstern[1], Manuel Würth[1], Florian Kerscher[1], Hartmut Spliethoff[1]	**1.** Chair of Energy Systems, Technical University of Munich, Boltzmannstr. 15, 85748 Garching, Germany
14.40 -15.00	**Study on the absorption of potassium by ilmenite ore and olivine sand in fluidized bed**	Dennis Lu[1], Yewen Tan[1], Marc Duchesne[1], David McCalden[1]	**1.** Natural Resources Canada, CanmetENERGY-Ottawa, 1 Haanel Drive, Ottawa, ON, Canada K1A 1M1

2D Combustion 14:00-15:00

14.00 -14.20	**Desulfurization in co-firing of sewage sludge and wooden biomass in a bubbling fluidized bed combustor under air and oxyfuel conditions**	Pavel Skopec[1], Jan Hrdlička[1], Matěj Vodička[1]	**1.** Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Energy Engineering, Technická 4, 160 00 Praha 6, Czech Republic
14.20 -14.40	**Experimental and process modelling study of the oxy-fuel combustion of solid recovered fuel at semi-industrial scale**	Joseba Moreno[1], Max Schmid[1], Günter Scheffknecht[1]	**1.** University of Stuttgart, Institute of Combustion and Power Plant Technology (IFK), Stuttgart, Germany
14.40 -15.00	**Pollutant Emissions during Oxy-CFB Combustion of Selected Biomass Fuels**	Monika Kosowska-Golachowska[1], Adam Luckos[2], Agnieszka Kijo-Kleczkowska[1]	**1.** Czestochowa University of Technology, Department of Thermal Machinery, Armii Krajowej 21, 42-201 Czestochowa, Poland **2.** University of the Witwatersrand, School of Chemical and Metallurgical Engineering, Braamfontein Campus East, Johannesburg, South Africa

Tuesday

3A Modelling/CFD/Advanced diagnostics 11:30-12:50

11.30 -11.50	**Three-dimensional full-loop numerical simulation of coal and sludge co-combustion in a circulating fluidized bed**	Wanqiang Wu[1], Lunbo Duan[1], Yuanqiang Duan[1], Lin Li[1], Daoyin Liu[1], David Pallarès[2]	**1.** Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, 210096, Nanjing, China **2.** Department of Space, Earth and Environment, Division of Energy Technology, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden
11.50 -12.10	**Dynamics of large-scale bubbling fluidized bed combustion plants for heat and power production**	Guillermo Martinez Castilla[1], Rubén M. Montañés[2], David Pallarès[1], Filip Johnsson[1]	**1.** Chalmers University of Technology, Hörsalsvägen 7b, Gothenburg, Sweden **2.** SINTEF Energy Research, Sem Saelandsvei 11, Trondheim, Norway
12.10 -12.30	**Hybrid Modelling Approach to Optimize Fouling Management in a Circulating Fluidized Bed Boiler**	Mika Liukkonen[1], Ari Kettunen[1], Jouni Miettinen[1], Enso Ikonen[2], István Selek[2], Markus Neuvonen[2], Anders H. Hansen[3], Mathias Edelborg[4]	**1.** Sumitomo SHI FW Energia Oy, Relanderinkatu 2, FI-78200 Varkaus, Finland **2.** University of Oulu, POB 4000, FI-90014 Oulun yliopisto, Finland **3.** SINTEF AS, Forskningsveien 1, 0373 Oslo, Norway **4.** Mälarenergi AB, Sjöhagsvägen 23, Västerås, Sweden
12.30 -12.50	**Incorporation of Flamelets Generated Manifold method in coarse-grained Euler-Lagrange simulations of pulverized coal combustion**	Chih-Chia Huang[1], Yali Tang[1,2], Jeroen van Oijen[1,2], Niels G. Deen[1,2]	**1.** Power & Flow group, Department of Mechanical Engineering, Eindhoven University of Technology, PO Box 513, 5600 MB, Eindhoven, the Netherlands **2.** Eindhoven Institute of Renewable Energy Systems (EIRES), Eindhoven University of Technology, PO Box 513, 5600 MB, Eindhoven, the Netherlands

3B Gasification and pyrolysis 11:30-12:50

11.30 -11.50	**Modelling of fluidized bed steam-oxygen gasification of sewage sludge with AspenPlus® using thermochemical equilibrium and experimental data**	Max Schmid[1], Christian Schmidberger[1], Günter Scheffknecht[1]	**1.** University of Stuttgart, Institute of Combustion and Power Plant Technology, Pfaffenwaldring 23, 70569 Stuttgart, Germany
11.50 -12.10	**Influence of ash-coated bed material on hydrocarbons steam cracking in dual fluidized bed systems**	Judith González-Arias[1], Teresa Berdugo-Vilches[1], Isabel Cañete-Vela[1], Chahat Mandviwala[1], Renesteban Forero[1], Tharun Roshan Kumar[1], Martin Seemann[1], Henrik Thunman[1]	**1.** Department of Space, Earth and Environment (SEE), Division of Energy Technology, Chalmers University of Technology, 412 96 Gothenburg, Sweden
12.10 -12.30	**Mathematical and physical modeling of an internally circulating fluidized bed for fast pyrolysis of biomass**	Maurizio Troiano[1], Valeria Ianzito[1], Stefano Padula[1], Elvis Tinashe Ganda[1], Roberto Solimene[2], Piero Salatino[1]	**1.** Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli Federico II, Piazzale V. Tecchio 80, 80125, Napoli, Italy **2.** Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili (STEMS), Consiglio Nazionale delle Ricerche, Piazzale V. Tecchio 80, 80125, Napoli, Italy
12.30 -12.50	**Development of a Parametric System Model to describe the product species distribution of Steam Pyrolysis process in a Dual Fluidized Bed**	Renesteban Forero Franco[1], Chahat Mandiwala[1], Teresa Berdugo Vilches[1], Martin Seemann[1], Henrik Thunman[1]	**1.** Department of Space, Earth and Environment (SEE), Division of Energy Technology, Chalmers University of Technology, 41296 Gothenburg, Sweden.

