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Sebastian Chialvo, Ph.D.
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Dr. Sebastian Chialvo has a Ph.D. in chemical engineering and specializes in modeling fluid flow, heat transfer, and reacting systems. He is an expert in computational fluid dynamics (CFD) and, more specifically, in developing and utilizing models to solve complex flow problems rapidly and accurately. He has applied his expertise to study safety and environmental incidents, chemical process risk assessment and mitigation, and chemical process improvements and scale-up.

Prior to joining ESi, Dr. Chialvo worked for eight years at ExxonMobil Research and Engineering where he supported numerous projects related to production of oil and gas, refined products, and chemicals. He also served as group lead for its fluid dynamics group and held technical quality oversight responsibilities for others' work in fluid dynamics and CFD modeling. His experience includes investigating root causes of safety and environmental incidents (as well as preventing them before they happen), identifying chemical process and equipment improvements to enhance throughput and reliability, and research into novel chemical and petrochemical process technologies. His work has spanned a diverse range of petrochemical application areas including catalytic and thermal cracking, polymerization, catalyst manufacturing, drying, multiphase separations, spray systems, heat exchangers, flares, and pipelines.

Areas of Specialization

Fluid Dynamics
Computational Fluid Dynamics (CFD)
Multiphase Flow
Heat and Mass Transfer
Chemical Reactor Engineering
Chemical Process Engineering
Chemical Process Scale-Up
Refining and Petrochemicals
Root Cause Investigation
Safety and Risk Analysis
Fire Science & Modeling
Design Analysis

Education

Ph.D., Chemical Engineering, Princeton University, 2014
B.S., Chemical Engineering, University of Florida, 2008

January 2024

Professional Affiliations/Honors

American Institute for Chemical Engineers (AIChE),
National Member since 2005
Loss Prevention Symposium member since 2023

Society of Petroleum Engineers (SPE)
National Member since 2023

Peer Recognition Award, ExxonMobil Process Technology Department,
for driving increased research collaboration across organizations, November 2020

Peer Recognition Award, ExxonMobil Process Technology Department,
for mentoring and driving technical quality in his workgroup, June 2019

Peer Recognition Award, ExxonMobil Refining & Supply,
for rapid evaluation of safety risk on refinery process, February 2019

Peer Recognition Award, ExxonMobil Fuels Process & Optimization,
for technical leadership on capital project support for oil sands, March 2018

Spot Award, ExxonMobil Process Technology Department,
for novel polymer process design support, June 2017

Peer Recognition Award, ExxonMobil Specialized Engineering Division,
for rapid modeling support of chemical plant environmental issue, September 2016

Peer Recognition Award, ExxonMobil Process Technology Department,
for innovation in oil sands process R&D, June 2016

Positions Held

Engineering Systems Inc. (ESi), Conroe, Texas

Senior Consultant	2022 -

ExxonMobil Research & Engineering, Spring, Texas

Engineering Associate, Fluid Dynamics/CFD Group	2021 - 2022
Group Lead, Fluid Dynamics/CFD Group	2018 - 2021
Senior Engineer, Fluid Dynamics/CFD Group	2015 - 2018
Advanced Engineer, Fluid Dynamics/CFD Group	2013 - 2015

Continuing Education

OSHA 30-Hour Training for General Industry	Jul 2022
Enterprise Leadership Program, UNC Kenan-Flagler Business School	May 2018
ExxonMobil Process Scale-Up Course	Nov 2017
ExxonMobil Process Development Course	Jun 2016
ExxonMobil Mixing Fundamentals Course	May 2016
Fundamentals of Oil Sands Extraction, Prof. Jacob Masliyah, U. of Alberta	Feb 2016
PSRI Fluidization Workshop	Sep 2015
OpenFOAM Training (Beginner and Advanced), OpenFOAM Foundation	May 2015
ANSYS Fluent Training	Nov 2013

Patents

US20230173447A1. S Karimipour, RW Impelman, **S Chialvo**, G Corona. Method of determining superficial gas velocity in fluidized bed reactors. Patent Pending.

CA3100024C. **S Chialvo**, JC Bondos, J Hernandez. Outlet nozzle for a fluid-solid processing unit. 25 Jan 2022.

US10427088B2. RF Tammera, BT Kelley, **S Chialvo**, AK Nagavarapu, W Barnes, TA Fowler. Apparatus and System for Swing Adsorption Processes Related Thereto. 01 Oct 2019.

