Cooling Tower Performance

DRIFT

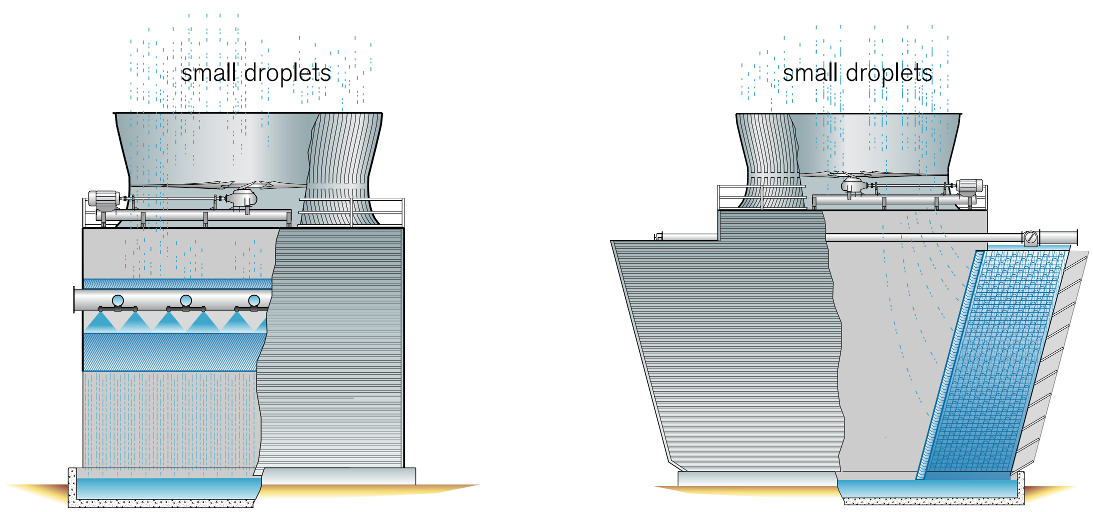
All evaporative cooling products, where air and water come into direct contact, experience some level of drift. Drift is defined as liquid water droplets from the recirculating flow entrained in the discharge air stream. These droplets contain the impurities and chemicals contained within the recirculating water. Drift is not tower condensate that may collect on surfaces and become entrained in the fan airstream; condensate is void of the impurities found in recirculating water. Tower condensate may develop overnight when ambient temperatures are cooler, falling from surfaces into the drift eliminators or fan airstream.

Whether for environmental permitting purposes or to limit the deposition of drift droplets on structures, vehicles, and populated areas, it is important to understand possible causes of excessive drift and how to reduce observed drift. This white paper serves both as an educational guide for defining drift and troubleshooting excessive drift. **Figure 1** shows drift within the cooling tower.

Drift rates vary with product type, eliminator design, application point and operation. Modern eliminator designs are much more efficient than their predecessors—both in capturing drift and achieving lower pressure drop. The latest technology often can achieve 0.001% drift rate, down to 0.0005% drift rate depending on tower configuration. To put that into context, for 1,000 gpm (63 l/s) water flow rate, predicted drift volume is approximately 1 ounce (30 ml) per minute. Field testing of drift rates below 0.0005% is difficult to accurately or repeatedly measure.

Proper design, installation and operation yield cooling towers with acceptable drift characteristics. As demonstrated in the above example, the amount of drift is so small that it may go undetected by observers. Many drift droplets are very small and lightweight, such that they waft into the atmosphere or evaporate before reaching the ground.

Occasionally observers may perceive unusually high cooling tower drift. Short-term conditions may contribute to elevated drift. It is important to acknowledge many factors that impact drift rate. The following guidelines can help alleviate concerns and improve drift performance.



