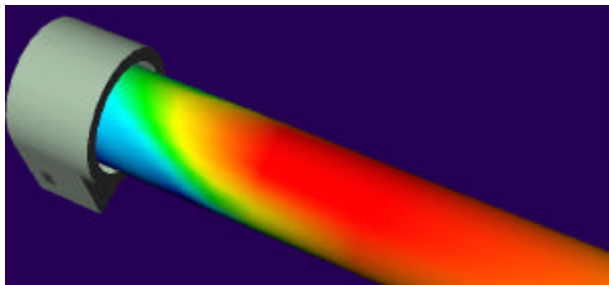




LIME KILNS

PSL offers a comprehensive combustion audit, analysis, optimization, and problem resolution for your kiln. Using advanced numerical tools, we diligently obtain comprehensive details of your process in a cost effective manner to:

- Reduce fuel costs
- Solve operational problems
- Increase production
- Reduce emissions
- Increase refractory life
- Optimize kiln operations
- Reduce residual carbonate
- Produce a controlled flame shape
- Significantly reduce decision making risks for retrofits



HEAT TRANSFER TO REFRACTORY

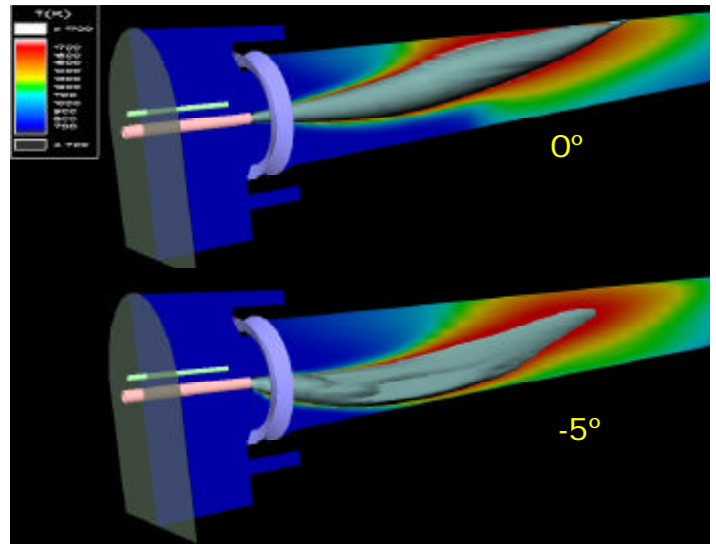
KILN ISSUES

Kilns are key equipment in the cement, mining, and pulp and paper industries. They consume a significant amount of fuel and have common operational problems including improper flame shape, flame impingement, premature brick failure, excessive emissions, low product output, poor hood aerodynamics, poor air/fuel mixing for combustion, and low fuel efficiency.

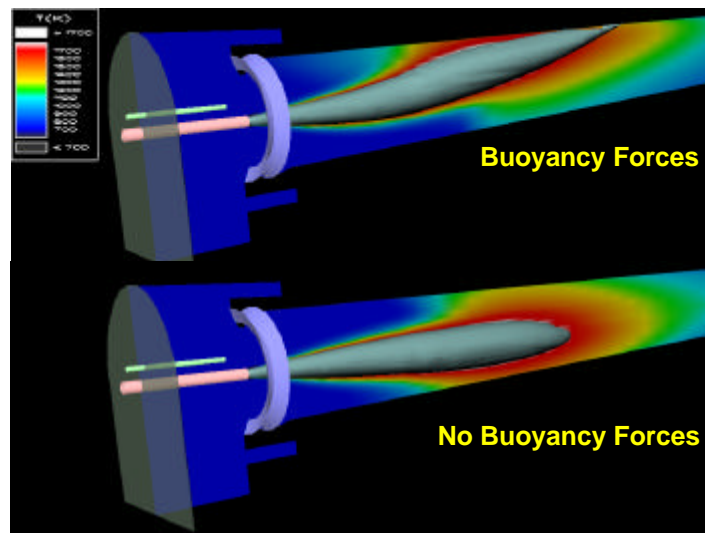
These problems are closely related to the flow and heat transfer to the mud and to the combustion processes in the kiln. PSL works closely with clients to determine the root cause of problems by performing comprehensive analysis to determine the most cost-effective solution. Clients are assured of an unbiased and independent source of information for decision making.

THE PSL ADVANTAGE

Detailed information from the analysis is used by process engineers to evaluate “what if” scenarios, by operators to avoid improper operational settings, by mill managers to make informed decisions regarding kiln retrofits, and by the mill to address environmental issues. PSL provides comprehensive information throughout your kiln at relatively low cost.



