

Approach Temperatures

– Key indicator to chiller performance –

Introduction

Most facilities track chiller performance data on a daily basis. Unfortunately, the data is not reviewed until it is too late. The most critical information that should be looked at on a daily basis is the condenser and evaporator water liquid approach temperatures.

Approach temperature is defined as the difference in temperature between the liquid water leaving temperature and the liquid refrigerant temperature. The difference in temperature is a method to determine the efficiency of the chiller (condenser and evaporator). Each machine comes with a “designed approach temperature” from the factory. New machines with enhanced tubes are now operating at about 0.6-1.0 degree full-load design approach temperatures. Many of these newer chillers have a screen display (Figure 1) showing the approach temperatures. It should be noted that approach temperatures will vary depending on the chiller load, incoming water temperature, water flow, refrigerant charge, and scaled and/or fouled tubes.

Indications

Increased approach temperatures indicate that the machine is not as efficient in increasing energy costs and loss of tonnage capacity. This is especially concerning during the warmer summer months when efficiency and capacity is needed. As approach temperatures increase, it is normally the result of scaled or fouled tubes. As you add scale or fouling, the heat must be transferred through this media as well as the tubes. The greater the thickness of scale or fouling media, the greater the efficiency loss. Many publications put the cost at 3-10% depending on the degree of scale or fouling. For example, a typical 750 ton chiller at \$0.10/kw operating at 50% average load could create an annual added cost of \$5,500 to \$18,750.

The other issue is the impact which deposits or fouling has on pitting-type corrosion. Biological fouling can result in biologically induced under-deposit corrosion as illustrated in Figures 2 and 3, and this is a quick and damaging type of corrosion. Good water treatment and monitoring of the approach temperatures will not only reduce energy costs, but provide early warning that the water treatment program is not protecting the condenser tubes.



Figure 1: Many newer chillers have approach temperatures already displayed

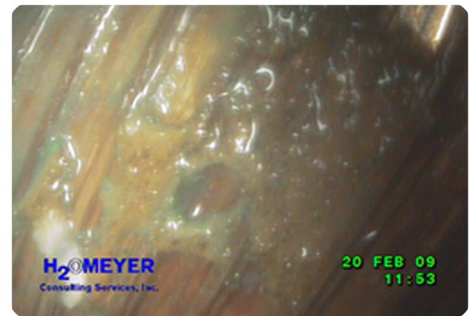


Figure 2: Enhanced tube filled with microbio slime reducing heat transfer efficiency and creating potential under-deposit corrosion

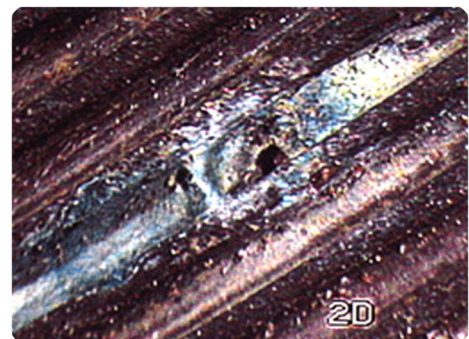


Figure 3: Under-deposit corrosion cell that lead to copper tube failure