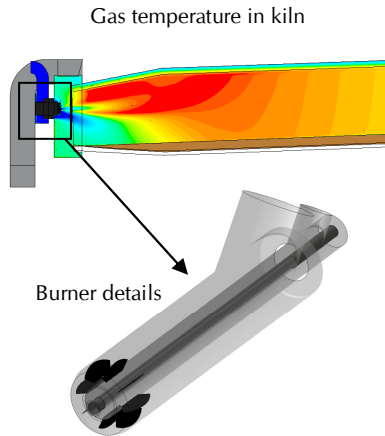
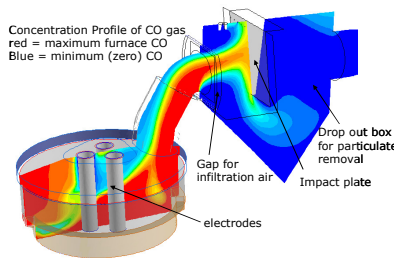




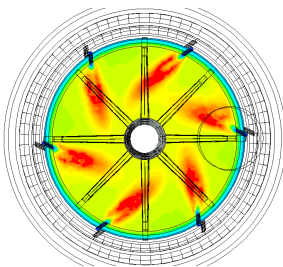
SPECIALIZED ENGINEERING
ANALYSIS & DESIGN GROUP



Combustion and flame prediction
in a natural gas fired rotary kiln for
roasting of iron ore concentrate.



Analysis and design optimization of
the CO combustion in an electric
arc furnace freeboard, 4th hole, and
drop-box box.



Flame profile in a counter current gas-
solids Hereshoff Roaster for ore
reduction

COMBUSTION SYSTEM DESIGN AND OPTIMIZATION USING SPECIALIZED ENGINEERING ANALYSIS

Combustion of fossil fuels continues to be the leading source of energy in many metallurgical, chemical, and power generation processes. To produce robust, reliable, and safe designs, there is a continuous need to improve the fundamental understanding of combustion phenomena and apply advanced design methodologies to solve the inherently complex engineering problems associated with these systems. Commonly observed problems include:

- inadequate mixing of fuels and oxidants leading to poor combustion efficiency
- non-ideal flame radiative heat transfer to processes or cooling systems.
- flame impingement and overheating of materials (refractory, ducts, etc.)
- flame instability, oscillation, and blow-off
- dynamic gas pulsations and flow induced vibrations on equipment/structures.
- gas pressurizations due to confinement leading to deflagrations, detonations, and explosions.
- coking of fuels on hot surfaces

These can often lead to inadequate process performance, operational problems, and safety hazards.

CAPABILITIES AND SERVICES

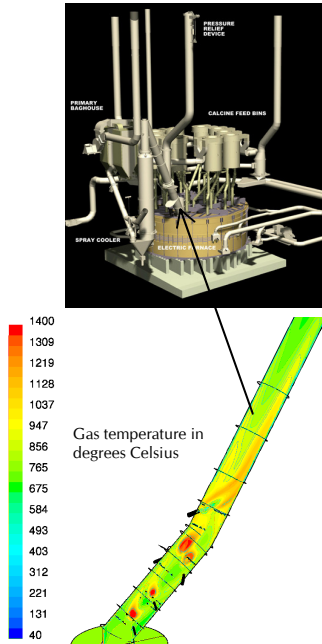
The Specialized Engineering Analysis & Design (SEAD) Group at Hatch has years of experience solving real world combustion problems where standard design practices, “rules of thumb”, and empirical methods are not sufficient. This multi-disciplinary engineering team have advanced level training and in-depth expertise in the areas of fluid mechanics, gas dynamics, heat transfer, chemical reaction engineering, thermodynamics, and solid mechanics. Advanced analysis tools such as Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) are often used in together with conventional design approaches to produce the optimum solution to a particular combustion problem.

Some of the typical applications the SEAD Group has been involved in include:

- Feasibility & conceptual studies, basic, and detailed engineering design of combustion systems
- Re-design of burner internals for improved mixing and combustion characteristics of specialty fuel-air mixtures
- Technical evaluation and re-design of combustion equipment in rotary kilns, roasters, boilers, dryers, reduction furnaces, and fluidized beds to improve metallurgical and chemical process performance
- Simulation and analysis of metallurgical furnace freeboard combustion systems for design optimization of burners, lances, and fuel-air ratios to achieve process performance criteria
- Analysis and design optimization of combustion chambers for destruction of combustible off-gas mixtures.
- Simulation of combustion process performance to assist in the design of cooling systems and selection of materials of construction.



SPECIALIZED ENGINEERING ANALYSIS & DESIGN GROUP



CFD prediction of gas temperature in a water cooled off-gas duct of a FeNi smelter using staged combustion.

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- Calculation of gas overpressures due to rapid combustion in confined spaces
- Design of explosion relief devices (rupture disks, explosion vents, etc.) in accordance with NFPA codes
- In field testing and data analysis of online monitoring systems for diagnosis and solution of combustion problems.
- Simulation prediction of unstable gaseous combustion and dynamic gas forces acting on support structures and equipment
- Structural design of refractory lined ducts, stiffeners, expansion joints, stacks under thermal and gas induced loads resulting from combustion processes.

SELECT PROJECT AND EXPERIENCE LIST

SOCIETE NICKEL de NOUVELLE CALEDONIE et COREE, SOUTH KOREA

Design evaluation of a FeNi smelter freeboard combustion system for improved air infiltration, combustion and heat transfer performance.

ARCELORMITTAL, KAZAKHSTAN

Re-design of a natural gas fired combustion system in a rotary kiln used for moisture removal and roasting of iron ore concentrate. The combustion system design was modified to meet the required residence time of the concentrate at the roasting temperature.

ESSAR STEEL ALGOMA, CANADA

Dynamic gas flow and combustion modeling was performed to troubleshoot and provide a solution to a BOF hood vibration problem. The recommended solution was implemented resulting in considerable reduction in hood vibration.

CONFIDENTIAL CLIENT, CANADA

Online monitoring data from burner management system and off-gas sampling ports used to diagnose a problem of irregular combustion in a carbon monoxide fired burner. Recommended solutions involved changes to burner operating practices, installation of explosion relief devices, and equipment replacement.

ANGLO AMERICAN CHILE, CHILE

Re-design of a concentrate burner used in a Flash Smelting Furnace to alleviate problems of flame impingement on reaction shaft walls, and incomplete combustion leading to material build-up and high cleaning frequency.

GORO NICKEL S.A., NEW CALEDONIA

Development of a premixed fuel delivery system for a nickel oxide pyrohydrolysis fluidized bed reactor. Combustion modeling and experimental work was performed to evaluate combustion characteristics of premixed kerosene air mixtures at moderately high temperatures and pressures.

CERRO MATOSO S.A., COLOMBIA

Basic engineering design of a dryer burner installation. Optimization of burner location, orientation, and discharge gas velocity to optimize mixing with dryer off-gas.

BARRICK GOLDSTRIKE MINES, ROASTER PROJECT, USA

Project engineering of multi-stage, fluid-bed roasters. These are the largest gold-ore roasters in the world, which use almost pure oxygen to remove contained organic carbon and sulfide sulfur before a conventional carbon-in-leach process for gold extraction.