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MIDDLE EAST

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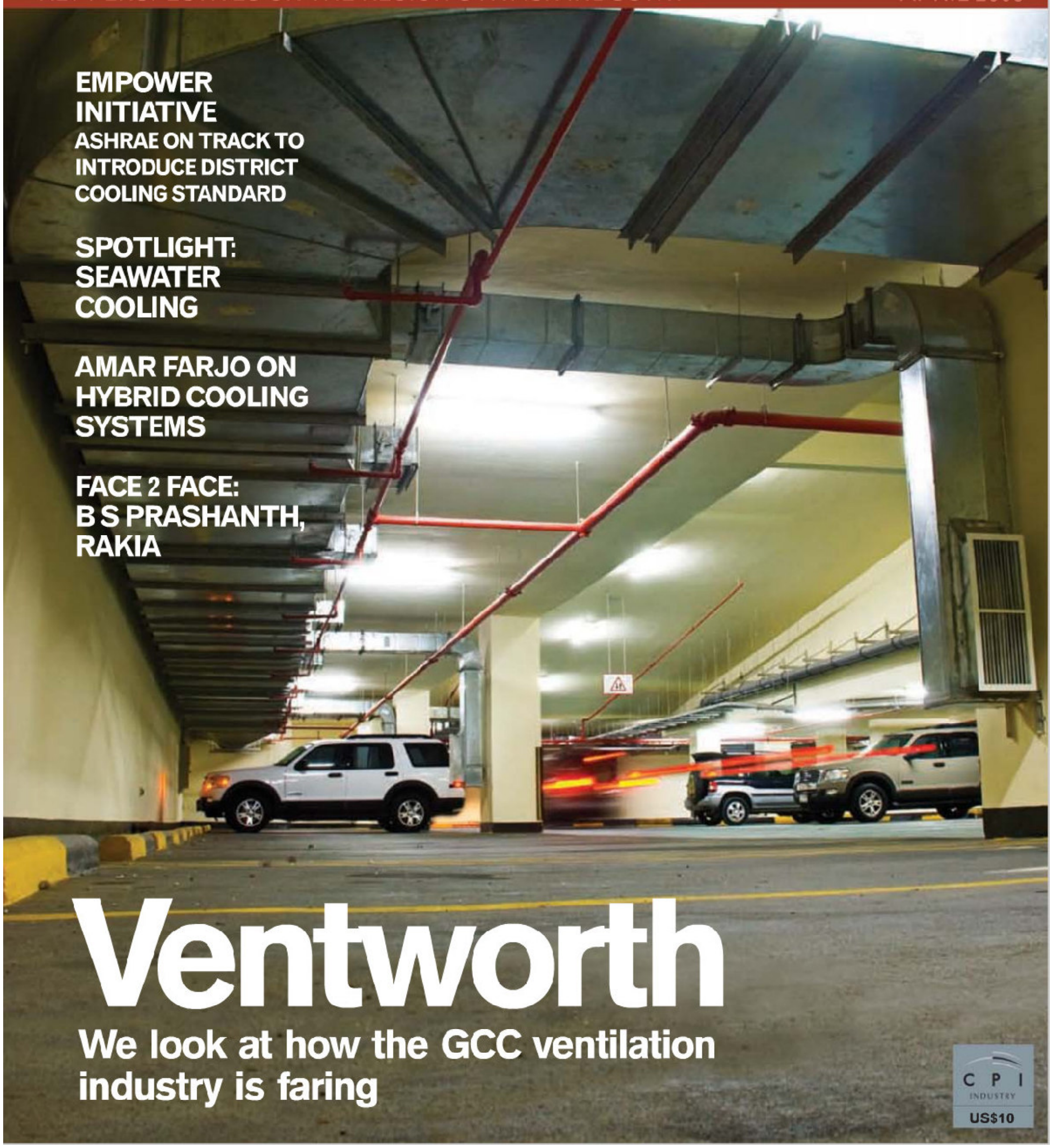

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Safe, efficient... by design

INTAKE DESIGN IS A CRUCIAL CONSIDERATION IN SEAWATER COOLING, NOT ONLY FOR OBTAINING BETTER PERFORMANCE BUT ALSO FOR PROTECTING SEA CREATURES FROM HARM, SAYS ASLAN AL-BARAZI

Whether considering seawater, or seawater with RO, in district cooling applications, a proper seawater intake design is necessary to ensure that the correct quality of seawater is delivered.

The relative size of the seawater intake will be determined based on whether re-cooling technology is used through the use of a seawater cooling tower or whether direct 'once through' seawater cooling is used. In the former, the seawater intake would be around five per cent of the water flow rate capacity in comparison with the direct seawater cooling method, and therefore, a considerable size and initial- and running-cost difference will result when comparing the cost and design of both the seawater cooling tower intake and the direct 'once through' seawater intake systems, including such considerations as differences in pumping, piping and space considerations.