Tuesday

3C High temperature looping cycles 11:30-12:50

11.30 -11.50	**H2 and syngas production by Chemical Looping Reforming using bio-oil as raw material**	Iñaki Adánez-Rubio[1], Francisco García-Labiano [1], Alberto Abad[1], Luis F. de Diego[1], Juan Adánez[1]	**1.**Instituto de Carboquímica (ICB-CSIC), Miguel Luesma Castán, 4, Zaragoza, 50018, Spain
11.50 -12.10	**Application of particle-scale modelling in combustion of char particle in an inert and active fluidised bed**	K.Y. Kwong[1], J.S. Dennis[1], E.J. Marek[1]	**1.**Department of Chemical Engineering and Biotechnology, University of Cambridge, United Kingdom
12.10 -12.30	**New Strategies for Solids Management in a Ca-Looping based TCES System**	S. Pascual[1], P. Lisbona[1], L.M. Romeo[1]	**1.**Departamento de Ingeniería Mecánica. Escuela de Ingeniería y Arquitectura (EINA). Universidad de Zaragoza, C/ María de Luna s/n, 50018, Zaragoza, Spain
12.30 -12.50	**Fate and Operational Implications of Alkalis in Chemical Looping Combustion of Biomass – Summary and Discussion of Recent Pilot Experiment Results**	Ivan Gogolev[1], Anders Lyngfelt[1]	**1.**Chalmers University of Technology, Hörsalsvägen 7, 412 96, Gothenburg, Sweden

3D FBC in China/Korea - Design adn Modelling (Hybrid) 11:30-12:50

11.30 -11.50	**Study on char combustion characteristics and isotope tracer decoupled gasification reaction under pressurized oxy-fuel combustion**	Pu Hong, Lin Li[1], Yuanqiang Duan[1], Yueming Wang[1], Lunbo Duan[1]	**1.**Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, School of Energy and Environment, Southeast University, Sipailou 2, Nanjing, China
11.50 -12.10	**Design of an Industrialized Chemical Looping Unit with Dual-CFB system**	Yangjun Wei[1], Leming Cheng[1], Erdong Wu[1], Liyao Li[1], Qingyu Zhang[1]	**1.**Institute for Thermal Power Engineering, State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou, 310027, China
12.10 -12.30	**Heat transfer behaviors of an immersed tube with sCO2 working fluid in a hot fluidized bed under high pressure**	Yu Huang[1], Xu Bao[1], Lin Li[1], Yuanqiang Duan[1], Dongdong Fang[1], Lunbo Duan[1]	**1.**Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, Nanjing, China
12.30 -12.50	**One-dimensional numerical simulation of a CFB combustor: Improvement of hydrodynamic models for accurate pressure and particle size distribution prediction**	Changwon Yang [1,2], Byeongryeol Bang [1,2], Hyunmin Kwon [1,2], Inhyuk Cho [1,2], David Pallarès [4], Bo Leckner [4], Uendo Lee [1,2,3]	**1.**Carbon Neutral Technology R&D Department, Korea Institute of Industrial Technology, Cheonan, Chungnam, Republic of Korea. **2.**Future Energy Plant Convergence Research Center, Korea Institute of Energy Research, Daejeon b. **3.**Green Process and Energy System Engineering, University of Science and Technology, Cheonan, Chungnam, Republic of Korea. **4.**Division of Energy Technology, Chalmers University of Technology, 43096 Göteborg, Sweden

