DIMENTIONING AND EVALUATION OF ATMOSPHERIC EMISSIONS CONTROL SYSTEM

Israel Pestana Soares
Daniella Correa Gonçalves de Rezende
Karinnie Nascimento de Almeida

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Aires
Environmental Services

OBJECTIVES

Main Objective:

Evaluate fog canyons efficiency in particulate matter mitigation

Specifics objectives:

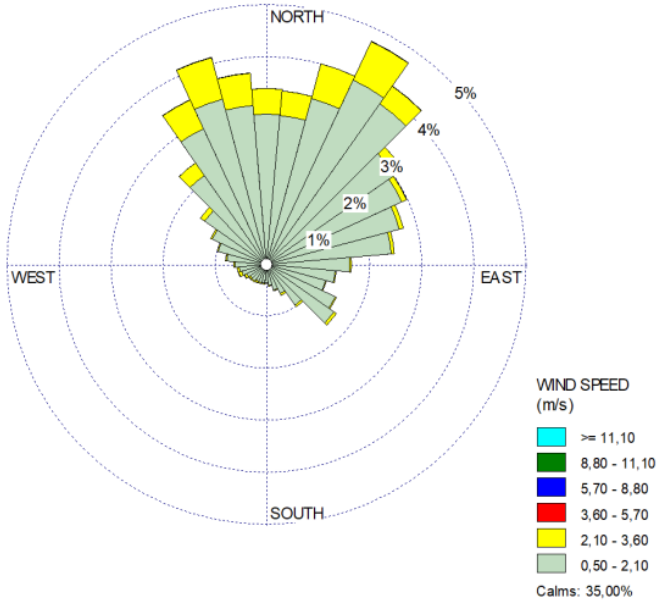
Determinate the best configuration of the control system regarding number and criteria of positioning in order to optimize particulate matter mitigation in critical areas of a steel mill plant using CFD modeling (Computational Fluid Dynamics).

Understand the advantages and disadvantages of OTM 32 method.