Also, with seawater cooling towers, given that the cold water required on the project is determined to a large extent by the design of the wet bulb temperature (as the major part of heat transfer in the cooling tower occurs in the process of evaporation) and is not determined by the seawater temperature off the sea (being the case for direct seawater cooling applications), the related intake piping can, therefore, be very near or next to the shoreline, with the suction side being possible from near shallow depth of the seawater, which substantially reduces the intake piping and pumping costs, as well. However, as the focus of this article is not about comparing the advantages and disadvantages of both systems, and is rather to put into consideration and perspective the seawater intake design parameters only, the former subject is left for a separate discussion. Though attention will be shown, below, for the different intake designs incorporating seawater cooling towers systems, which is gaining momentum in this region, particularly due to the shallow depth of the Arabian Gulf (average depth 30-40 metres), where coastal waters may take up to one kilometre or more in many areas before reaching any substantial seawater depth level, an important feasibility for the seawater intake and discharge design amongst many other reasons, the space here does not allow for a detailed discussion.

The seawater intake design generally becomes more efficient, and more cost effective over the lifecycle cost analysis study, and with reduced maintenance, as the seawater intake size becomes larger. Therefore, wherever possible, a central utilities concept, or combined seawater intake flow rates for the total project capacity would be preferred over the alternative of several smaller intakes feeding the several plant rooms for the given project. It is also highly recommended that for the design of a seawater intake, the manufacturer's scope encompasses all types of screening and filtration levels from the big and coarse level type of screening to the very small level of particle size collected from the sea, all the way down to 50 microns in filtration size and further, if possible, to the seawater heat exchanger condenser cleaning system (normally the seawater chiller condenser), in order to guarantee the heat exchanger operates at maximum heat transfer level of efficiency and is not affected by any types of seawater scaling.

The type of seawater intake used for plant rooms up to 50,000 or 70,000 TR capacity (around 210,000 USGPM at five per cent make-up seawater flow rate only using seawater cooling towers) may

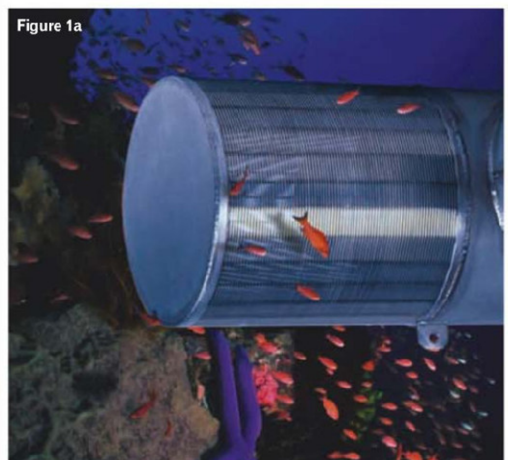
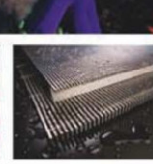


Figure 1a



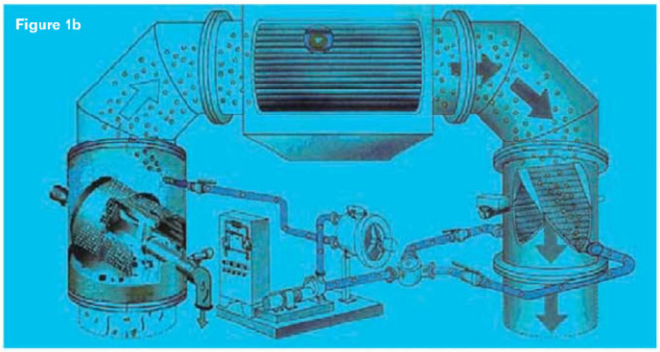


Figure 1b


Figure 2c

be what is termed as the passive-screen concept. In it, very low intake velocity is applied for high flow rates, as low as 0.15m/s, which will not disrupt or affect the seawater marine life swimming in the vicinity area. Furthermore, this passive screen – with a built-in wedge wire system, with 3-10mm in between spacing for filtration functional purposes – also serves for coarse filtration as well as prevents biological fouling. An air bubble burst system is employed to discharge any sub-surface debris. Once the seawater enters into this passive screen, the next level of filtering would be through a backwash filter, which removes any particle size from 1mm to 50 microns, discharging large particles through backwash. Thereafter, a second higher level of filtration may be installed to achieve values lower than 50 microns. Figure 1 shows this type of passive screen system design used for such capacity seawater intakes. Thereafter, a seawater chiller condenser cleaning system, such as the one shown in Figure 1b, may be used to ensure that the heat transfer surface of the tube condenser is kept clean and free of seawater scaling effects and any further biological fouling.

