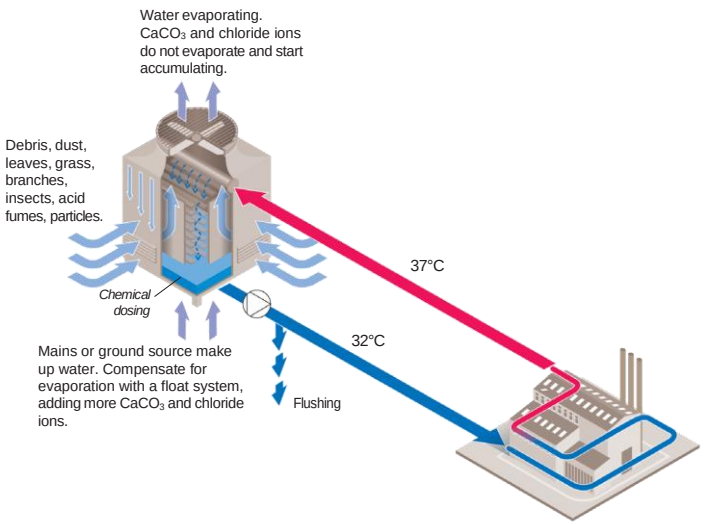
Cooling tower interchanger

Open cooling towers are a major source of fouling for industrial plants, causing the need for frequent maintenance of other equipment in the plant. The plant cooling loop is normally completely closed and chemically treated, other than the open cooling tower - which forms the only interface with the atmosphere.

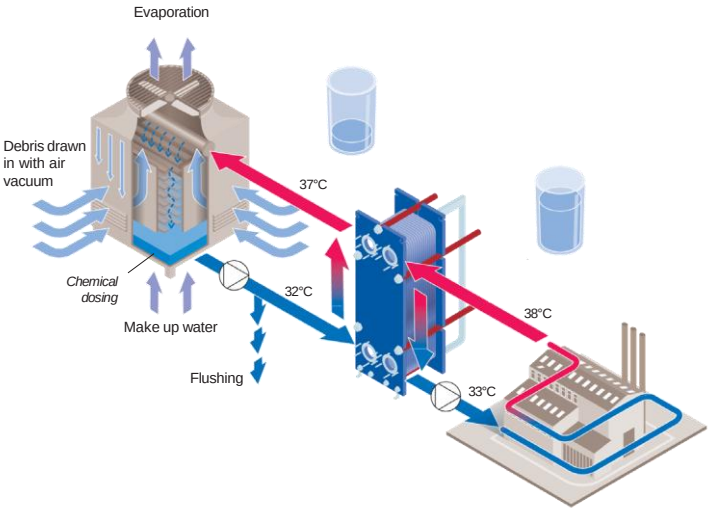
As the cooling water, circulating through the plant, falls freely across the cooling tower packing, the fan(s) pull in fresh air, creating a vacuum around the tower, which attracts air borne particles in close vicinity. These many and varied debris will find their way inside the plant's cooling equipment such as shell-and-tube heat exchangers. The debris settle in low flow areas or dead spots and cause high costs in maintenance, unplanned shut down, condensers' losses in heat transfer efficiencies and additional pumping costs.

Open cooling tower systems are also a source for increasing levels of calcium carbonate and corrosive chloride ions in the circulating cooling water. These unwanted minerals enter via make-up water and accumulate over time to unacceptable levels. The water in the open cooling tower water loop evaporates, but the minerals stay and increase in concentration in the cooling system. Over a six-month period, calcium carbonate and chloride ions can double in concentration! The only way to rid the system of these unwanted minerals is to periodically flush the loop. This means increased operational costs and is normally not done, as water costs are high (typically in western Europe at 1 euro per m^3).



Alfa Laval gasketed plate heat exchangers as an interchanger

Plate type heat exchangers with countercurrent flow are commonly used as a 'cooling water loop circuit breaker' because of their excellent flow regime making it possible to achieve a temperature approach of as low as 1°C. With the help of an Alfa Laval gasketed plate heat exchanger installed as an interchanger, instead of sending 32°C dirty cooling tower water to the plant, it is possible to supply 33°C closed clean water.



