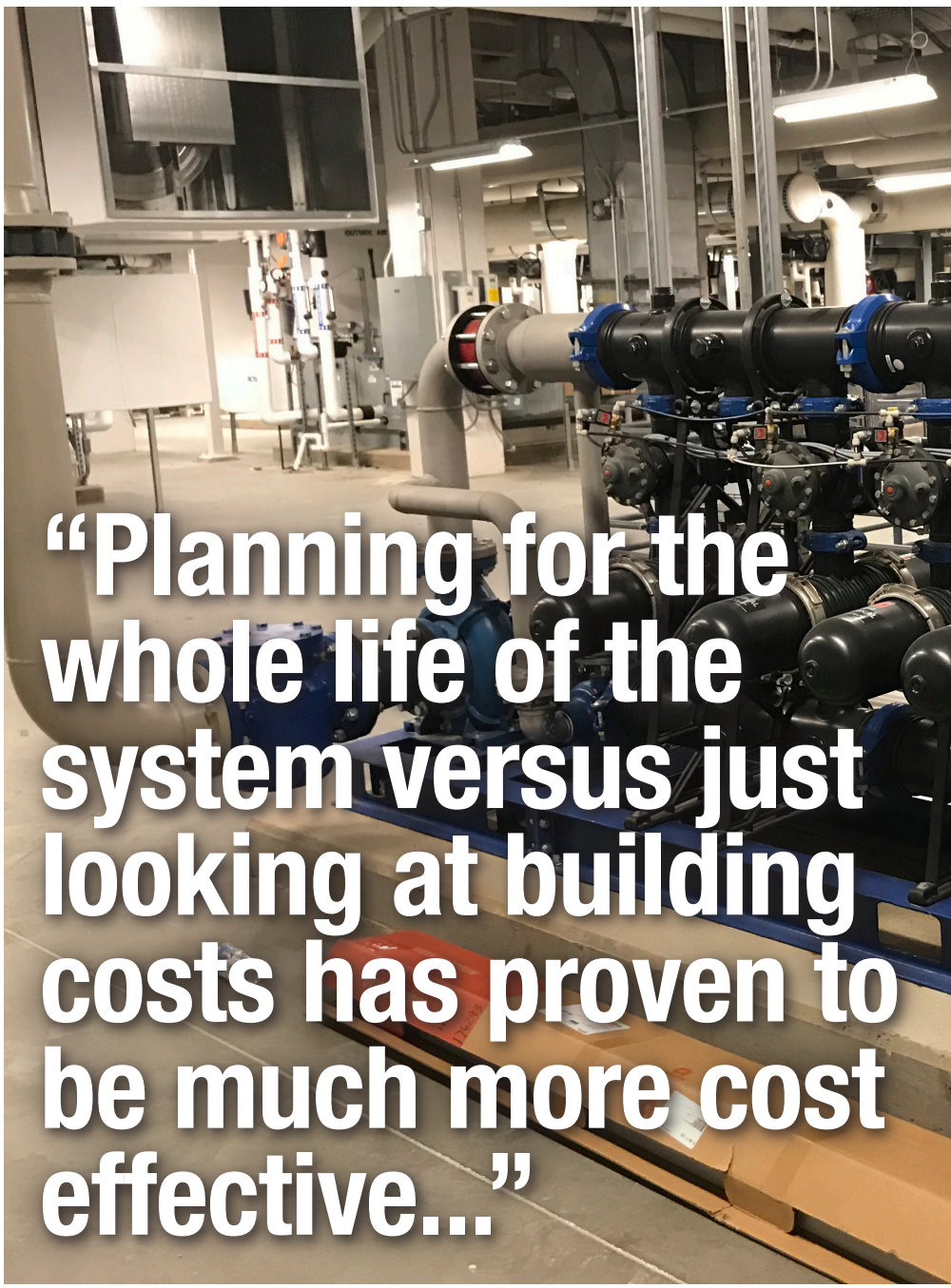
IMEC executive director **Aslan Al Barazi** on the importance of cooling tower filtration



Cooling tower filtration comprises many different types of systems and options, including disc filters.

Cooling tower filtration is an important subject that is frequently ignored or under emphasised by many clients and consultants on a project.

The chemical treatment deals with the dissolved solids, while the physical treatment (filtration) deals with the undissolved or suspended solids (TSS).

They do have a common factor though, whereby the inclusion of a proper cooling tower filtration system does reduce the scope of the water treatment and related chemical costs as well.