CA3011234C. **S Chialvo**, BD Albert, O Gervais, KA Abel. Feedwell system for a separation vessel. 06 Aug 2019.

US10322365B2. TA Fowler, S Ramkumar, JW Frederick, AK Nagavarapu, **S Chialvo**, RF Tammera, JW Fulton. Apparatus and system for swing adsorption processes related thereto. 18 Jun 2019.

US10040022B2. TA Fowler, S Ramkumar, JW Frederick, AK Nagavarapu, **S Chialvo**, RF Tammera, JW Fulton. Apparatus and system for swing adsorption processes related thereto. 07 Aug 2018.

Publications

S Chialvo. Constitutive model development for flows of granular materials. Ph.D. Dissertation, Princeton University, September 2014.

Y Gu, **S Chialvo**, S Sundaresan. "Rheology of cohesive granular materials across multiple dense-flow regimes." Physical Review E 90(3), 032206 (2014).

S Chialvo, S Sundaresan. "A modified kinetic theory for frictional granular flows in dense and dilute regimes." Physics of Fluids 25, 070603 (2013).

S Chialvo, J Sun, S Sundaresan. "Bridging the rheology of dense granular flows in three regimes." Physical Review E 85(2), 021305 (2012).

S Chialvo, J Sun, S Sundaresan. "A comprehensive rheological model for granular flows: from quasi-static to rapid regimes." Unpublished proceeding. Symposium on Recent and Emerging Advances in Chemical Engineering. IIT-Madras, Chennai, India. 2 Dec 2010.

Conference Presentations

S Chialvo. "Acceleration of Fluidized Bed Scale-Up and Troubleshooting Via Computational Fluid Dynamics (CFD) Modeling." SPE Gulf Coast Section Modelling and Simulation Symposium. 6 April 2023, Houston, TX.

JA Federici, **S Chialvo**, B Du, SE Feicht, SP Haynie, DJ Sandell. "Scaling down a purge bin: a multiscale model-centric focus on process fundamentals." Southwest Process Technology Conference. Galveston, TX, 9 October 2018.

S Chialvo, S Sundaresan. "A modified kinetic theory for frictional granular flows in dense and dilute regimes." APS Division of Fluid Dynamics Annual Meeting. San Diego, CA, 19 November 2012.

S Chialvo, S Sundaresan. "A modified kinetic-theory model bridging dense and dilute regimes of frictional granular flow." AIChE Annual Meeting. Pittsburgh, PA, 30 October 2012.

S Chialvo, J Sun, S Sundaresan. "Bridging the rheology of granular flows in three regimes." APS Division of Fluid Dynamics Annual Meeting. Baltimore, MD, 21 November 2011.

S Chialvo, J Sun, S Sundaresan. "Rheology of simple shear flows of dense granular assemblies in different regimes." APS Division of Fluid Dynamics Annual Meeting. Long Beach, CA, 23 November 2010.

Selected Project Experience

- **Rail tank car thermal protection assessment**
  As part of a small team funded by the Federal Railroad Administration (FRA), Dr. Chialvo investigated the efficacy of insulation layers on DOT-117 tanker cars at protecting the cars during exposure to a pool fire. He helped design and run experiments in which the insulation materials were exposed to a pool fire and the heat transfer through them was measured. He also performed modeling of heat transfer and boiling thermodynamics to estimate the tank's time to failure from overpressure. On the basis of the experimental and modeling results, the team concluded that the insulation is adequate for protecting the tank cars until firefighters arrive.

- **Dispersion analysis for fire incidents at industrial facilities (various projects)**
  Industrial fires and explosions occur when flammable vapors reach an ignition source in the presence of oxygen. Dr. Chialvo has assisted investigations of several such incidents using CFD modeling to predict the dispersion of flammable vapors under the influence of wind. These analyses allowed the investigation team to screen both possible fuel sources and possible ignition sources to determine the root cause of the incident.

- **Injury investigation after pressure vessel gasket failure**
  Two plant workers claimed various injuries after a vessel lost containment during pressure testing. Upon reviewing post-incident photos and performing calculations to characterize the gas discharge, Dr. Chialvo determined that only one worker was in or near the flow path of the released gas. He then quantified the force with which this worker was impacted, and this information was used by the team to assess the plausibility of each worker's injury claims.