Benefits of a gasketed plate heat exchanger as an interchanger

- Closed loop cooling with clean cooling water that is free of debris and steady acceptable levels of calcium carbonate and chloride ions.
- Savings in pumping costs with clean pipes, which diameter has not reduced due to adhesion of calcium deposits on inner hot pipe surfaces.
- Savings in reduced maintenance costs of downstream cooling equipment like shell-and-tube heat exchangers.
- Savings in heat transfer area, not having to plug tubes of a shell-and-tube due to crevice corrosion caused by high levels of chloride ions.
- Less money spent on chemical dosing and treatment of a smaller volume of open cooling tower loop. Typically, 10% of overall cooling loop in volume.
- Savings in unplanned shut downs interrupting processes due to mechanical corrosion and needs of maintenance.
- Plant's low grade steel equipment will be protected from corrosion as a gasketed plate heat exchanger interchanger with Alloy 316 stainless steel plate material, will handle up to 300 ppm of chlorides at 40°C.
- Fast simple and easy cleaning of gasketed plate heat exchanger by a single person in a few hours.

Energy Hunter – Utilities

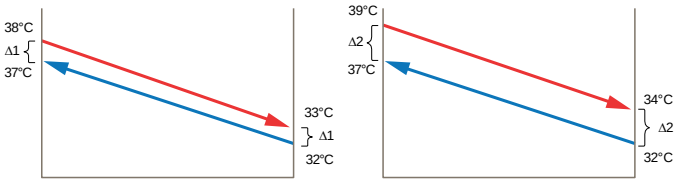
Typical temperature profile for a 27°C dew point are:

With a 1°C approach

Clean closed loop water to plant	38°C → 33°C
Dirty open cooling tower	37°C ← 32°C

With a 2°C approach

Clean closed loop water to plant	39°C → 34°C
Dirty open cooling tower	37°C ← 32°C



Other than protecting the plant from fouling due to air borne particles, biological growth, and other debris, a gasketed plate heat exchanger will ensure a lower life cycle cost for numerous other cooling equipment throughout the plant.

Problems form calcium carbonate accumulation

Increasing concentration of calcium carbonate minerals in the cooling water loop will cause major losses in energy efficiency, higher pumping costs with reduced diameter of cooling water pipes, maintenance, replacement of cooling equipment, unexpected shutdowns, losses in heat transfer efficiency, requiring more cooling water hence further investments in cooling tower capacity.

Due to its nature, calcium carbonate is soluble in cold water but will precipitate in hot water or hot surfaces. The bone like material will deposit itself on surfaces of equipment like cooling water pipes, shell side of a shell-and-tube heat exchanger and other cooling equipment. Every millimetre of calcium coating on a shell-and-tube, means resistance for heat transfer and the need for more cooling water, leading to higher pumping costs.

Cooling tower water piping circulating throughout the plant, will reduce in flow diameter over time, with calcium carbonate deposits on the inner surfaces. This will result in reduced flow to needed cooling equipment and higher pumping costs due to increased friction and smaller diameter.

Problems from chloride ion accumulation

Many cooling equipment in the plant like shell-and-tube heat exchangers are constructed of mild steel or carbon steel and will corrode due to increasing high levels of chloride ions with accumulation from make-up water. Dead spots or crevices are specially at risk with higher concentration of chloride ions in sedimentation, which is difficult to clean.

▼ PRACTICAL TIPS

1. It is advised to keep the cooling equipment full of water during shutdowns to avoid crevice corrosion with evaporating water on the surfaces due to ambient conditions. In a system drained and open to atmosphere, a droplet of water on a heat transfer surface will half in volume over time, hence doubling the concentration of chloride ions at that point. With continued evaporation, concentration will increase, hence corrosion will be inevitable.
2. Install a Y strainer (or two in parallel) of 2 mm mesh at the cooling tower inlet to the gasketed plate heat exchanger, to ensure longer periods of operation before cleaning. Any debris under 2 mm diameter will travel through the gasketed plate heat exchanger and exit at peak running conditions.