Tuesday

4A Fluidized bed design and operation 14:00-16:00

14.00 -14.20	**Improving availability of the 460 MWe CFB boiler through preventing erosion in the furnace chamber**	Wojciech Nowak[1], Tadeusz Uhl[1], Łukasz Ambrozinski[1], Mariusz Giergiel[1], Tadeusz Stepinski[1], Jakub Wojcik[1], Tomasz Chmielniak[1]	**1.**AGH University of Science and Technology,30-059 Krakow A. Mickiewicza 30, Poland
14.20 -14.40	**Investigation of fouling and corrosion of low-temperature reheater in a CFBC boiler**	Alar Konist[1]	**1.**Tallinn University of Technology, Ehitajate tee 5, Tallinn, Estonia
14.40 -15.00	**Investigating the performance of novel FeCrAl alloys in a loop seal superheater application of a waste fired CFB boiler**	Hampus Lindmark[1], Julien Phother[1], Maria Dolores Paz Olausson[1], Johanna Nockert Olovsjö[2], Fredrik Lind[3], Anna Jonasson[3], Vesna Barišić[4], Kyösti Vänskä[4], Laura Rioja-Monllor[5], Jesper Liske[1]	**1.**Chalmers University of Technology, SE412 96, Gothenburg, Sweden **2.**Kanthal AB, SE734 27, Hallstahammar, Sweden **3.**E.On Energy Infrastructure AB, SE205 09, Malmö, Sweden **4.**Sumitomo SHI FW, FI782 01, Varkaus, Finland **5.**AB Sandvik Materials Technology, SE811 81, Sandviken, Sweden
15.00 -15.20	**Investigation of the hydrodynamics of packed-fluidized beds: characterization of solids flux**	Nasrin Nemati[1], Pablo Filiu Moreno[1,2], Magnus Rydén[1]	**1.**Division of Energy Technology, Department of Space, Earth and Environment, Chalmers University of Technology, Göteborg, Sweden **2.**ETSII, Universitat Politècnica de València, Valencia, Spain
15.20 -15.40	**Design and experimental long-term results of micro-CHP systems based on Stirling engines and fluidized bed combustion**	Dominik Müller[1], Julian Nix[1], Tanja Schneider[1], Jürgen Karl[1]	**1.**Chair of Energy Process Engineering, Friedrich-Alexander-University Erlangen-Nürnberg, Fürther Straße 244, 90429 Nürnberg, Germany
15.40 -16.00	**CFD modelling of an indirectly heated calciner reactor, utilized for CO2 capture, in an Eulerian framework**	Georgios Kanellis[1,3], Myrto Zeneli[1,2], Nikolaos Nikolopoulos[1], Carina Hofmann[4], Jochen Ströhle[4], Sotirios Karellas[2], Jukka Konttinen[3]	**1.**Centre for Research and Technology Hellas, Chemical Process & Energy Resources Institute (CERTH/CPERI), Thessaloniki, Greece **2.**Laboratory of Steam Boilers and Thermal Plants, National Technical University of Athens, 9 Heroon Polytechniou Street, 15780 Zografou, Greece **3.**Faculty of Engineering and Natural Sciences, Tampere University, P.O. Box 541, FI-33101,Tampere, Finland **4.**Institute for Energy Systems and Technology, Technische Universität Darmstadt, Darmstadt, Germany

4B Fundmentals: particles and fluidization 14:00-16:00

14.00 -14.20	**Experimental investigation on lateral mixing of large and light particles in a fluidized bed**	Diana Carolina Guío-Pérez[1], David Pallarès[1], Filip Johnsson[1]	**1.**Department of Space, Earth and Environment, Division of Energy Technology, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden
14.20 -14.40	**Fluid-dynamics of a loop seal: an experimental study**	M. Suárez-Almeida[1], A. Gómez Barea[1]	**1.**Chemical and Environmental Engineering Department, Escuela Técnica Superior de Ingeniería, University of Seville, Camino de los Descubrimientos s/n, 41092 Seville, Spain
14.40 -15.00	**Experimental evaluation on gas lateral mixing in fluidized beds with B-type solids**	Francisco M. Baena-Moreno[1], Diana Carolina Guío-Pérez[1], Timon Benz[1], Bo Leckner[1], David Pallarès[1]	**1.**Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Göteborg, Sweden
15.00 -15.20	**Hydrodynamic characterization of hot dense fluidized beds by capacitance probes**	L. Molignano[1], M. Troiano[1], R. Solimene[2], S. Tebianian[3], P. Salatino[1], J. F. Joly[3]	**1.**Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli Federico II, Piazzale Tecchio 80, 80125, Napoli, Italy **2.**Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili, Consiglio Nazionale delle Ricerche, Piazzale Tecchio 80, 80125, Napoli, Italy **3.**Direction Conception Modélisation Procédés, IFP Energies Nouvelles, Rond-point de l'échangeur de Solaize, 69360, Solaize, France.
15.20 -15.40	**Modeling of minor solid phase mixing in circulating fluidized beds**	Markku Nikku[1], Kari Myöhänen[1], Jouni Ritvanen[1], Timo Hyppänen[1]	**1.**LUT University, P.O. box 20, FI-53851 Lappeenranta, Finland
15.40 -16.00	**Particle circulation characteristics of a loop seal operated by vibrated gas flow**	Reiji Noda[1], Hiroki Sato[1], Reiya Kanai[2]	**1.**Graduate School of Science and Technol., Gunma University, 1-5-1 Tenjin-cho, Kiryu, Japan **2.**School of Science and Technol., Gunma University, 1-5-1 Tenjin-cho, Kiryu, Japan

