

How to optimize an engine cooling system by 38%

A system consisting of nozzles and a manifold optimizes the cooling of a yacht engine exhaust tank



SCENARIO FOR THE SECTOR

Cooling yachts engines

All engines produce heat, especially naval ones. The exhaust line must be cooled in marine applications to contain the heat transmitted to the hull and other vessel parts. This purpose is achieved by exploiting seawater, used as a thermal vector.

THE PROBLEM OF OUR CLIENT

Our customer is a manufacturer of exhaust lines and cooling systems for yacht engines. He needed to redesign the cooling system of the exhaust line of a machine.

The customer had a non-performing cooling system in which the cooling water could not mix effectively with the exhaust gases, remaining adherent to the external walls. The result was hot exhaust gases and an extremely high temperature on the walls of the exhaust line, damaging the paint and resin of the yacht's hull.

The technical department of PNR Italia has decided to address the problem by relying on the calculation of CFD (computational fluid dynamics). We analyzed the cooling system in place to understand the critical issues and design a new one.

CFD simulation

Non-performing cooling system

In this phase, we did a CFD simulation of the existing cooling system to understand its strengths and weaknesses.

These were the performance of the cooling system in place:

	VALUE
GAS INLET - EXHAUST GAS FLOW	4,75 mc/s at 500°C
WATER INLET - SEA WATER FLOW	116 mc/h at 50°C

CFD simulation - results

Non-performing cooling system

The water flow takes on a unique feature due to the tangential injection in the cylindrical mixer: it enters the mixer, expands along the walls for the imprinted vorticity, and retains this vorticity along the discharge line up to the case changing axis and always adhering to the walls.

Since the water remains 'centrifuged' on the outer walls, there is a 'core of hot gases that follow the current lines. (image 1)

INDUSTRY

Shipbuilding industry



APPLICATION

Cooling and washing of fumes and gases



PROBLEM

Excessive heating of a vessel's engine exhaust system



SOLUTION

Manifold with spray nozzles



The result of all these factors is a temperature over 130°C on the walls of the exhaust tank.

PNR ITALIA SOLUTION

PNR Italia's technical department developed a system for cooling the engine's exhaust system. A manifold with three full cone nozzles AL is placed over the exhaust line. The nozzles inject additional water into the design from the primary circuit.

ADVANTAGES FOR OUR CLIENT

The system developed by PNR Italia effectively reduces the temperature of the outgoing gases and of the walls of the exhaust system.

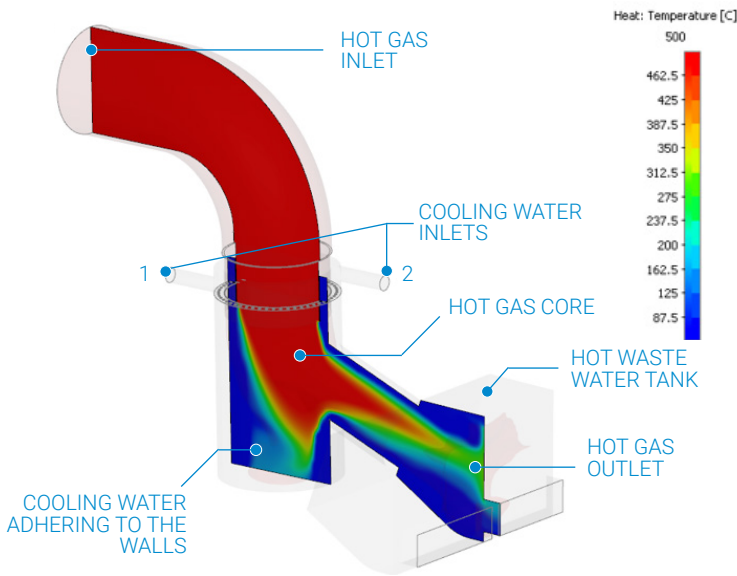
Before our intervention, the outgoing gases and the case were respectively at a temperature of 155 °C and 105 °C. With our cooling system, the temperatures settled at 95 °C and 65 °C. (images 2 and 3). The cooling system improved by 38%.

FOCUS ON THE PRODUCT



AL
FULL CONE NOZZLES

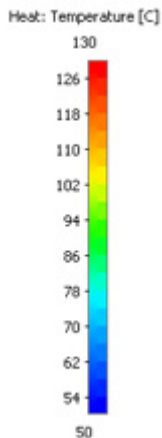
The AL solid cone nozzles offer several advantages thanks to their unique construction, with an S-shaped vane integrated into the nozzle body. They offer the largest free pass available in a full cone nozzle and can easily handle impurities or recirculation liquids.



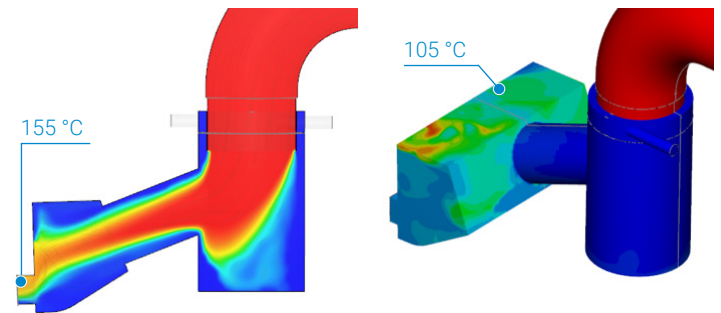
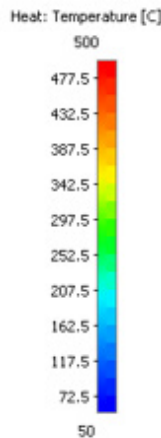
GAS COOLING SYSTEM BEFORE OUR INTERVENTION

A portion of the exhaust line of the yacht's engine. Since the cooling water stays on the walls, the gas flow remains hot in the center
IMAGE 1

TEMPERATURE
LEGEND 1



TEMPERATURE
LEGEND 2

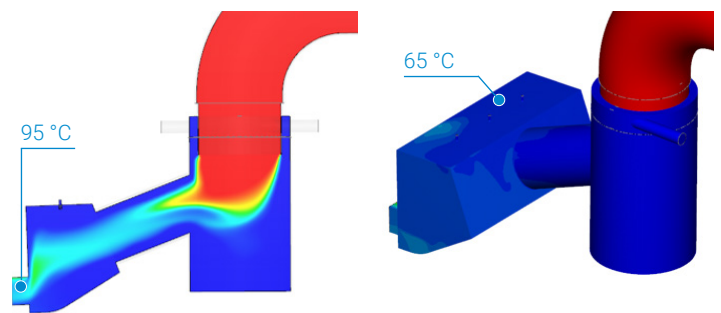


TEMPERATURE LEGEND 1

TEMPERATURE LEGEND 2

CFD ANALYSIS OF THE GAS COOLING SYSTEM BEFORE OUR INTERVENTION

IMAGE 2



TEMPERATURE LEGEND 1

TEMPERATURE LEGEND 2

CFD ANALYSIS OF THE GAS COOLING SYSTEM DEVELOPED BY PNR ITALIA

MANIFOLD AND SPRAY NOZZLES
IMAGE 3

PNR Italia

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