Lowering NOX Emissions By Optimizing The Mixing Quality Across A Perforated Plate

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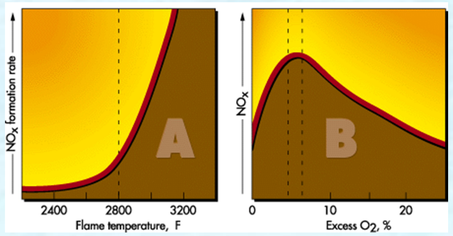
Introduction

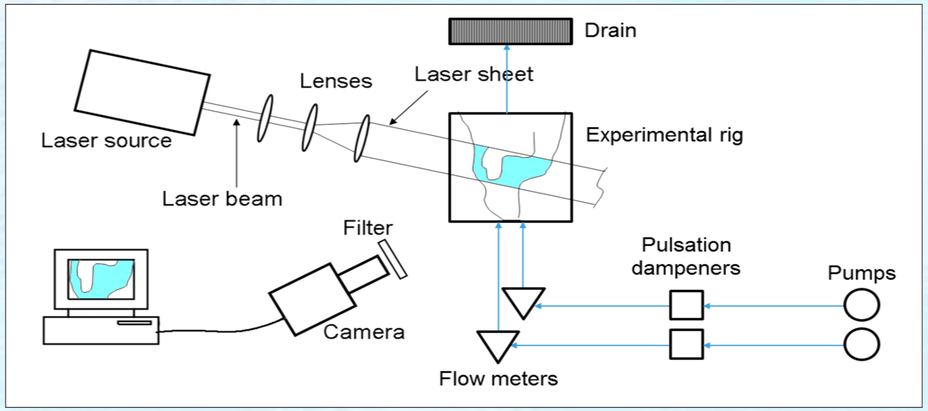
- Nitrogen oxides (NOX) pose significant environmental and human health hazards.
- At high concentrations, nitric oxide (NO) and nitrogen dioxide (NO_2) cause inflammation of the respiratory system and ground level ozone formation which damages vegetation.
- NOX emissions mainly result from the incomplete combustion of fuel and air in engines at high temperatures.

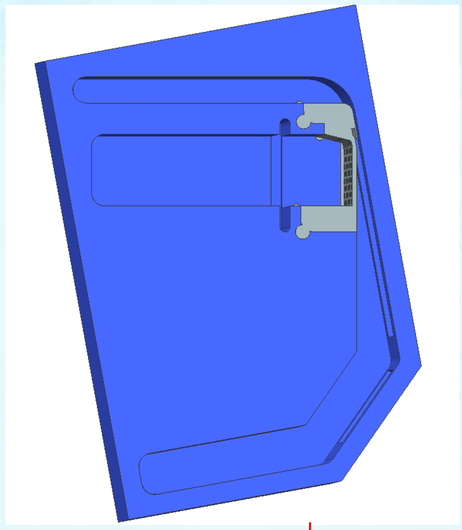


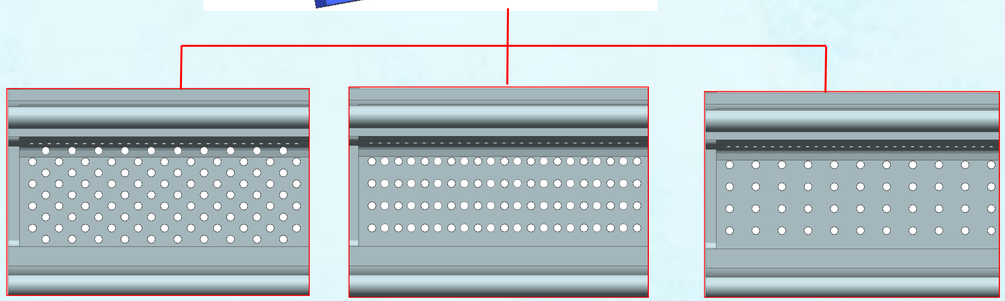
Project Aim

- This project is developed in collaboration with Siemens Canada. The company aims to reduce NOX emissions from an aero-derivative gas turbine used for electricity generation.
- The goal is to optimize the mixing configuration between air and gas by testing several perforated plates through which air flows before mixing with gas. Plate solidity, hole patterns and tapering are to be examined.
- A prototype is built to serve this purpose. Gas and air are simulated using dyed and transparent water respectively and Planar Laser Induced Fluorescence (PLIF) is used to asses the wellness of the mixing.

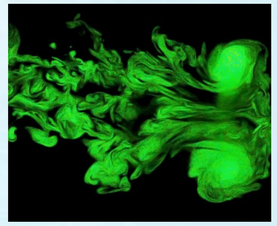
Methodology and Design







Expected Outcomes



While prototype testing has not yet been conducted, previous literature showed promising results.

1) Higher plate solidity causes higher flow turbulence and thus better mixing.

2) Tapered (converging) holes cause better fluid mixing due to shorter jet development lengths and less recirculation zones.

3) Adding small bumps to the plate trips the flow and makes it more turbulent.

Future Perspectives

- Turbulence homogeneity and intensity are important factors that should be considered in the assessment of fluid mixing. Being dependant on the flow's velocity, Particle Image Velocimetry (PIV) is to be considered.
- The optimal mixing chamber length as well as the converging hole's angle could also be areas of further research.

Acknowledgments

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