Tuesday

4C Novel processes and concepts 14:00-16:00

14.00 -14.20	**Developing a novel approach for modelling particle-wall heat transfer in fluidized bed reactors for CO2 capture**	Jan Hendrik Cloete[1], Roel Geurts[2], Schalk Cloete[1], Yali Tang[2], Abdelghafour Zaabout[1]	**1.**SINTEF Industry, S.P. Andersens veg 15B, Trondheim, Norway **2.**Eindhoven University of Technology, P.O. Box 513, Eindhoven, The Netherlands
14.20 -14.40	**Extension of the product portfolio of fluidized bed boilers by bed-sectioning – effects on the original boiler system**	Anna Köhler[1], Gabriel Gustafson[1], Guillermo Martinez Castilla[2], David Pallarès[2]	**1.**BioShare AB, Karlstad, Sweden **2.**Chalmers University of Technology, Gothenburg, Sweden
14.40 -15.00	**Heat transfer conditions impact on the fluidized adsorption chiller performance**	K. Grabowska[1], J. Krzywanski[1], A. Zylka[1], A. Kulakowska[1], D. Skrobek D.[1], M. Sosnowski [1], W. Nowak [2], T. Czakiert [3]	**1.**Jan Dlugosz University in Czestochowa, Faculty of Science and Technology, Armii Krajowej 13/15, 42-200 Czestochowa, Poland **2.**AGH University of Science and Technology, Faculty of Energy and Fuels, A. Mickiewicza 30, 30-059 Cracow, Poland **3.**Czestochowa University of Technology, Department of Advanced Energy Technologies, Dabrowskiego 73, 42-201 Czestochowa, Poland
15.00 -15.20	**Monitoring of bed material in a biomass fluidized bed boiler**	T. Leffler [1], F. Lind[2], B. Leckner[2], F Winquist[3], M Eriksson[3], P. Knutsson[1]	**1.**Department of Chemistry and Chemical Engineering, Chalmers University of Technology, SE-41296, Gothenburg, Sweden **2.**Department of Space, Earth and Environment, Chalmers University of Technology, SE-412 96, Gothenburg, Sweden **3.**Department of Physics, Chemistry and Biology, Linköping University, SE-581 83, Linköping, Sweden
15.20 -15.40	**Retrofitting Fluidized Bed Power Plants for Waste-Derived Fuels and Novel Process Concepts**	Martin Haaf[1], Vesna Barišić[1], Edgardo Coda Zabetta[1], Marcin Kost[2], Marcin Bartosz[2], Jochen Ströhle[3], Bernd Epple[3]	**1.**Sumitomo SHI FW Energia Oy (SFW), Relanderinkatu 2, FI-78200 Varkaus, Finland **2.**Fortum Power and Heat Polska Sp. Z o. o., Slonimskiego 1a, Wroclaw 50-413, Poland **3.**Institute for Energy Systems and Technology, Technische Universität Darmstadt, Otto-Berndt-Str. 2, 64287 Darmstadt, Germany
15.40 -16.00	**Simulation of a Sorption-Enhanced Methanation Process in Fluidized Bed**	Antonio Coppola[1], Fabrizio Scala[2]	**1.**STEMS, Consiglio Nazionale delle Ricerche, 80125 Napoli, Italy **2.**DICMaPI, Università degli Studi di Napoli Federico II, 80125 Napoli, Italy

4D Ash and spent solids 14:00-16:00

14.00 -14.20	**Characterisation of Ashes Formed at CFB Oxy-fuel Combustion of Ca-rich Fuel**	Mais Baqain[1], Can Rüstü Yörük[2], Dmitri Nešumajev[1], Oliver Järvik[1], Alar Konist[1]	**1.**Department of Energy Technology, Tallinn University of Technology, 19086, Tallinn, Estonia **2.**Department of Materials and Environmental Technology, Tallinn University of Technology, 19086, Tallinn, Estonia
14.20 -14.40	**Magnetic Properties of Ilmenite used for Oxygen Carrier Aided Combustion**	Robin Faust[1], Ignacio Lamarca[1], Andreas Schaefer[1], Fredrik Lind[2], Pavleta Knutsson[1]	**1.**Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Gothenburg, 412 96, Sweden **2.**Department of Space, Earth and Environment, Chalmers University of Technology, Gothenburg, 412 96, Sweden
14.40 -15.00	**Investigation of the release behaviour of caesium and strontium during the incineration of municipal solid waste in fluidized beds**	Martin Dunker[1], Daniel Bernhardt[1], Michael Beckmann[1], Hermann Nordsieck[2], Nina Thiel[2]	**1.**TU Dresden, Chair for Energy Process Engineering, George-Bähr-Str. 3b, Dresden, Germany **2.**bifa Umweltinstitut, Am mittleren Moos 46, Augsburg, Germany
15.00 -15.20	**Formation of agglomerates with core-shell structure in a large-scale CFB boiler**	Dongfang Li[1,2], Seokgi Ahn[2,3], Junjie Li[2], Sungmook Jung[3], Chunghwan Jeon[2]	**1.**State Key Laboratory of Complex Nonferrous Metal Resources Clean Utilization, Faculty of Metallurgical and Energy Engineering, Kunming University of Science and Technology, Kunming, China **2.**Pusan CFBC Research Center, Pusan National University, Busan, Republic of Korea **3.**Samcheok Thermal Power Plant Division, Korea Southern Power Company, Samcheok, Republic of Korea
15.20 -15.40	**Conversion of local sewage sludge in a laboratory scale fluidized bed rig**	Daulet Zhakupov[1], Dhawal Shah[1], Yerbol Sarbassov[2]	**1.**Department of Chemical and Materials Engineering, School of Engineering and Digital Sciences, Nazarbayev University, Nur-Sultan, Kazakhstan - 010001 **2.**Department of Mechanical and Aerospace Engineering, School of Engineering and Digital Sciences, Nazarbayev University, Nur-Sultan, Kazakhstan - 010001
15:40 -16:00	**Coli-Shaped Rotating spiral gas-solid reactor**	Tadaaki Shimizu[1], Tomonori Kobayashi[1], Heizo Kato[1], Liuyun Li[1], Akimichi Hatta[2], Toshinori Kojima[3]	**1.**Program of Chemistry and Chemical Engineering, Niigata University, 2-8050 Ikarashi, Niigata, Japan **2.**CR-POWER LLC., 7–3–37 Place-Canada, Akasaka, Minato-ku, Tokyo, Japan2 **3.**(Former) Seikei University, 3–3–1 Kichijoji-kitamachi, Musashino-shi, Tokyo, Japan