Cooling towers are also considered to be the best air washers, cleaning all the ambient air that enters the tower and discharging the clean plume with a very negligible amount of emissions through drift.

All the sand, sediments and other dirt then accumulates in the cold water basin and goes into the condenser circuit, unless properly filtered.

Cooling tower filtration comprises many different types of systems and options.

These include side stream separators, full stream separators, basin sweeper systems, disc filtration sand media filters, as well as screen filters. It sounds overwhelming at first, but actually it is rather simple to understand.

Sand media filters are considered old technology, although some 'old school' consultants still use them as they are comfortable specifying them, as they have used the system in the past.

It comprises of a tank with a medium such as sand or crushed gravel or possibly a type of crushed glass. The condenser water flows through it and whilst the dirt is accumulated on top of the media, the clean water continues its passage through the condenser circuit – it's a simple process.

The problem with it though is that the types of media filters normally used in the HVAC market have a high pressure drop (extra head for the pump), which is further increased by the dirt/sand/sediment build up.

As well, these systems would also need a fair amount of backwashing and system interruption to clean the dirt from the system anytime the pressure differential reaches a pre-determined set point.

These systems also require full flow for backwashing the system. This is especially the case in our region here where there is lots of sand and dust in the ambient air, which is washed down in the cooling tower towards the condenser circuit and media filtration device and then back to the cooling towers again.

The most popular system in the UAE is

the side stream separator. That is because it has the flexibility of being placed in most parts of the condenser circuit, as well as being a very cost effective and proven solution in the HVAC industry.

However, these separators are only practically effective for filtration rates of 80µ for particles with a specific gravity of 2.6 and higher.

In the UAE they are an effective filtration method as the majority of the filtration needed in our region is for sand and dust.

For clients who have a tight space design, a side stream separator with its own pump also has the flexibility of being placed in different parts of the condenser circuit.

One caveat is that it is always preferable to place the side stream separator after the condenser pump or far before it so that the small side stream separator pump does not compete with the big condenser pump for the flow rate, which is not good engineering practice.

A typical design side stream separator would incorporate between 10-20% of the total condenser flow rate.

My point of view is that the full stream separator is not given enough importance as a highly efficient and cost effective physical filtration solution in the market.

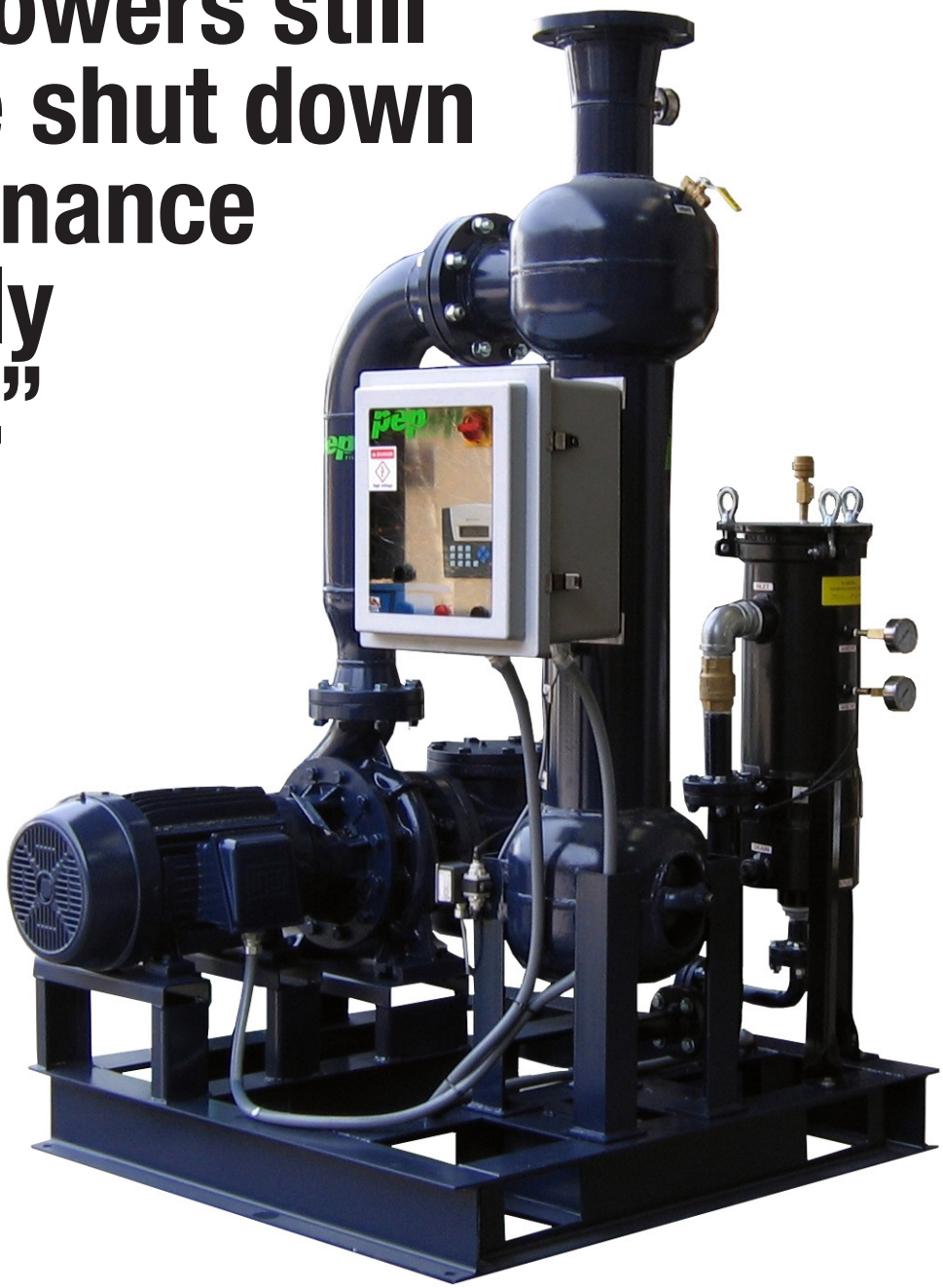
It filters 100% of the water flow rate with a relatively small price premium of approximately 25-35% greater than a side stream separator.