EFFECT OF BURNER ANGLE ON FLAME

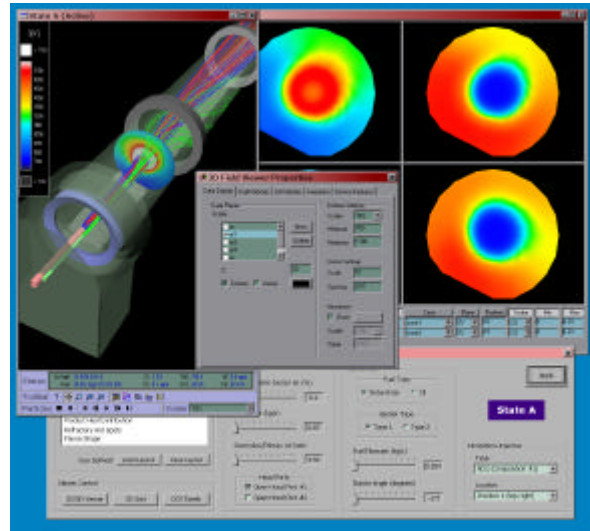


BUOYANCY EFFECTS ON FLAME

PSL uses a validated and coupled combustion, convection, diffusion, and radiation models that provide significantly more realistic solutions than non-thermal physical or simplified mathematical models.

Results can be applied with confidence to:

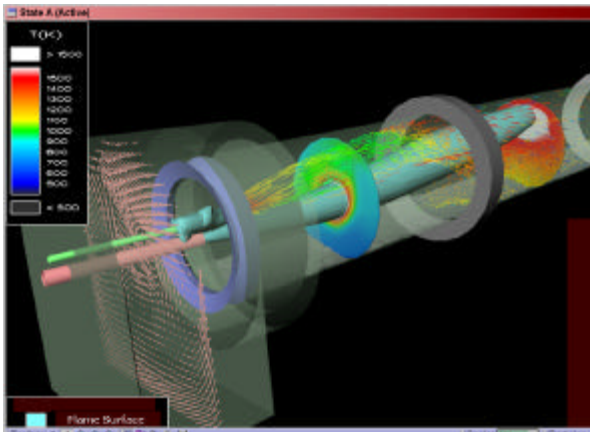
- Reduce fuel consumption
- Adjust primary/secondary air and fuel ratios and burner settings to maximize kiln efficiency
- Identify and eliminate thermal hot spots that lead to reduced brick liner lifetime
- Develop strategies for reducing ring formation
- Identify and fix problems with kiln performance due to hood shape and secondary air ports location and size
- Evaluate NCG injection alternatives - optimize injection
- Evaluate alternative fuels
- Minimize emissions
- Optimize heat transfer to mud
- Improve combustion stability through retrofit and adjustment of the burner and burner structure



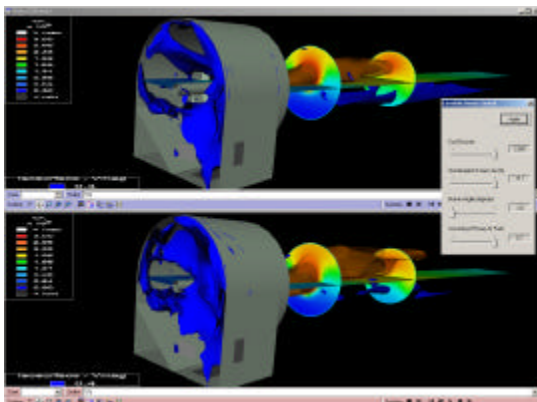
DATA CAMERA AND KILN TRAINER

HOW WE DO IT

PSL performs a site visit and collects detailed information about the kiln design, operational issues and problems, and current and past operational settings. A comprehensive, customized flow and combustion model is then developed for your kiln. We provide gas flow velocity fields, temperature distributions and heat transfer to wall surfaces and mud, gas species (e.g. H_2 , O_2 , N_2 , CO , CO_2 , H_2O , CH_4) distributions, and pollutant emissions (i.e., NO_x and TRS). Our model includes gas, liquid, or solid fuel (tires, coke, coal, etc.) combustion and droplet trajectory. PSL thoroughly investigates the source of particulate emissions, burner setting effects, flame shape (with thermal buoyancy effects), aerodynamic and thermal effects of alternative fuels, chemical species distribution, heat release profile to product, detailed gas flow mixing and aerodynamics, hood shape, Primary/Secondary/Fuel ratio influence, and NCG/DNCG burning. Results from the analysis can be coupled to PSL's user-friendly simulator technology to provide excellent training for operators. Users can compare and contrast different operating conditions in a real-time 3D interactive environment. The software is used to rapidly analyze and rectify process problems, or to create virtual equipment for operator training.



BURNING ALTERNATIVE FUELS (EXAMPLE NCG)



INFLUENCE OF EXCESS AIR ON KILN OPERATIONS

PROCESS SIMULATIONS LIMITED

Consulting engineers specializing in the modeling and analysis of industrial process equipment including:

- Recovery Boilers
- Biomass/Utility Boilers
- Headboxes
- Digesters
- Lime Kilns
- Wood Kilns
- Hydrocyclones
- Air Ports, Nozzles, Ducts