Wednesday

5A Modelling/CFD/Advanced diagnostics 09:40-11:00

09.40 -10.00	**Modelling triboelectric charging in fluidized bed by coarse grained DEM-CFD**	Erasmo S. Napolitano[1], Alberto Di Renzo[1], Francesco P. Di Maio[1]	**1.**DIMES Department, Università della Calabria, Via P. Bucci, 87036 Rende (CS), Italy
10.00 -10.20	**Radar-based measurements of the solids flow in a circulating fluidized bed – first experiences**	Diana Carolina Guío-Pérez[1], Marlene Bonmann[2], David Pallarès[1], Tomas Bryllert[2], Filip Johnsson[1]	**1.**Department of Space, Earth and Environment, Division of Energy Technology, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden **2.**Department of Microtechnology and Nanoscience, Terahertz and Millimetre Wave Laboratory, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden
10.20 -10.40	**The Role of GPU Computing in the Commercialization and Scale-Up of Fluidized Bed Conversion Processes**	Peter Blaser[1], Andrew Larson[1], James Parker[1], Ali Akhavan[1], Niraj Mehta[1]	**1.**CPFD Software, 1255 Enclave Parkway, Houston, Texas, 77077, USA
10.40 -11.00	**Artificial intelligence for emissions control – application to oxy-fuel fluidized bed combustion**	Babak Heydari[1], Sadegh Seddighi[1,2], Raheleh Mohammadpour[3], David Pallarès[2], Filip Johnsson[2]	**1.**K. N. Toosi University of Technology, Tehran, Iran **2.**Chalmers University of Technology, 412 96 Göteborg, Sweden **3.**Sharif University of Technology, Tehran, Iran

5B Gasification and pyrolysis 09:40-11:00

09.40 -10.00	**Fluidized Bed Gasification of Solid Recovered Fuels in a 500 kWth Pilot Plant**	E. Langner[1], J. Kaltenmorgen[1], C. Heinze[1], J. Ströhle[1], B. Epple[1]	**1.**Technical University of Darmstadt, Institute for Energy Systems and Technology, Otto-Berndt-Str. 2, 64206 Darmstadt, Germany
10.00 -10.20	**Selection of oxygen carrier for chemical looping gasification of biomass**	Amir H. Soleimanisalim[1], Fredrik Hildor[2], Daofeng Mei[1], Ivan Gogolev[1], Tobias Mattisson[1]	**1.**Division of Energy Technology, Department of Space, Earth, and Environment, Chalmers Universityof Technology, Göteborg 412 58, Sweden **2.**Division of Energy and Material, Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Göteborg 412 58, Sweden
10.20 -10.40	**Steam-CO2/Oxygen gasification of biomass waste in fluidized bed reactors**	Alex Sebastiani[1], Stefano Iannello[1], Suviti Chari[1], Domenico Macrì[1], Massimiliano Materazzi[1]	**1.**Department of Chemical Engineering, University College London, London WC1E 7JE, UK
10.40 -11.00	**Syngas production via Biomass Chemical Looping Gasification (BCLG) in a 50 kWth unit using ilmenite as oxygen carrier**	O. Condori[1], F. García-Labiano[1], L.F. de Diego[1], M.T. Izquierdo[1], A. Abad[1], J. Adánez[1]	**1.**Instituto de Carboquímica, ICB-CSIC, C/ Miguel Luesma Castán, 4. 50018, Zaragoza. Spain

Wednesday

5C High temperature looping cycles 09:40-11:00

09.40 -10.00	**Batch fluidized bed study of the interaction between alkali impurities and braunite oxygen carrier in chemical looping combustion**	Daofeng Mei[1], Anders Lyngfelt[1], Henrik Leion[2], Tobias Mattisson[1]	**1.** Division of Energy Technology, Department of Space, Earth and Environment, Chalmers University of Technology, Chalmersplatsen 4, Göteborg, Sweden **2.** Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Chalmersplatsen 4, Göteborg, Sweden
10.00 -10.20	**Performance Evaluation of different Limestone-Based Sorbents for the Sorption-Enhanced Gasification in a Dual Interconnected Fluidised Bed Reactor**	Antonio Coppola[1], Fabrizio Scala[1,2], Fabio Montagnaro[3]	**1.** STEMS, Consiglio Nazionale delle Ricerche, 80125 Napoli, Italy **2.** DICMaPI, Università degli Studi di Napoli Federico II, 80125 Napoli, Italy **3.** Dipartimento di Scienze Chimiche, Università degli Studi di Napoli Federico II, 80126 Napoli, Italy
10.20 -10.40	**Sorption-Enhanced Methanation in a Lab-Scale Twin Fluidized Bed System**	Antonio Coppola[1], Fiorella Massa[2], Fabrizio Scala[1,2]	**1.** STEMS, Consiglio Nazionale delle Ricerche, 80125 Napoli, Italy **2.** DICMaPI, Università degli Studi di Napoli Federico II, 80125 Napoli, Italy
10.40 -11.00	**The effect of oxygen carrier's mass conversion degree on the kinetics of char gasification in a lab-scale fluidized bed batch reactor**	Victor Purnomo[1], Daofeng Mei[2], Amir H. Soleimanisalim[2], Tobias Mattisson[2], Henrik Leion[1]	**1.** Division of Energy and Materials, Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Göteborg 412 58, Sweden **2.** Division of Energy Technology, Department of Space, Earth, and Environment, Chalmers University of Technology, Göteborg 412 58, Sweden

