Cooling towers in Hong Kong
Guidance for energy efficient operation

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The Capex (capital expense) in air-conditioning systems is insignificant compared to the TCO (Total Cost of Ownership). Experience from across Asia shows us that many cooling tower systems are designed, operated or installed incorrectly, have poor efficiency, and bad practice causes unnecessary energy losses. But before we delve in to more detail, why do we need cooling towers? Refrigeration systems effectively absorb heat energy from our buildings, and we need a method to reject this unwanted heat energy in to the outside. Basically there are two options, an air cooled or water rejection system, cooling towers fall into the latter category. Cooling towers offer building owners opportunities to lower their TCO (Total Cost of Ownership), compared to air-cooled, here in Hong Kong that equates to annual savings of up to seventeen percent.

So what is the secret behind efficient cooling tower operation? It must be cleanliness. The majority of towers deployed in Asia are the open (direct) type, so that is where we will focus this article. You are probably already asking yourself why all this enthusiasm for cooling towers? Well it is quite simple, water-cooled chillers used in conjunction with cooling towers have many advantages over there air-cooled, the least of which are

Figure 1: Avoid primers for biological growth

圖1：避免採用引致微生物滋生的底漆
lower noise levels, smaller size, and lower Opex (operating expense). For example, in standard configuration a 600TR cooling tower only requires 15kw to power the fan, six times less than an air-cooled system, that is a significant saving.

Top Five Tips
• Cleanliness
• Location
• Water Treatment Plan
• Automatic Controls
• Save Water

Cleanliness
Water is a power solvent, and the life blood of cooling towers; it needs to be clean, and kept clean, design to minimise contamination, keeping the tower clean prevents contamination of the piping and chiller. A plate-to-plate heat exchanger is an effective strategy to prevent the ingress of contaminants - prevention is always better than cure.

Location
Ease of access for maintenance is critical, out of sight is out of mind. Avoid locations that invite contamination, for example areas close to parking or garden areas. Avoid primers for biological growth (refer to photo Figure 1). Short-circuiting of vitiated air dramatically lowers the towers capacity.

Water Treatment Plan
Despite best practice, the condenser water contamination occurs, and we need a strategy to take care of that. Coupled with water lost through evaporation process that concentrates constituents, unattended particulates accumulate plugging the tower fill.

Cooling tower water has all the right ingredients for bacteria soup; it is warm, exposed to air and towers provide plenty of crevices to support growth.

A water treatment programme is essential to inhibit corrosion, the build-up of scale and fouling, and control microbial contamination.

Corrosion, scale and microbe development foul condenser tubes and the pipework distribution system resulting in poor system efficiency and premature failure. These factors can also provide a favourable environment for the growth of microbes such as Legionella. Although a thorough discussion of the complexities of water treatment management is beyond...
the scope of this article suffice to say that it is necessary to provide the proper operation of both the tower and the chiller.

**Automatic Controls**
The majority of the power consumed by air conditioning is used in the chiller. Therefore even small improvements are beneficial, reducing running costs. Its workload is governed by the difference between evaporator and condenser refrigerant pressure - in simple terms lower the differential pressure saves energy. We expect that the chiller plant will operate at full load and at design conditions, to suit the worse case scenario, a hot humid day in July. However 99% of the time the plant operates at a lower load, providing ample opportunities for energy conservation strategies.

For cooling towers, controlling the speed of the fan is an essential strategy, and ASHRAE 90 demands it. VFD (Variable Frequency Drive) speed control effectively lowers power needs saving money. The control philosophy must be designed from day one with energy efficiency in mind, operating multiple cooling towers simultaneously lowers chiller energy needs.

**Save water**
For retrofit projects, substituting electricity savings for water consumption is not sustainable solution. Since cooling towers don’t demand potable water, harvesting rainwater is an effective method to provide make-up water and also lower your operating costs.

No article regarding cooling towers can overlook the Legionella. Cooling towers have been implicated in a number of high-profile outbreaks, and whilst the confines of this article preclude a detailed explanation of the risks, readers are reminded that compliance with relevant codes, including the HKCOP is recommended. In conclusion, cooling towers offer the best heat rejection solution for many larger applications, offering lower energy. Cooling tower problems can be avoided and or eliminated through rigours design, and operation protocols. Managing your towers effectively reduces your energy cost today and tomorrow.