The reason that the full stream separator is not proportionately more expensive than a side stream separator in ratio of the water percentage being side streamed, is because it does not need its own extra pump, relying instead on the condenser pump to circulate the flow in the separator.

However, the condenser pump head normally needs to be upsized by a further 5-8 PSI to overcome the extra head generated

Stand alone full stream separators are one such solution to aid in cooling tower filtration systems.

“Cooling towers still need to be shut down for maintenance at quarterly intervals...”



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from the full stream separator. Also, there is normally a limitation to the maximum unit size available in the market for full stream separators.

Therefore, full stream separators are possibly more suited for package range cooling tower projects as opposed to district cooling industrial range cooling towers.

Also, the possible location area of the full stream separator is not as flexible as that of a side stream separator (with its own separate pump).

You can’t, for example, place a full stream separator after the cooling tower cold water basin (before the condenser pump) for the evident reason that there is very little pressure at that stage for the separator to work efficiently well.

Therefore, the full stream separator must be located downstream of the condenser pump in the pressurized zone for proper and efficient operation.

Basin Sweeper Systems should be used more often in our HVAC industry and should be standard practice. They tackle the dirty water at initial source point, in the cold water basin where the sand and other sediments settle down in the low velocity water of the basin, and just before entering the condenser circuit.

This means that the condenser pump is protected against most sand and sediments that go inside it due to the basin sweeper design and operation.

That is very important as it gives the pump a longer life, protecting such important parts as the mechanical seal and the impeller from wear and tear, leaking, erosion, and reduced pump efficiency in the long run. This additional protection results in that the mechanical seal of the pump will not leak due to such type of damage and the replacement time of the seal would therefore be extended.

As the condenser pump is critical for the chiller and cooling tower, being literally the heart of the operation, this is an important factor to the advantage of the basin sweeper design. Another nice advantage to the basin sweeper system is that it does ‘auto cleaning’ to the basin by itself.

The cooling tower basin would not need to be regularly cleaned and therefore would not require frequent shut down of the cooling towers for regular basin manual cleaning.

This is good for clients who prefer a more automated hands free approach with reduced maintenance requirements. Given

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that the basin sweeper system is cleaning at the source point, it also means that the basin sweeper system is one of the most effective enhancements for all filtration methods after the full stream separator.

However, an important point to mention here with respect to the design of the system is that due to the fact that we live in a desert climate where there is much more sand and dust in the air, and where there are frequent sand storms, the design of the basin sweeper system should be more conservative than in other parts of the world.

In the USA and Europe, for example, it is sufficient to utilize a basin sweeper system with around 5-10% side stream of the water flow to the separator. Here in our region this should be upped to around 20-25% side stream by the basin sweeper system to properly sweep the basin from accumulated sand and other dirt.