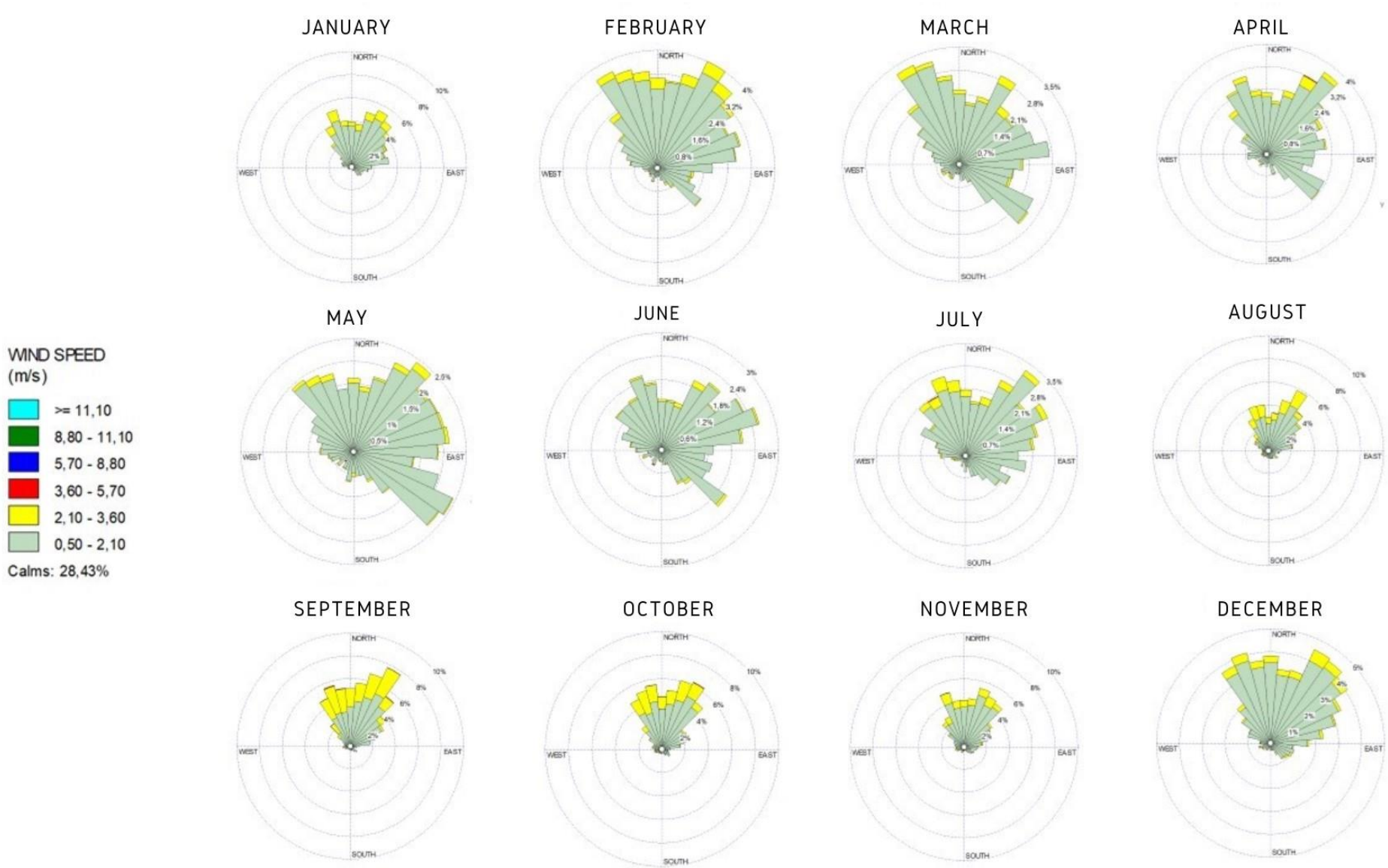
MATERIALS AND METHODS

Meteorology

The analysis of atmospheric emissions requires a reasonable knowledge of micro-scale meteorological conditions that occurs on the influence area of the emission sources. Wind rose measure on site during the monitoring campaign.

