



SEBASTIAN CHIALVO, Ph.D.

SENIOR CONSULTANT

schialvo@engsys.com

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 help understand fires, loss of containment, atmospheric dispersion, fluid forces on people and structures, erosion and corrosion, noise and vibration, thermal fatigue, equipment fouling, reactor runaway, and fluid mixing.

Prior to joining ESi, Dr. Chialvo worked for eight years at ExxonMobil Research and Engineering where he supported numerous projects for oil and gas production, refining, and chemicals production. 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 spanned a diverse range of 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

August 2022

Professional Affiliations/Honors

American Institute for Chemical Engineers (AIChE),
National Member since 2005

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 my 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

Continued 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

- 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

- 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

- **Injury investigation after pressure vessel gasket failure**
A plant worker claimed various injuries after being hit by a pressure wave when a pressure vessel ruptured. I performed calculations to characterize the gas discharge and quantify the force with which the worker was impacted. This information was used to assess the plausibility of the injury claims.
- **Investigation of indoor explosion from flammable vapor accumulation**
An explosion occurred in an indoor facility that handled various organic solvents. I 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, I 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. I 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. I 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. I 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, I 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, I 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. It 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, I have assessed flow distribution through these structures via CFD modeling and determined whether it met process performance requirements (e.g., for desired product spec). I also screened for high velocities that could lead to bed erosion. In cases where flow distribution was inadequate and/or bed erosion was possible, I 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, I 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, I have been asked to design or verify the design of a mixing system, including in-line static mixers and mix tanks with impellers. While I 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 I 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.