With basin sweeper systems, the basin configuration and drawings should be properly studied by the basin sweeper separator manufacturer for an optimum system design as there are many different types of basin configurations.

Separator technology normally filters the flow rate down to the range of 80 micron levels on particles with a specific gravity of 2.6 and greater. This is generally sufficient for HVAC applications.

However, for clients who require higher level of filtration or where the cooling towers are used for an industrial or manufacturing process that require a higher level of filtration, there are other filtration products to cater for such requirements. The screen filters and disc filters technology meet these requirements.

Disc filtration can filter down to any level as low as 5-10 micron with screen filtration filling the middle range between disk and separators; typically we see screen filters operating in the 20-50 micron level.

For the HVAC industry, however, the market generally veers for the separator technology which is "good enough" for most applications in our area.

But for clients with higher budgets who want to go for a more efficient design then they should consider the screen and disc filter technologies, albeit a more expensive solution.

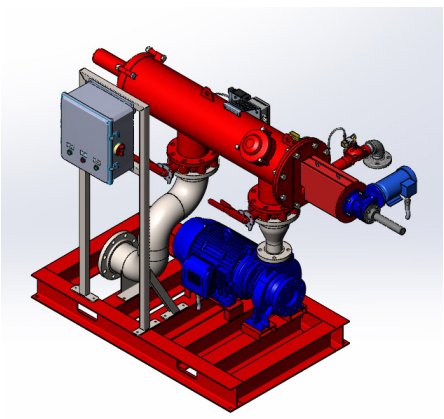
One important point to be mentioned here is that cooling tower filtration products do not substitute for regular cleaning of the cooling towers.

Cooling towers still need to be shut down for maintenance and regularly cleaned and maintained, preferably at quarterly intervals through AMC (annual maintenance contracts) with a specialist company in order to properly clean the PVC fill (the heat exchanger of the cooling tower), nozzles, hot water basin (in case of crossflow cooling tower design), piping, air inlet louvres, drift eliminators, structure (including any corrosion and proper treatment), and the rest of the cooling tower.

PVC fill scaling and improper cleaning not only reduces the life time of the PVC fill, but also increases the energy consumption due to scaling which reduces the heat transfer efficiency of the water forced convection, and the culminating evaporation process.

Improper cleaning by companies who are not experienced or specialists in the field of cooling towers can result either improper cleaning of the PVC fill with residues being left over, or worse, applying too much water pressure on the PVC fill, thereby damaging the PVC fill and having 'bits and pieces' circulating in the condenser circuit, thereby potentially damaging the pumps and even the cooling towers and condenser heat exchangers.

Also, proper cleaning of the cooling towers is very important in order to ensure that they do not become contaminated with Legionella virus, which can be a health hazard for workers as well as the end users if not properly treated with both chemical and physical water treatment that complement each other.



Screen filters are a popular choice.

Cooling tower filtration products are not just about cleaning the cooling towers. They do much more than that for the whole condenser system.

Whichever system is used, with proper design they will also optimize the heat exchanger of both the cooling tower as well as the chiller condenser performance.

It should be stated that 0.1mm scaling only on the heat exchanger reduces the heat transfer efficiency by as much as 25%.

Double that to nearly 0.2mm scaling factor and the number reaches around a 50% reduction in heat transfer efficiency.

All the system components from the pump, to the chiller, to the cooling towers are protected by filtration technology.

The condenser piping, which normally scales overtime and may reduce in terms of the available cross sectional area of the pipe for the water flow to circulate over time, will also be optimized in performance when using a proper filtration system, and will consequentially have much less scaling and therefore reduced pressure drop and related pump energy consumption in the long run of the system operation.

Scaled pipes will obviously make the pumps work much harder.

The cooling tower nozzles, distribution pipes, PVC Fill, drift eliminators and hot water/cold water basins will all operate as designed and with increased efficiency, reduced chance of fouling, improved performance, and lower scaling potential when utilizing proper filtration technology and design.

The above sheds light on the different segments of cooling tower separators and filtration products in the market, an area often ignored or likely to be under emphasised in the design stage of a mechanical system.

It is important that more study and emphasis be placed on the need for filtration and good filtration practices during the design stage when considering a water cooled chiller on a project, and especially when looking at ways to improve system efficiency, reduce energy consumption, and decrease life cycle costs over the life of a system.

Preparing and planning for the whole life of the system versus just looking at building costs has proven to be much more cost effective when viewed over the lifetime total cost of ownership of an HVAC system.