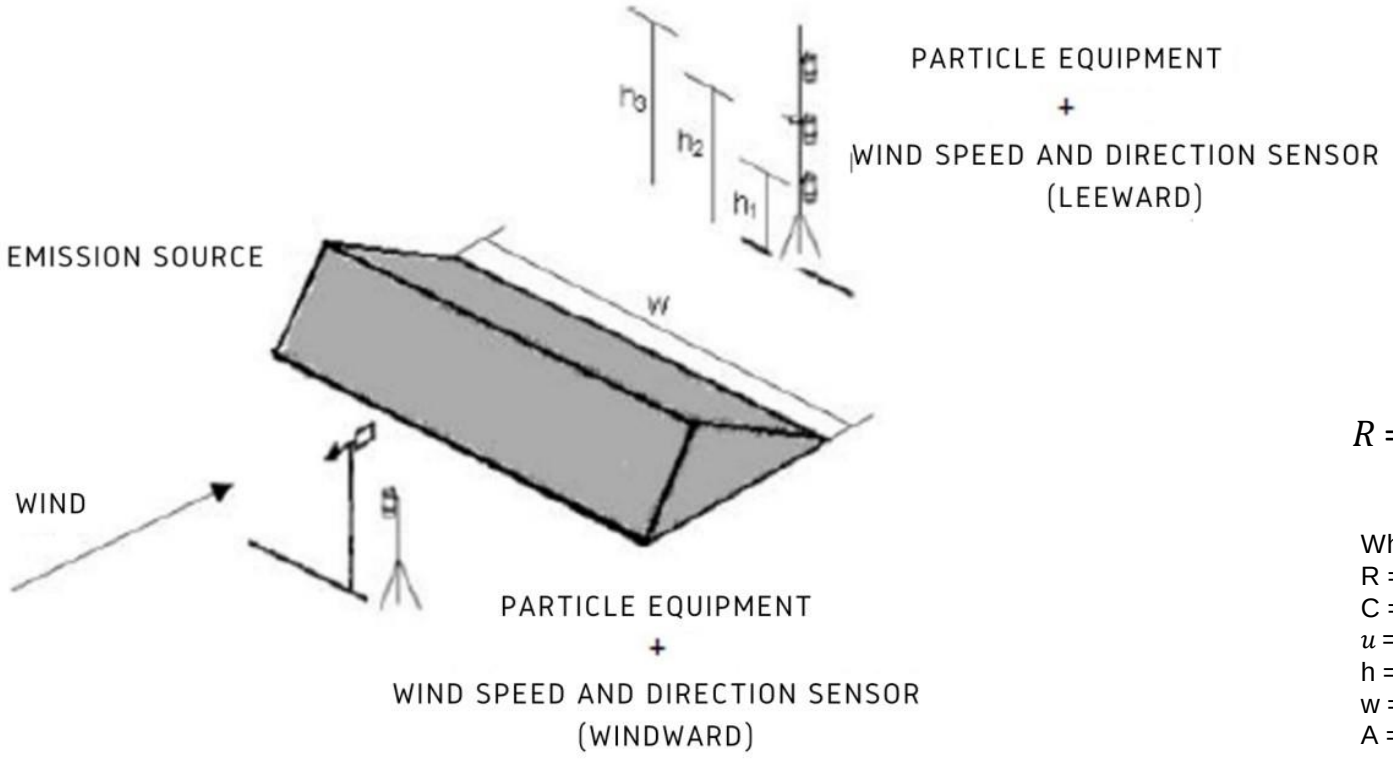


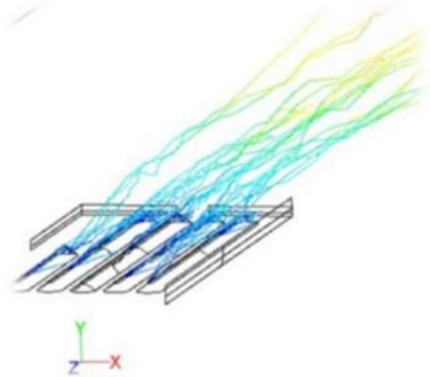
MATERIALS AND METHODS



MATERIALS AND METHODS

Exposure Profiling Method – OTM 32



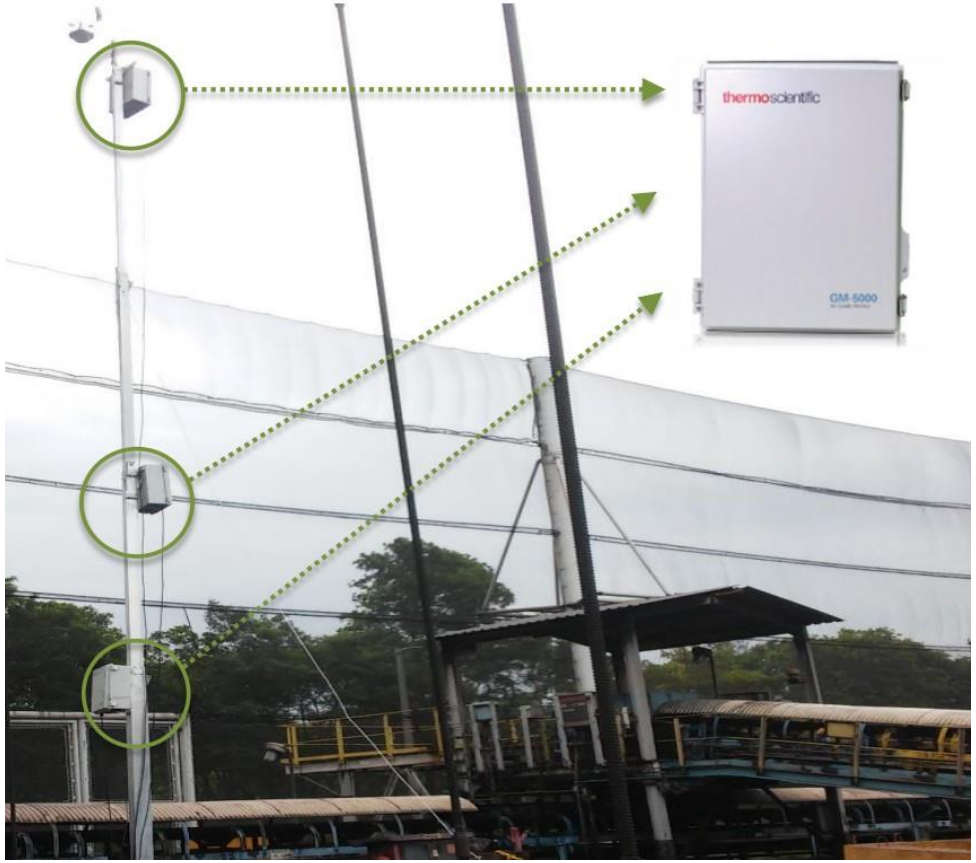


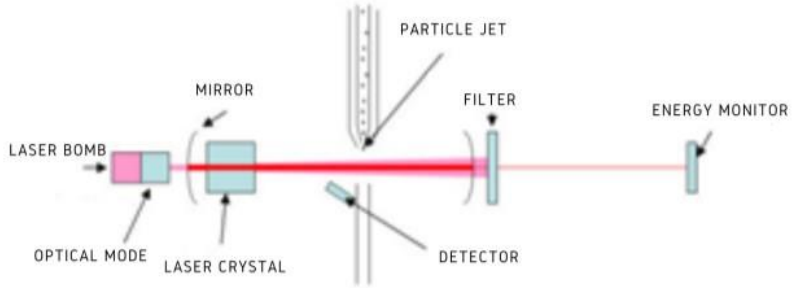
$$R = \int_A C(h, w)\, u(h. w)\, dh\, dw$$

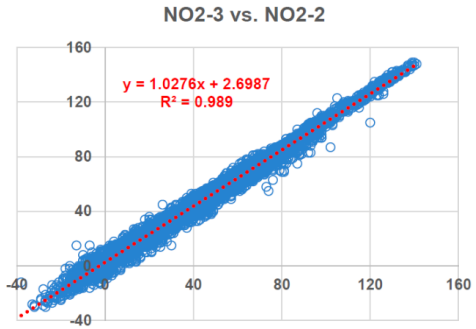
Where:
R = emission rate, µg/s
C = net particle concentration, µg/m^3
u = wind speed, m/s
h = vertical distance coordinate, m
w = lateral distance coordinate, m
A = effective cross-sectional area of the plume, m^2

