

INTERNSHIP CASE STUDY

Enhancing combustion efficiency in alumina production

HILTCRC partner: Emirates Global Aluminium (EGA)

Internship supervisor: Emilio Pai, EGA

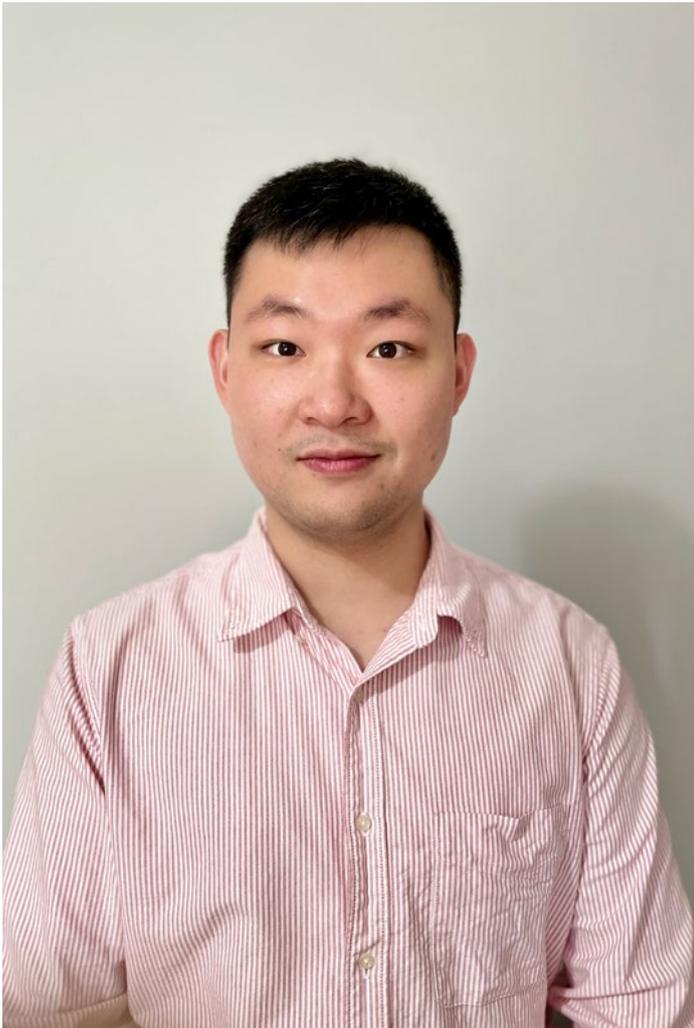
PhD student: Daniel Ang

PhD supervisor: Dr Woei Saw, University of Adelaide

PhD project: Assessment of hydrogen-driven alumina calcination process

Industries: Alumina and aluminium 

Internship period: May to September 2024



OVERVIEW

Daniel Ang undertook a research internship with Emirates Global Aluminium (EGA) from May to September 2024. Supervised by Emilio Pai, Senior Manager – Process Engineering at EGA, the internship focused on improving combustion efficiency and reducing volatile organic compound (VOC) emissions in EGA's alumina calcination process.

The calciner, a critical part of the alumina production process, burns natural gas for high-temperature processing of aluminium hydroxide derived from bauxite. Daniel's work employed computational fluid dynamics (CFD) modelling to assess combustion performance and explore improvements, including the potential for using hydrogen as a cleaner fuel.

CHALLENGES

The internship arose from EGA's need to improve combustion efficiency.

"Our calciner uses fluidised bed recirculation, and we noticed some incomplete combustion, meaning that some natural gas was bypassing the furnace," Emilio says. "The challenge was to improve the mixing of natural gas with air in the furnace to enhance efficiency without compromising alumina quality."

The project also explored the potential for hydrogen fuel in alumina calcination.

"Daniel's PhD focuses on understanding hydrogen combustion through CFD modelling," Emilio says. "This internship provided an excellent opportunity for him to develop his knowledge by studying the current process using natural gas."

"HILTCRC GIVES EARLY-CAREER RESEARCHERS LIKE ME A PLATFORM TO CONNECT WITH INDUSTRY. IF I WAS AN INDEPENDENT PHD STUDENT, IT WOULD BE ALMOST IMPOSSIBLE TO SECURE AN INTERNSHIP LIKE THIS."

- Daniel Ang, University of Adelaide

INTERNSHIP APPROACH

After an initial two weeks on site in the United Arab Emirates, Daniel worked from Australia, meeting weekly with EGA's team to refine his approach and update them on his findings.

His CFD modelling simulated modifications to the calciner's geometry and operating conditions, including repositioning gas lances (used to inject gas into the combustion chamber) and heating air supplied to enhance combustion.

Key elements of Daniel's work included:

- Detailed analysis of gas mixing and combustion in the calciner
- Simulation of various modifications to improve efficiency
- Comparison of methane and hydrogen combustion for future decarbonisation options.

"We tested two methods to change operating conditions – modifying the calciner's geometry and implementing an electric air heater," Daniel explains. "The goal was not just to cut emissions, but also to ensure the quality of the alumina wasn't compromised."

The internship allowed Daniel to apply theoretical knowledge in a real-world industrial setting.

"It was rewarding to see how fundamental techniques could be applied to solve practical problems," he says. "It was also a great way to learn about the potentially major variations between small-scale experiments and large-scale industrial settings."

OUTCOMES AND IMPACT

Daniel's findings have supported EGA's approach to addressing the calciner issues.

"The modifications Daniel suggested are relatively simple and much less costly than other solutions proposed," Emilio says. "Even if an approach doesn't work perfectly, the trial-and-error process using CFD modelling is invaluable because the costs of testing these modifications are low."

The study's insights will also support future decarbonisation efforts at EGA, particularly as the company considers transitioning to hydrogen fuel.

"Collaborating with students like Daniel can help us explore innovative solutions and accelerate our progress towards decarbonisation," Emilio says.

For Daniel, the internship affirmed his passion for industrial research and development.

"It opened my eyes to the importance of industry collaboration in solving real-world problems," he says.

Daniel's work demonstrates the power of collaboration between industry and research, advancing the goal of decarbonisation while providing real-world experience for emerging researchers.

As Emilio notes, "Internships like these are crucial for exploring new technologies and driving progress in sustainability."



Left to right: Emilio Pai, Dr Woei Saw, Daniel Ang and Siyun Ning, another HILT CRC PhD student, at EGA headquarters in Dubai.