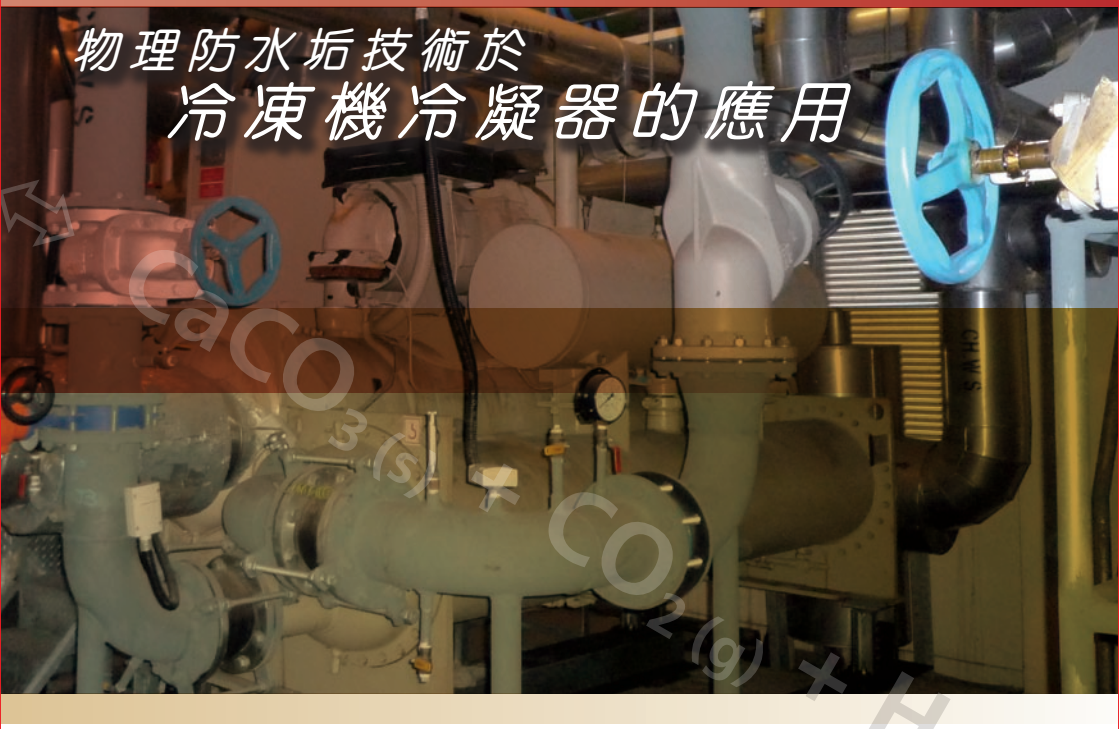
Application of Physical Scale Prevention Technologies for Chiller Condenser

物理防水垢技術於冷凍機冷凝器的應用



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A major advantage of this technology for retrofit application is no modification of pipe work is required because the coil is externally mounted to the pipe. However, the technology is restricted to pipe made of non-ferrous material like copper and plastic because ferrous pipe, such as iron and steel pipe, does not allow magnetic field to penetrate and magnetic field could not reach the water inside.

該技術對改裝工程的主要優點是由於線圈安裝在冷凝水管之外，而無需改動現有冷凝水管道。然而，該技術只能應用於非含鐵的水管，如銅水管和塑膠水管，此因含鐵的水管（如鐵水管和鋼水管）不讓磁場穿過，磁場便不能達到管道內的水。

ii) Permanent Magnet Device

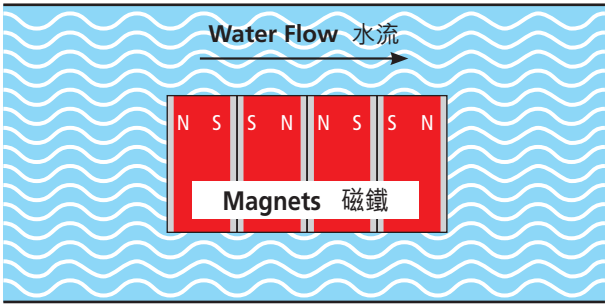
This is similar to the single coil electromagnetic device as discussed above except that the magnetic field is produced by permanent magnet, which is incorporated in specially designed pipe as illustrated in figure 3. The device is invasive and requires some minor modification work to existing condensing pipe to fit device into the system. As such, shutdown of the chiller is required for installation and cause inconvenience to end-users. Special caution should also be taken if it is connected to ferrous pipe, in which a magnetic insulation needs to be installed to avoid magnetic field disturbance. The addition of the device may also increase the pump head to overcome the water resistance of the device.