5D FBC in China - Novel processes and concepts (Hybrid) 09:40-11:00

09.40 -10.00	**Research on the Influence of Multi-cyclone Arrangement of CFB Boiler on the Gas-solid Inhomogeneity in the Tail Second Pass**	Shuangming Zhang[1], Boyu Deng[1], Xinhua Yang[1], Tuo Zhou[1], Man Zhang[1], Hairui Yang[1]	**1.** Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China
10.00 -10.20	**Computational Simulation of Secondary Air Penetration in a 350MW Circulating Fluidized Bed Boiler**	Ruiqi Bai[1], Shuangming Zhang[1], Xinhua Yang[1], Tuo Zhou[1], Man Zhang[1], Hairui Yang[1]	**1.** Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China
10.20 -10.40	**Effect of bed material particle size and inventory on gas-solid flow characteristics in a large-scale CFBB furnace: A numerical study**	Liyao Li[1], Leming Cheng[1], Yangjun Wei[1], Jingsong Zhou[1], Kunzan Qiu[1], Yingchun Wu[1]	**1.** Institute for Thermal Power Engineering, State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou China
10.40 -11.00	**Numerical study of the distribution characteristics in a cyclone gas-solid distributor**	Manxia Shang[1], Yuge Yao[1], Zhong Huang[1], Tuo Zhou[1], Man Zhang[1], Hairui Yang[1], Junfu Lyu[1]	**1.** Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China

Wednesday

6A Emissions and CO2 capture 11:30-12:30

11.30 -11.50	**Negative CO2 Emission from Oxy-fuel Combustion in Circulating Fluidized Bed Boilers**	Bo Leckner[1]	**1.**Division of Energy Technology, Chalmers University of Technology, 41296 Göteborg, Sweden
11.50 -12.10	**Emission Prediction and Reduction in a Biomass BFB Cogeneration Plant: A Data Analysis and Image Processing Approach**	Johannes Lukas[1], Simone Emmert [1], Sebastian Kolb[1], Dominik Müller[1], Thomas Plankenbühler[1], Jürgen Karl[1]	**1.**Chair of Energy Process Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg, Fürther, Str. 244f, 90429 Nürnberg
12.10 -12.30	**Experiences from NOx Optimizations through Primary Measures in a CFB boiler, Fired with RDF and Paper Mill Sludge**	Richard Kitzberger[1], Bernhard Pfaffenthaler[1], Gottfried Mittendrein[1], Sebastian Kaiser[1]	**1.**Andritz AG, Vienna, Austria

6B Fundmentals: particles and fluidization 11:30-12:30

11.30 -11.50	**Scale-up of vibro-fluidization of fine powders**	Kaiqiao Wu[1], Rens Kamphorst[1], Gabrie M.H. Meesters[1], J. Ruud van Ommen[1]	**1.**Product and Process Engineering, Department of Chemical Engineering, Delft University of Technology, Mekelweg 5, 2628 CD Delft, the Netherlands
11.50 -12.10	**Interaction behavior of sand-diluted and mixed Fe-based oxygen carriers with potassium salts**	Fredrik Hildor[1], Duygu Yilmaz[1,2], Henrik Leion[1]	**1.**Energy and Materials, Chemistry and Chemical Engineering, Chalmers University of Technology, 412 96 Gothenburg, Sweden **2.**Institute for Energy Technology (IFE), Department of Environmental Industrial Processes, Instituttveien 18, 2007, Kjeller, Norway
12.10 -12.30	**Impact of gas distributor on hydrodynamics in a cold flow annular dual fluidized bed for pressurized chemical looping**	Amanda Alain[1,2], Nicole Bond[1], Scott Champagne[1], Christopher McIntyre[3], Sabrina Francey[3], Arturo Macchi[2], Robin Hughes[1]	**1.**Natural Resources Canada, CanmetENERGY, 1 Haanel Drive, Ottawa, Canada. **2.**Department of Chemical and Biological Engineering, University of Ottawa, 161 Louis Pasteur Street, Ottawa, Canada. **3.**Hatch Ltd., 2800 Speakman Drive, Mississauga, Canada

Wednesday

6C Novel processes and concepts 11:30-12:30

11.30 -11.50	**Solar directly irradiated fluidized bed autothermal reactor (DIFBAR): hydrodynamic characterization**	Stefano Padula[1], Maurizio Troiano[1,2], Claudio Tregambi[2,3], Roberto Solimene[2], Piero Salatino[1]	**1.** Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli Federico II, Piazzale V. Tecchio 80, 80125, Napoli, Italy **2.** Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili (STEMS), Consiglio Nazionale delle Ricerche, Piazzale V. Tecchio 80, 80125, Napoli, Italy **3.** Dipartimento di Ingegneria, Università degli Studi del Sannio, Piazza Roma 21, 82100, Benevento, Italy
11.50 -12.10	**Steam Methane Reforming in Fluidized-Bed Heat Exchangers – A Case for Chemical-Looping Combustion**	Tobias Pröll[1], Anders Lyngfelt[2]	**1.** University of Natural Resources and Life Sciences, Vienna, 1190 Vienna, Austria **2.** Chalmers University of Technology, 412 96 Göteborg, Sweden
12.10 -12.30	**Fluidized bed design and process calculations for the continuous torrefaction of tomato peels with solid product separation**	Michele Miccio[1], Paola Brachi[2], Antonio Guerriero[1]	**1.** Dipartimento di Ingegneria Industriale (DIIN), Università degli Studi di Salerno, via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy **2.** Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili – Consiglio Nazionale delle Ricerche, Piazzale V. Tecchio 80, 80125 Napoli, Italy