Counterflow — Crossflow

Figure 1 Cooling Tower Drift

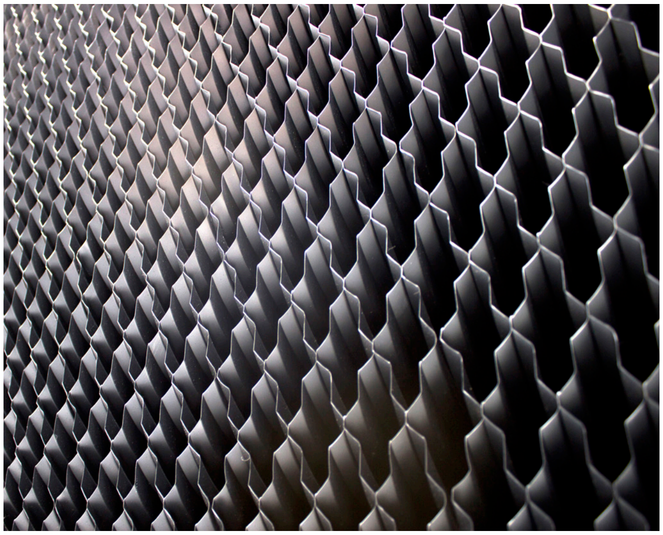


Figure 2 MX75 MarKey® crossflow drift eliminator

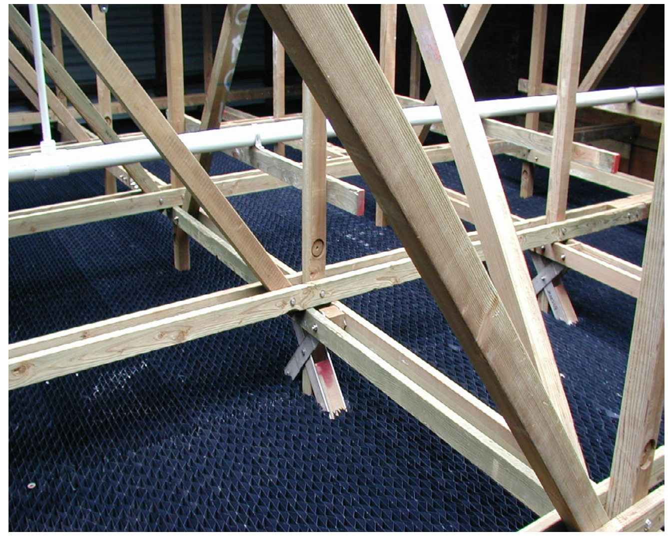


Figure 3 XCEL® TU12C counterflow drift eliminator

Eliminator "Seasoning"

Drift eliminators are manufactured from PVC, which is a hydrophobic material. When the cooling tower is new, drift eliminators exhibit increased beading of the recirculating water, which increases propensity for drift to escape. Optimal performance is obtained through a process called "seasoning," typically after water has been flowing over the tower for a significant amount of time. If observed drift is higher than expected and evenly distributed across the eliminator face, the cause may be lack of seasoning. Continue to operate the cooling tower normally with water and heat load for 1,000 or more hours, then assess.

Installation

Proper fill and drift eliminator installation is critical to drift performance. If excess drift is observed and concentrated in one area, rather than uniform across the eliminator face, this could indicate damaged or missing fill sheets and eliminators. Verify fill and drift eliminator installation meets factory or field installation standards. For crossflow, film-fill products (NC, AV, MH Fluid Cooler, etc.) count fill sheets and check for eliminator face damage. **Figure 2** shows the eliminator face of MX75 fill and how the sheets and eliminators should appear with proper installation. Quantity of fill sheets should match the product specification. **Figure 3** shows the installation of counterflow TU12 eliminators in a W400 tower.

Water Management

Hot water distribution issues may contribute to drift. Verify that the operating water flow rate is within recommended range. Proper water distribution is necessary for eliminators to function correctly. Missing or incorrect nozzles may lead to flooding of drift eliminators. When inundated with water, drift eliminators cannot control drift adequately. Nozzles located too close to drift eliminators can also cause excess drift.

Application

Proper eliminator function is dependent upon both water rate and air velocity. Difficult thermal design conditions have a direct impact on these parameters. Unusual design conditions (for example, long approach temperature and high water loading) may result in product selection approaching eliminator design limits. Particularly drift-sensitive applications must be assessed prior to award to ensure proper product selection. Selecting a larger cooling tower with lower design fan power can be an effective strategy to reduce eliminator velocity and resulting drift rate.

