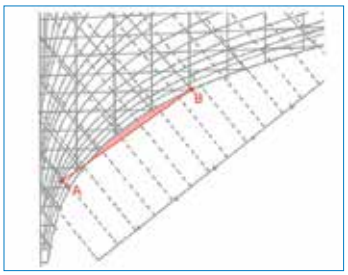
15 Plume Abatement

1. What is Plume?

At the air discharge water droplets can be formed by condensation of warm humid discharge air by contact with the colder ambient air upon leaving the equipment. This type of condensation is the visible plume that often can be seen rising above evaporative cooling equipment during the winter season. The water vapour caused by condensation contains droplets of pure water and is harmless. In some instances visible plumes are considered as a hinder, in which case measures must be taken to minimise or eliminate the occurrence of plume. Consult the BAC Balticare Representative for such requests.

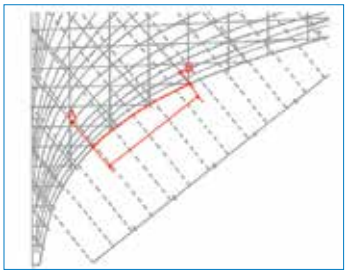
2. Evaporative Cooling and Plume



- Air enters at condition A.
- Air picks up heat and water in the evaporative fluid cooler (discharge condition B).
- Ambient air serves as heat sink for the discharge air (line AB).
- Intersection of saturation line leads to visible plume.
- Large intersection area: more plume; small intersection area: less plume.

Plume is the condensation of water vapour and is harmless to the environment.

3. Condition of the Ambient Air



Temperature and relative humidity of the entering air influence the condition of the discharge air. Depending on the entering air condition the discharge air IS NOT ALWAYS 100 % SATURATED.

- Dry ambient air: discharge air has low relative humidity and high temperature.
- Wet ambient air: discharge air has high relative humidity and lower temperature.
- Warm ambient air: discharge air has lower relative humidity and higher temperature.
- Cold ambient air: discharge air has higher relative humidity and lower temperature.
- Discharge air of open cooling towers is generally higher saturated than discharge air of evaporative coil products.

Evaluation of Plume Formation Requires:
Knowledge of climatic conditions (ambient air) in which the equipment will operate. In depth knowledge of evaporative heat transfer to determine the relative humidity and temperature of discharge air in prevailing climate conditions.

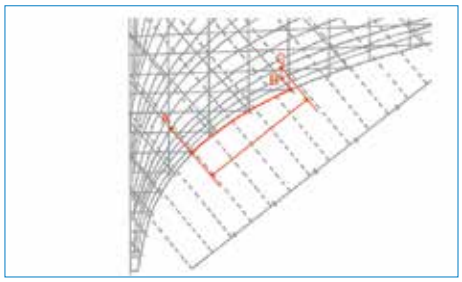
4. Plume Influencing Factors

- High humidity of ambient and discharge air enhance plume potential and vice versa.
- Large temperature difference between discharge and ambient air increases plume potential and vice versa.
- High heat load/ air flow ratio provides large temperature difference and high plume potential and vice versa (Typically heat load/ air flow ratio for evaporative coil products is smaller.).
- Next to equipment selection plume formation is a function of the actual heat load and climatic conditions and needs to be evaluated over a wide band of operating conditions. BAC provides the methodology to make such an evaluation.

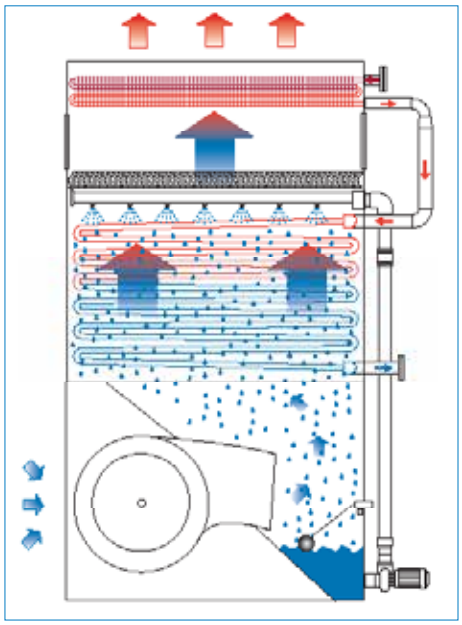
5. Plume Abatement Coils

Large surface area plume abatement coils are installed in the air discharge of the evaporative coil products and piped in series with the "wet" coil. To be effective they must have low air and fluid side pressure drops. This results in:

- Significant extension of dry operation capacity.
- Effective increase of discharge air temperature to reduce / eliminate plume during wet operation.
- Additional sensible heat transfer during wet operation which saves water and treatment costs.



Plume abatement coil sizing and performance prediction require a thorough evaluation of thermodynamic and airside behaviour as well as an understanding of climate condition influences. BAC can provide properly sized plume abatement coils and accurate performance data.



Plume Abatament Coil

6. Capacity Control Strategy

Capacity control of the evaporative cooling equipment has a considerable influence on plume formation.

- No capacity control results in the lowest heat load / air flow ratio and low plume potential.
- Dual drives (BALTIGUARD®) and two speed motors result in higher heat load / air flow ratio; acceptable plume elimination is achieved with plume abatement coils.
- Modulating airside capacity control results in highest heat load / air flow ratio which gives the highest plume potential.

Operating and capacity control strategies are an integral part of the plume evaluation process. Consult your local BAC Balticare Representative for guidance and assistance.