6D FBC in China - Gasification and Novel processes (Hybrid) 11:30-12:30

11.30 -11.50	**Numerical study of the flow pattern and performance of the dense medium cyclones with different inlet lengths**	Yuge Yao[1], Manxia Shang[1], Zhong Huang[1], Tuo Zhou[1], Man Zhang[1], Hairui Yang[1], Junfu Lyu[1]	**1.** Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China
11.50 -12.10	**Catalytic fast pyrolysis of steam-explosion pretreated corn stalk for long-chain ether precursors over Fe-Ce mixed oxides**	Yuan Liu[1], Shiliang Wu[1], Huiyan Zhang[1], Rui Xiao[1]	**1.** Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, School of Energy and Environment, Southeast University, 221116 Nanjing, China
12.10 -12.30	**Study on the generation characteristics of tar in bubbling fluidized bed biomass gasification**	Shangzhi Deng[1], Huawei Jiang[1], Junfu Lyu[2], Yanhui Li[1], Cuiping Wang[3], Qingjie Guo[4]	**1.** College of Mechanical and Electrical Engineering, Qingdao University, Qingdao, China **2.** Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Tsinghua University, Beijing, China **3.** College of Civil Engineering and Architecture, Shandong University of Science and Technology, Qingdao, China **4.** State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering, Ningxia University, Yinchuan, China

Poster Session

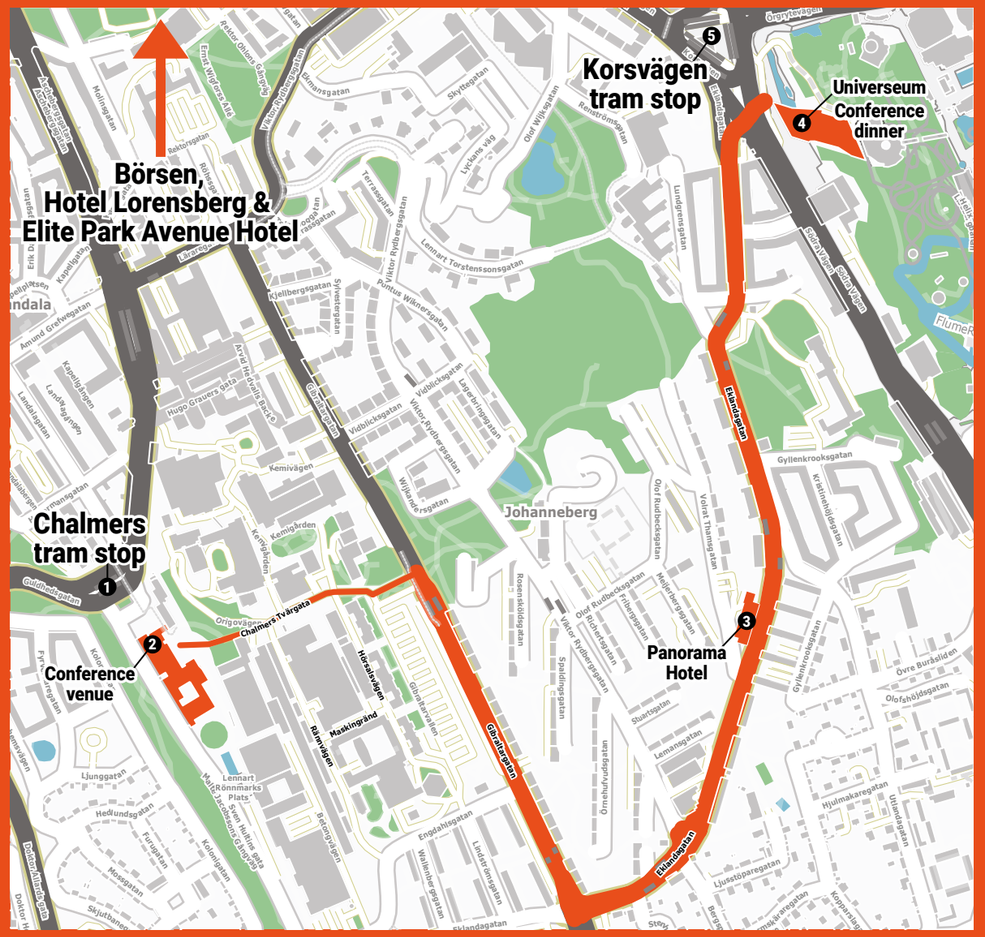
Monday 15:30-17:00 and Tuesday 17:00-18:30