- **Investigation of indoor explosion from flammable vapor accumulation**
  An explosion occurred in an indoor facility that handled various organic solvents. Dr. Chialvo performed various analyses including estimating the combusted fuel quantity, hydraulic calculations to determine the rate at which fuel entered the building from its source, and CFD simulations to assess the HVAC system's adequacy to disperse heavier-than-air vapors. On the basis of these results, the ESi team made recommendations to the client on how to prevent future reoccurrence.

- **Thermal response prediction of a hydrocracking reactor exposed to an external fire**
  A client requested assistance in assessing the risk of compromising the shell of a hydrocracker during a hypothetical fire in the plant. After performing heat transfer calculations and reviewing catalyst reactivity data, Dr. Chialvo identified a failure mode that the client had not previously appreciated, and which turned out to be the most critical of the safety risks being assessed. He then made recommendations on insulation to ensure the reactor could remain safe long enough for emergency response to extinguish the fire.

- **Rapid assessment of wastewater sampling location**
  A client who performed periodic sampling of a large wastewater stream became concerned that their samples might not be representative of the bulk stream in a way that could impact environmental regulatory compliance assessments. Dr. Chialvo performed CFD simulations to assess the flow patterns in the channel and determined that their sampling location was in the middle of a recirculation zone that could accumulate solid waste material and bias the chemical analysis. He recommended a new sampling location that would not suffer from this issue. The entire workflow was completed in less than 24 hours.

- **Thermal fatigue risk assessment in thermal mix points (various projects)**
  Mix points at which streams of two very different temperatures meet can pose a risk of thermal fatigue and subsequent loss of containment. On various occasions, a client has requested the design of a thermal sleeve to protect against this risk. For such problems, Dr. Chialvo performed CFD simulations to predict temperature profiles on the pipe walls over time during operation. This data then fed into a thermal stress assessment, usually via finite element analysis (FEA), to determine whether and where a thermal sleeve was needed.

- **Erosion assessment in oil sands processing equipment (various projects)**
  Flows of particle-laden fluids such as oil sands slurries can erode process equipment including pipes, valves, and vessels and can lead to loss of containment. On several occasions, Dr. Chialvo was engaged to assess how an erosion issue arose and what process or hardware changes could be made to alleviate it. In some cases, CFD modeling was required, while in others a reduced-order model was sufficient to screen these changes.

- **Feedwell design for an oil sands primary separation cell (PSC)**
  A client desired the flexibility to make repairs on the feed line of its PSC without shutting down the unit. They also desired, if possible, to improve separation performance, especially during turndown. Our team developed and patented a two-inlet feedwell design in which either or both inlets could be operated as needed. Each inlet was accompanied by a novel “scoop” baffle that greatly improved flow distribution into the PSC (both during normal and turndown operation), which had the potential to yield higher bitumen recovery.

- **Inlet distributor design for plug flow reactors (various projects)**
  Uniform flow (i.e. plug flow) is a common requirement for good performance in chemical reactors featuring packed beds or channeled monoliths. On several occasions, Dr. Chialvo has assessed flow distribution through these structures via CFD modeling and determined whether it met process performance requirements (e.g. for desired product spec). He also screened for high velocities that could lead to bed erosion. In cases where flow distribution was inadequate and/or bed erosion was possible, he designed distribution internals and tested them via CFD to arrive at a final, acceptable solution for the client.

- **Separation drum performance troubleshooting and improvement (various projects)**
  It is common for separation drums to suffer from underperformance as throughput rates are increased. In vapor-oil-water separators, issues may include liquid carryover or vapor carryunder. Using a fit-for-purpose CFD modeling approach, Dr. Chialvo assessed carryover and carryunder tendencies in various separators, proposed and simulated hardware modifications to mitigate them, and recommended solutions that the client could implement.

- **Mixing system design for liquids and slurries (various projects)**
  Proper mixing of liquids or slurries is often crucial to the performance of processes that rely

on these fluids. On several occasions, Dr. Chialvo has been asked to design or verify the design of a mixing system, including in-line static mixers and mix tanks with impellers. While he resolved most of these problems using mixing 'rules of thumb' or correlations, some required CFD modeling because of nonstandard design features.

- **Catalyst slurry preparation and injection system design**
  A client requested assistance in designing a system to prepare a catalyst slurry and inject it into a reactor continuously during operation. A colleague and Dr. Chialvo developed a spreadsheet tool that modeled various physical phenomena impacting the catalyst system operation, including viscous pressure losses, particle settling, and fluid-fluid mixing. The client's process designers then utilized this tool to narrow down and finalize their design choices.