For bigger seawater district cooling plants, or central utility plants of the size above 100,000 TR (300,000 USGPM at five per cent related make-up water capacity for the seawater cooling towers), the Travelling Band Screen System design comes into prominence, with its more efficient and advanced design application. At the entry of such a type of a system, a fish-protection system would be recommended to help deter fish from entering the intake as well as to keep the intake system in full and efficient operation. Fish have a number of well-developed senses, and are able to detect and react to a number of stimuli, like sound, light, vibration and electrical impulses. The behavioural guidance systems stimulate the natural senses of fish to guide them away from a preferred habitat, such as an intake. For seawater-intake applications, such fish-protection systems include sound-deterring systems that are most widely used (also called acoustic screens; Figure 2a), air bubble systems that are suitable for guiding fish to a point downstream (also called bubble curtains; Figure 2b), and strobe-light systems (which are used in conjunction with other behavioural systems and are suitable for deflecting fish less sensitive to sound, such as eels).

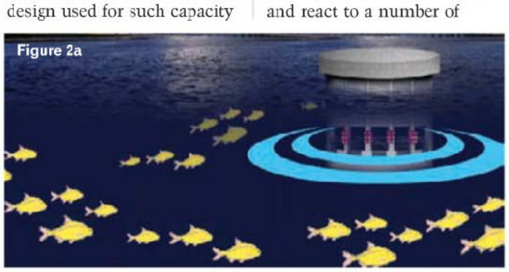


Figure 2a

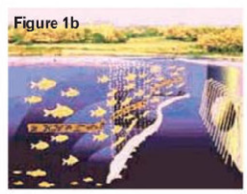


Figure 1b

Other design considerations for a more fish-friendly as well as better operational design would be to increase the sectional area of entrance to the intake, thereby reducing the velocity of flow rate at the intake and, consequently, allowing the fish an easy escape, once they are close to the intake. However, in cases where the fish still enter the intake band screen system, there is an optional fish bucket-carrying device that allows the fish to be lifted away through the rotating intake band screen into a channel back to the sea, also known as fish recovery and return system (Figure 2c). In addition to being environmentally and ecologically friendly, fish-deterring devices keep the intake system more efficient in operation, reducing handling costs, ensuring disposal of fish kills, and maintaining the mechanical plant and process. Please note that, in addition to the above-stated points, new legislations and environmental laws and requisites would normally necessitate such systems in place, as well. A good source for reference for these would be the Environment Agency Best Practice Guide, which recommends seawater intake screening techniques for different applications, and is regularly updated. Furthermore, using the guide makes it easier to gain regulatory approval, wherever required.

After the fish-protection system, stop gates are put in place. They are mainly used for building the seawater intake and for future maintenance and shutdown, whenever required. Thereafter, the bar »


Figure 2c


Figure 4

« screens are installed in order not to allow big coarse elements from entering the system (with 5-10mm spacing between the bar elements used). As an option, several levels of bar screens, each with a smaller clearance area, may also be used, if needed, in the intake system design.

Raking systems are also used, which automatically clean the course screens and dispose of the debris (Figure 3) for areas where there is a high-volume debris, trash, seaweed or other seawater obstacles.

The traveling-band screens then come into play (Figure 4). These filter the seawater down from 2mm to 10mm in particle size, depending on the project and design requirements. Thereafter, the systematic approach would be the same as in design (1) – that is, a progressive usage from 1mm debris filtration to more effective filtration and, thereafter, the optional chiller condenser tube cleaning system to guarantee heat

THE PASSIVE SCREEN – WITH A BUILT-IN WEDGE WIRE SYSTEM, WITH 3-10MM IN BETWEEN SPACING FOR FILTRATION FUNCTIONAL PURPOSES – ALSO SERVES FOR COARSE FILTRATION AS WELL AS PREVENTS BIOLOGICAL FOULING.


Figure 3

transfer efficiency from such effects as seawater scaling. As well as being bigger, this type of intake system requires concrete civil structure work.

For the largest size seawater-intake stations, drum screens (Figure 5) would normally be used. However, seawater cooling tower applications would not normally use such systems, as the sea water intake flow rate in a cooling tower system would only be around five per cent of the flowrate used in comparison to the direct seawater cooling flowrate. The 'once through' applications are more suited for this type of large seawater intake design application. This intake system design is considered the most efficient design and the one that requires the least maintenance, but due to its big capacity it is more suited for very large industrial applications, like desalination plants, large power stations, refineries and other large capacity industrial applications. ■

The writer is the Executive Director of IMEC and the exclusive representative for GLV-EIMCO Water Technologies, UK. He can be contacted at imec@emirates.net.ae.

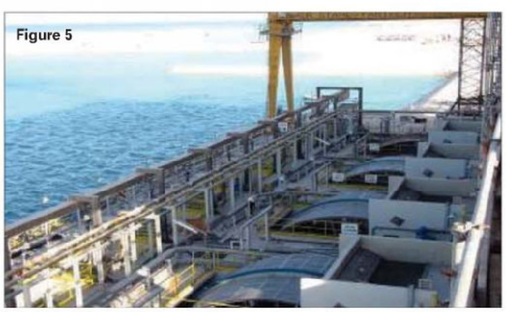


Figure 5