Surroundings

External obstructions may disrupt eliminator function. These may be caused by nearby structures or objects that create an airflow imbalance, leading to higher air velocity in one region of the cooling tower. Increased eliminator velocity can lead to higher drift rate in those localized regions. Layout and obstructions must be assessed prior to award. If the cooling tower is to be installed adjacent to a drift-sensitive location (e.g. a parking lot), cooling tower selection should be reviewed to ensure drift rates are the lowest available. Dissolved solids from settled drift droplets may leave spots on cars, windows and other surfaces after many hours of operation.

Water Chemistry

Similar to the eliminator seasoning issue, recirculating water with low surface tension is a common problem. Water at room temperature has a lab measured surface tension of approximately 72 dynes/cm. When surface tension is below 65 dynes/cm, eliminators no longer function correctly, leading to the formation of very fine water droplets and drift. Most water treatment chemicals do not impact surface tension, but some, including but not limited to surfactants, dispersants and antifoam agents, can have the unintended consequence of lowering water surface tension. The problem constituent may even occur in the make-up water source, unrelated to the treatment program. It is important to review water chemistry prior to the cooling tower design phase and diligently monitor during operation, particularly when reclaimed water is used as a make-up source.

	Inspection Guidelines and Troubleshooting	Counterflow	Crossflow
Seasoning	Operate tower normally with water and heat load for 1,000 or more hours.	✔	✔
Installation	Eliminators shall be snug, with proper seals and retainers (if applicable), and no gaps.	✔	✔
	Eliminators shall be in good condition, with no damage or crushing.	✔	✔
	Fill shall be installed correctly, with no air or water bypass directly to the eliminators.	✔	✔
	Verify correct sheet count on film-fill crossflow towers.		✔
	Improve integral eliminator alignment on crossflow film fill by installing combs or stuffers, as needed.		✔
	Verify correct mechanical components are installed, with fan power draw at or below design.	✔	✔
Water Management	Inspect for leaks or streams through the eliminators, then address by caulking or sealing upstream source of the leak.	✔	✔
	Ensure all nozzles are installed and undamaged.	✔	✔
	Balance water distribution basins or change nozzle size to prevent basins from overflowing.		✔
	Plug a small percentage of nozzles or use smaller orifice size nearest the eliminators.		✔
Application	Drift is higher at high air rates; apply a variable frequency drive (VFD) to reduce fan speed at off-peak cooling conditions.	✔	✔
	Increase cold water set point to help reduce fan speed at off-peak cooling conditions.	✔	✔
	Applications with high water loading or air rate may warrant a second layer of eliminators to help control drift. A drift eliminator overlay may have an impact on thermal performance.	✔	✔
Surroundings	If possible, relocate nearby obstructions that may cause airflow imbalance to the cooling tower.	✔	✔
	Observe wind or atmospheric patterns that cause higher or more perceived drift. Plan for a cooling tower enclosure to lessen wind effects or a structure to block drift from affecting areas near the cooling tower.	✔	✔
Water Chemistry	If drift eliminators are fully seasoned, but excessive drift persists across the entire eliminator face, low water surface tension may be the culprit. Perform a Du Noüy ring surface tension measurement on the circulating water. The sample may need to be sent to a qualified lab, rather than performed on site. Bubble tensiometer method for measuring surface tension is not accurate.	✔	✔
	If surface tension is below 65 dynes/cm, eliminate constituent from the circulating water system (water treatment chemical, additive, pollutant, etc.) causing low surface tension. Consult water treatment expert prior to altering water chemistry. Maintaining proper biocide to control microbial growth is required.	✔	✔

thermal science

SPX COOLING TECHNOLOGIES, INC.
7401 WEST 129 STREET
OVERLAND PARK, KS 66213 USA
913 664 7400 | spxcooling@spx.com
spxcooling.com

TR-024 | ISSUED 11/2019

SPX®