Regeneration of metal powder: closing the metal fuel cycle	Nicole C. Stevens[1,2], Giulia Finotello[1,2] and Niels G. Deen[1,2]	**1.** Eindhoven University of Technology / Power & Flow – Netherlands **2.** Eindhoven Institute for Renewable Energy Systems (EIRES) - Netherlands
Thermal conversion of sodium phytate using the oxygen carrier ilmenite, interaction with Na-phosphate and its effect on reactivity	Emil O. Lidman Olsson[1,2], Victor Purnomo[3], Peter Glarborg[1], Henrik Leion[3], Kim Dam-Johansen[1], Hao Wu[1]	**1.** Department of Chemical and Biochemical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark **2.** Sino-Danish College, University of Chinese Academy of Sciences and Sino-Danish Center for Education and Research, Beijing, China **3.** Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Gothenburg, Sweden
Review of modelling approaches for sorption-enhanced steam reforming (SE-SR) process in fluidised bed reactors for low-carbon hydrogen production	Chinonyelum Udemu[1], Carolina Font-Palma[1]	**1.** Department of Engineering, University of Hull, Hull HU6 7RX, UK
Bed homogeneity of nano- and microsilica in a vibro-fluidized bed	Rens Kamphorst[1], Matthijs van Baarlen[1], Gabrie M.H. Meesters[1], J. Ruud van Ommen[1]	**1.** TU Delft, Van der Maasweg 9, Delft, The Netherlands
Gas-solids distribution measurements in sub-fluidised horizontal stirred bed reactors by fast X-ray analysis	P. Christian van der Sande[1], Amarenske C. Vogtlander[1], Evert C. Wagner[1], Gabrie M.H. Meesters[1], J. Ruud van Ommen[1]	**1.** Delft University of Technology, Van der Maasweg 9, Delft, The Netherlands
Parametric analysis of factors affecting the thermal-hydraulic behaviour of agglomerates in gas-solid fluidized-bed reactors	Matteo Errigo[1], Massimiliano Materazzi[1], Paola Lettieri[1]	**1.** Department of Chemical Engineering, University College London, Gower St, London, United Kingdom
Analysis of factors affecting N2O and NOx emissions from CFB boilers and small fluidized bed	Miao Miao[1], Yupeng Feng[1], Xinhua Yang[1], Zhong Huang[1], Shuai Ren[1], Hairui Yang[1]	**1.** State Key Laboratory of Power System and Generation Equipment, Department of Energy and Power Engineering, Tsinghua University, Beijing 100084, China
Behaviour of oxygen carriers under siloxanes containing biogas during chemical looping combustion operation	M.T. Izquierdo[1], T. Mendiara[1], A. Cabello[1], A. Abad[1], T. Mattisson[2], Juan Adánez[1]	**1.** Instituto de Carboquímica, ICB-CSIC, C/Miguel Luesma Castán, 4. 50018, Zaragoza, Spain **2.** Chalmers University of Technology, Dept Space Earth & Environment, SE-412 96, Gothenburg, Sweden

Notes

Orientation Maps

Chalmers Student Union Building



2. Chalmers Conference Venue

3. Panorama Hotel

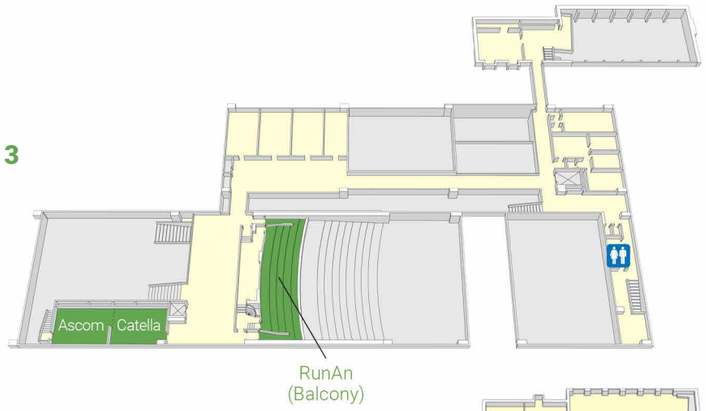
4. Universeum

Börsen

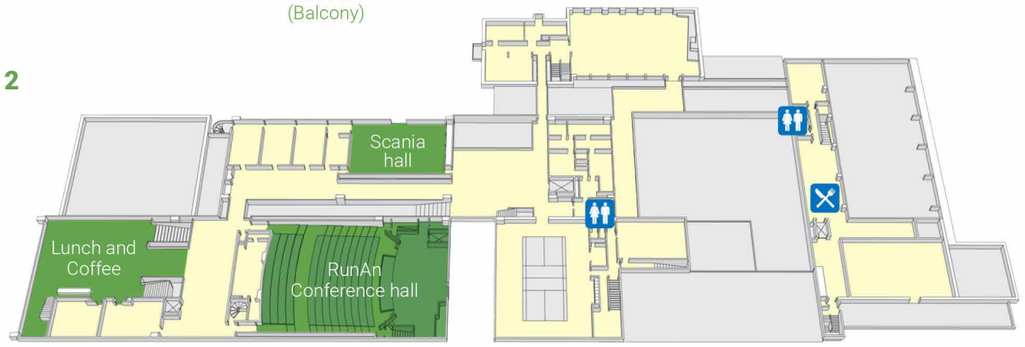
Hotel Lorensberg

Elit Park Avenue Hotel

Level 3



Level 2



Ground floor