ii) 永久磁鐵裝置

該裝置類似上述的單線圈電磁裝置，分別是它把永久磁鐵嵌入特別設計的水管中，用以產生磁場，詳情如圖3所示。該類裝置是有一定破壞性，要把現有冷凝水管作出輕微改裝，使現有冷凝水管得以配合這裝置的安裝，因此，冷凍機也需於改裝時停止運作，對終端用戶造成不便。如把該裝置連接到含鐵的水管，需特別留意於連接端安裝磁場絕緣設備，以避免所產生的磁場受到干擾。此外，加裝該裝置也可能會增加系統水壓的要求，以克服該裝置引致的水阻力。

In addition, the change in magnet field along the section of the pipe depends on the change of magnetic pole physically, which is less frequent than the magnetic field generated by electromagnetism. Hence, less collision takes place, which eventually affects the formation of aragonite and the performance in scale prevention. For optimization, this kind of device is designed for a particular flow velocity in the condenser pipe in order to have adequate force to cause collision. For detail about the flow velocity requirement, please consult respective manufacturers for recommendation.

另外，這裝置內沿管道的磁場變化取決於實際磁極的變化，其變化較由電磁產生的磁場變化為少。因此，正負離子的碰撞也會少一點，從而影響該裝置防水垢和文石形成的表現。為達優化效果，該裝置需配合特定冷凝水管內的流速，以確保有足夠的力量導致正負離子碰撞。有關流速要求的詳情，請查詢相關製造商。



Invasive Device
永久磁鐵裝置

Figure 3 – Simplified diagram of device using permanent magnet method
圖 3 — 永久磁鐵裝置簡化圖

iii) Electromagnetic Induction Device

A typical electromagnetic induction device for treatment of condensing water flowing in a pipe comprises core elements of magnetically conductive material surrounding the pipe spaced from one another lengthwise of the pipe (as illustrated in figure 4). The device establishes radio frequency electric fields in the fluid in the pipe originating at spaced positions along the pipe.

iii) 電磁感應裝置

一個處理喉管內冷凝水流的典型電磁感應裝置，是由一些導磁電材料所組成的元件，圈套著水管，並沿水管相互間隔而安裝（如圖4所示），這裝置會於沿水管相互間隔的位置，在水管內的流體產生無線電頻率的電場。

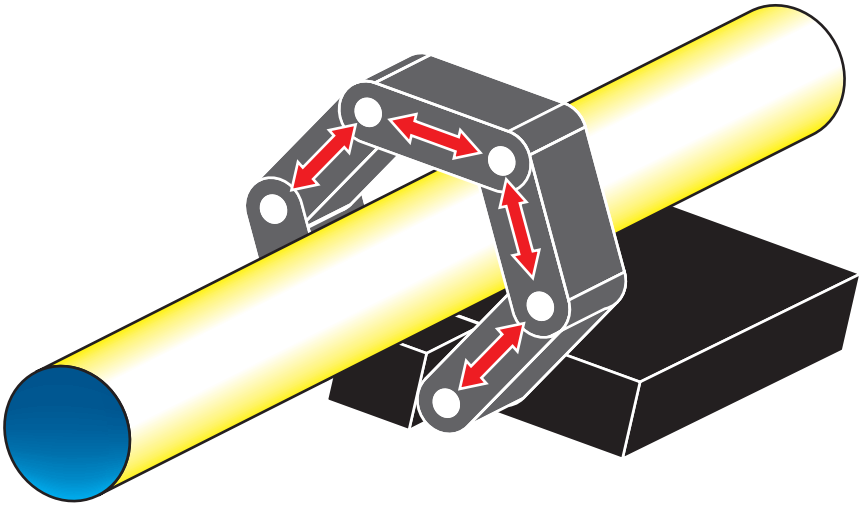


Figure 4 – An electromagnetic induction device externally mounted on a condensing water pipe.
圖 4 — 安裝於冷凝水管外的電磁感應裝置

With the use of this technology, mineral ions in water will experience a force when they are under an electric field generated by the device. Particles will be positively and negatively charged. They are forced to collide and form aragonite crystal (softer form of calcium carbonate), which will cause less calcium ions available for formation of hard scale (calcite, a harder form of calcium carbonate).

The application of this technology to existing condensing water circuit is simple and has no particular water flow velocity requirement. Besides, the device is externally mounted to an existing pipe work without any invasive modification to the existing installation and hence no shutdown of chiller plant is needed. This causes minimal disturbance to end-users. The application of this technology is also independent of the pipe material.

在使用了這項技術，當水中礦物離子流過該裝置所產生的電場時，它們會受到一股力量所牽動，而微粒被帶上正電荷和負電荷，迫使它們互相碰撞，形成文石晶體（較軟型態的碳酸鈣），這將導致冷凝水中較少鈣離子可供形成硬水垢（方解石 — 較硬型態的碳酸鈣）。

應用此技術於現有冷凝水系統是簡單和沒有特定的水流量要求。此外，由於這裝置安裝在水管之外，而無需對現有設備進行破壞性的改動，故冷凍機無需停止運作，這對終端用戶造成最少的不便。還有，應用這項技術對水管材料並沒有特別的要求。

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