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SIZING OF PLUME ABATEMENT COILS - PART 2

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ABSTRACT

Plume abatement coils are used to reduce/prevent visible plumes of moisture exiting a wet cooling tower fan stack. Typically, this is done by mixing in dry, heated ambient air with the moist air stream exiting the drift eliminators. The cold ambient air passes over the “airside” of the coil and is heated by transferring heat from a hot fluid source flowing on the “tube side” of the coil. The paper is a follow on to the paper presented in 2022 and will present the methodology and equations required to calculate the air side pressure drop of a thermally sized plume abatement coil.

NOMENCLATURE

Symbol	Description	Metric	English
A_f	Total surface area of the finned tube	sqm	sqft
A_t	Bare tube surface area per tube	sqm	sqft
h_f	Fin height	m	in
K_a	Acceleration Loss Factor	Dimensionless	Dimensionless
K_f	Friction Loss Factor	Dimensionless	Dimensionless
L	Tube length	m	ft
P_c	Coil Static Pressure	Pa	In H2O
Pl	Longitudinal Tube Pitch	m	in
Pt	Transverse Tube Pitch	m	in
M	Mass flow rate	kg/hr	lb/hr
N	Number of tube per row	Dimensionless	Dimensionless
N_r	Number of tube rows	Dimensionless	Dimensionless
OD	Tube outer diameter	m	in
OD_f	Fin outer diameter	m	in
Re	Reynolds Number	Dimensionless	Dimensionless
t	Fin Thickness	m	in
t_s	Space Between Fins	m	in
V_{max}	Velocity within the tube coil	m/s	ft/min
μ	Kinematic Viscosity	N-s/m ²	lbf-s/ft ²
ρ	Density	kg/m ³	lbm/ft ³
σ	Coil Minimum Free Flow Cross-Section Area to the Total Frontal Area	Dimensionless	Dimensionless

INTRODUCTION

Plume abatement coils can be used in both counter flow or cross flow cooling towers as shown below in Figures 1 and 2. The plume abatement coils sit above the water distribution system and drift eliminators on the perimeter/sides of the tower. Dry air from ambient is drawn through the plume abatement coils and is mixed with the moist air exiting the drift eliminators. The resultant air mixture is then expelled from the cooling tower via the fan and fan stack.

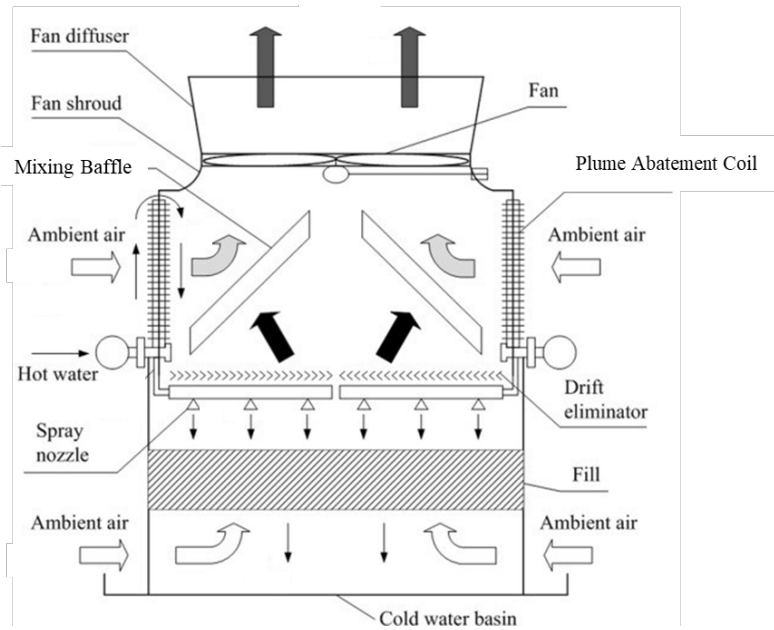


Figure 1. Counter Flow Cooling Tower with Plume Abatement

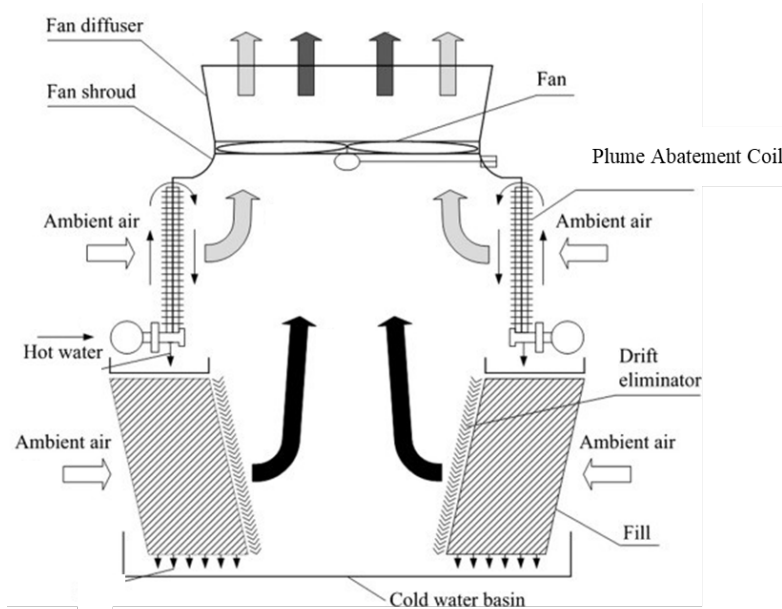


Figure 2. Cross Flow Cooling Tower with Plume Abatement

Several excellent papers on the science of plumes and the ways and methods to reduce and/or eliminate them have been written on this subject (References 1, 2, 3 and 4) and as such, will not be covered here. As covered in last years paper (Reference 5), a simple budget methodology was presented that allowed one to thermally size a plume abatement coil. This paper will build on that method and provide the method and equations needed to determine the air side static pressure drop through a plume abatement coil which is needed to properly size the cooling tower