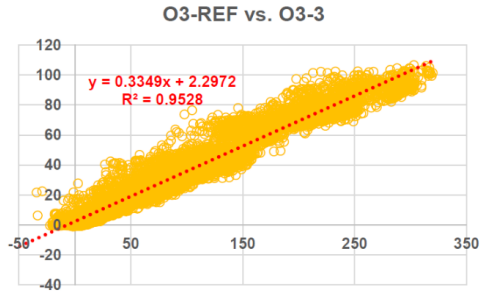
MATERIALS AND METHODS

Sampling Methodology





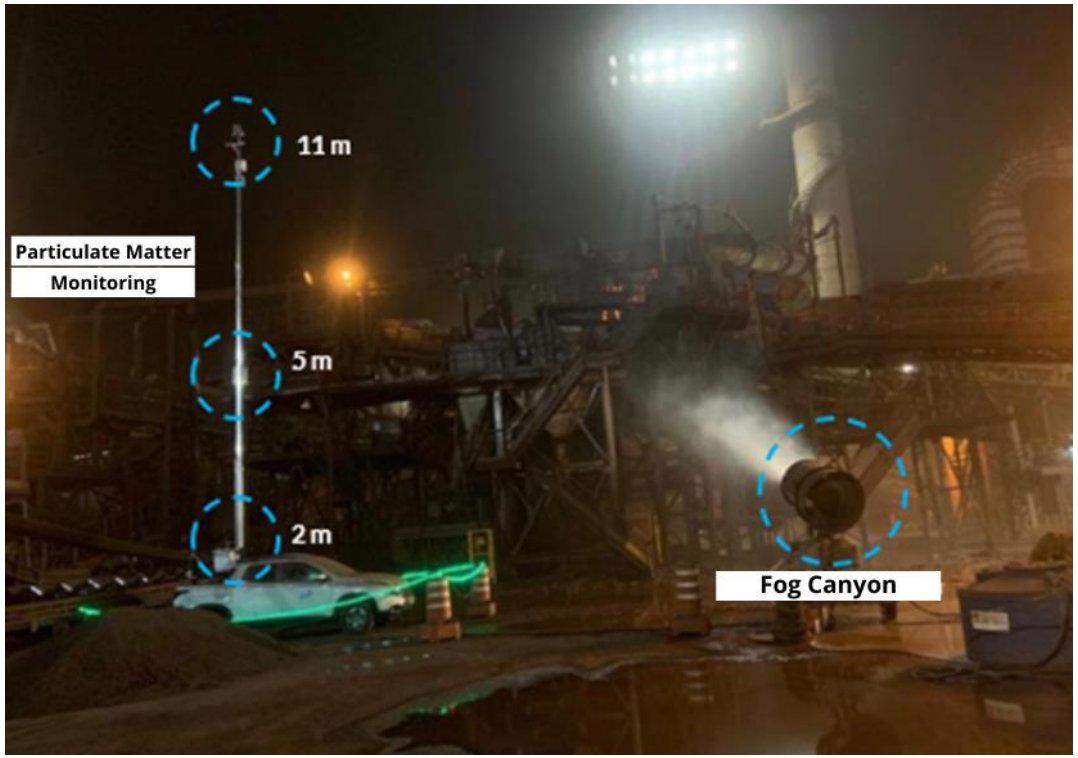




GM-5000 Field Test Data

MATERIALS AND METHODS

Sampling Methodology

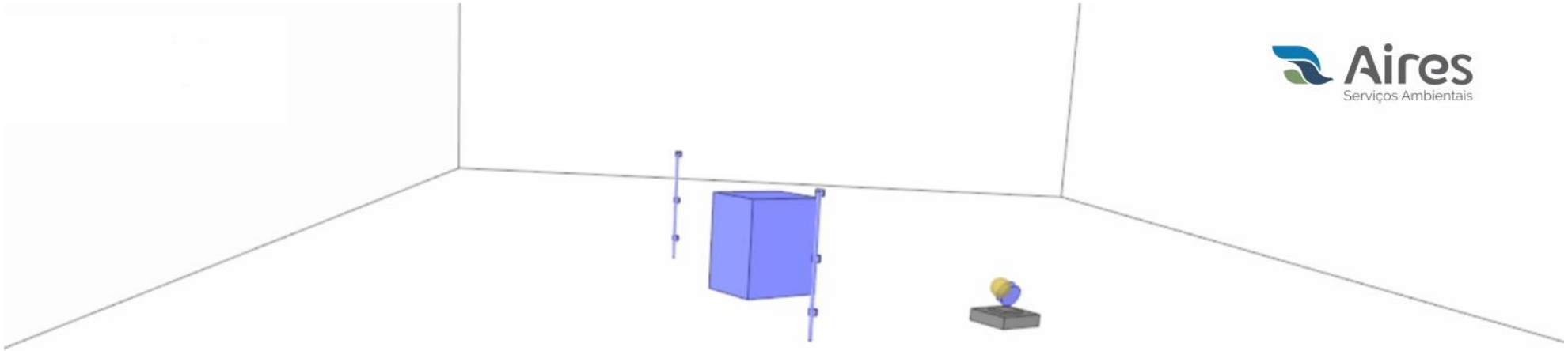


MATERIALS AND METHODS

Fog Cannon

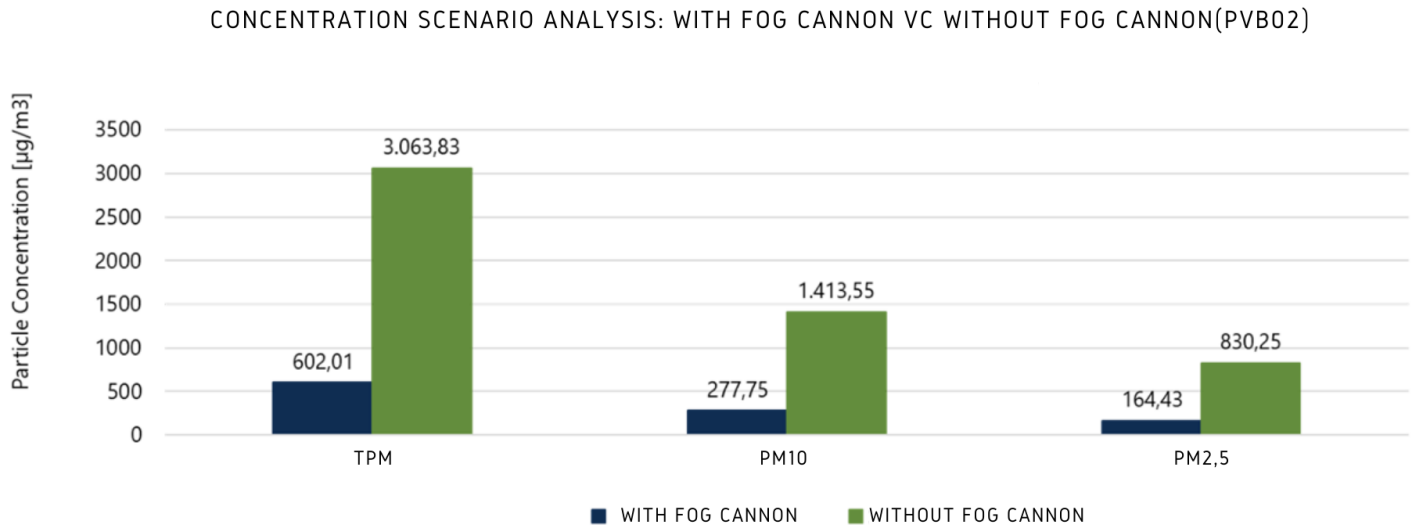
RESULTS

CFD Modeling



RESULTS

Control efficiency



Period	Efficiency		
	TSP	PM_{10}	$PM_{2,5}$
17/10/2019 à 25/10/2019	33%	33%	32%
04/11/2019 à 20/11/2019	81%	81%	80%

CONCLUSIONS

- The control system efficiency depends of a series of parameters such as:

  wind speed,
  fog canyons height,
  angle
  its position regarding the monitoring source of interest.
  and particulate matter diameter

- With the obtained results, meteorological data evaluation and computational numerical simulation were perfomed to avoid bad data . It was possible to elaborate some technical guidelines to adjust and optimize the canyons positioning on the areas of interest, such as:

  - Minimum distance from the source: high turbulence zone and erosion potential;
  - Application of cannons with 50° angle: cover a larger influence area and less turbulent impact area;
  - Application of cannons in “Parabola Effect”: allow the creation of a fog curtain in the local predominating wind direction;
  - Maximum distance from the source: 60 to 70m;
  - Cannons positioning above ground level, preferably equal or greater than source’s height.

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+55 27 3376-0473
+55 27 3376-0475

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