

Applying the Fundamentals

PSRI and Petrochemical Technology



PSRI has over 200 years of experience in design, development, and troubleshooting with over 250 reviewed publications, most of which focus on fluidized beds and circulating fluidized beds in the petrochemical industry. We understand each operation associated with fluidized catalyst cracking and cokers. We have been solving problems in these areas for over 45 years, and many petrochemical companies are already PSRI members. The benefit of such is being on the ground floor in new technology and new design concepts.

PSRI Particulate Solid Research, Inc.

Applying the Fundamentals

Challenges in Process Engineering for FCC and Coker Operations

FCC technology has been around for over 60 years; but, the technology continues to grow. With business drivers such as environmental regulations and rapidly changing economies, the petrochemical industry can no longer afford to have laps in modernization and upgrades. Today's units need to be at peak performance to squeeze out that additional profit margin which will make all the difference.

PSRI has been part of this. Our research and technical knowledge base as provide solutions to our clients that directly impact the bottom line. For example, we have state-of-the-art design procedures for gas distributors, standpipes, bed internals and cyclones. We have analyzed and evaluated several close-coupled cyclone designs. PSRI studied different riser exit configurations with respect to erosion, pressure drop, and particle attrition. PSRI developed an efficient third-stage separator (TSS) for a member company that led to the successful implementation of the TSS into several commercial plants.



Furthermore, PSRI conducted extensive testing on gas bypassing to determine why it occurs, what parameters influence it and how it can be mitigated. We demonstrated how gas bypassing in a fluidized bed could result in the reduced performance of the primary cyclone dipleg leading to flooding.

PSRI is the leader in studying and optimizing standpipe operation/standpipe entrance configurations and aeration amount and location. We have also developed correlations to determine the optimum amount of aeration to add to a standpipe. In addition, PSRI developed a bypass line (called a burp tube) for hybrid-angled standpipes to allow gas collecting at an elbow to be bypassed from the elbow into the freeboard of the fluidized bed above it.

PSRI has done extensive studies on improving the hydrodynamics of fluid coker operation. We performed cold-flow modeling of the Cold Coke Transfer Line (CCTL) and Scouring Coke Transfer Line (SCTL) to improve the understanding the operation of the standpipes in these lines. PSRI investigated an improved standpipe inlet configuration (call a sore thumb) for the CCTL. PSRI designed a horizontal cold coke transfer line to eliminate saltation and its associated vibration in the line. We also investigated solids maldistribution in parallel cyclones to help understand uneven coking of coker parallel cyclones. PSRI, examined the loading and variability of solids loading to the cyclones. Demonstrated the mechanism of cyclone fouling and improved the designs. Similarly, PSRI demonstrated the mechanics for stripper fouling as related to agglomerate formations in the fluidized bed due to nozzle hydrodynamics¹.

¹ J. McMillan, F. Shaffer, B. Gopalan, J.W. Chew, C. Hrenya, R. Hays, et al., Particle Cluster Dynamics During Fluidization, *Chemical Engineering Science*. 100 (2013) 39–51. C.B. Solnordal, K.J. Reid, L.P. Hackman, R. Cocco, J. Findlay, Modeling Coke Distribution above the Freeboard of a FLUID COKING Reactor, *Ind. Eng. Chem. Res.* 51 (2012) 15337–15350.

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PSRI Process Development Experts



Dr. S.B. Reddy Karri, Consulting Director: Reddy has 28 years experience in particle technology and fluidization. He has worked on FCC technology, cokers, polyolefins, methanol to olefins, maleic anhydride, acrylonitrile, TiO₂, polycrystalline silica, gasification, pyrolysis, sulfur capture, CO₂ capture, biomass and radioactive materials.



Dr. Ted Knowlton, Fellow: Ted has 46 years experience in particle technology. He has worked on FCC technology, cokers, polyolefin, MTO, maleic anhydride, acrylonitrile, TiO₂, polycrystalline silica, gasification, pyrolysis, sulfur capture, CO₂ capture, and mining. He has developed well-known processes such as HYGAS, U-GAS, PEATGAS, RENUGAS, HYTORT, PFH and is the developer of the L-valve.



Mr. John Findlay, Technical Consultant: John has 34 years of experience in particle technology and fluidization. He has worked on FCC technology, cokers, polyolefin, TiO₂, coal gasification, pyrolysis, sulfur capture, CO₂ capture, and biomass.



Dr. Ray Cocco, President and CEO: Ray has 27 years experience in reactor engineering, modeling, fluidization, and particle technology. He has worked on ceramic processing, oxydehydrogenation, pharmaceutical hydrogenation, catalytic oxidation, hydrogenation, hydrodesulfurization, composite materials, biomass, chemical looping, polyolefin, chlorination and oxychlorination.



Mr. C.J. Farley, Technical Consultant: CJ has 28 years of FCC experience. He has worked for operating companies, FCC design groups, FCC catalyst providers, and has been an independent consultant. He has extensive troubleshooting experience and skill. He has assisted more than 200 FCC units in troubleshooting, optimization, and design issues.



Dr. Ben Freireich, Technical Director: Ben has 8 years of experience in particle technology and has recently been listed as one of AIChE's 35 under 35. He has worked on a wide range of reactor engineering and solids processing problems including catalyst deactivation and attrition, bin design, fluidized beds, pneumatic conveying, mixing and blending, segregating systems, size reduction, etc.



Dr. Greg Mehos, Technical Consultant: Greg has 20 years of experience in hopper and feeder design, design of gravity reclaim systems, spray dryers, and analysis of purge columns.. He has worked with pharmaceutical formulations, wet granulation, fumed metal oxides, biomass gasification, pigments, and emulsification.



Dr. Ulrich Muschelknautz, Technical Consultant: Ulrich has 27 years experience in particle technology with emphasis on cyclone design and optimization as applied to the energy and chemical sectors. Of late, he has been involved in the R&D efforts for the next generation of axial separators.

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