EXPERIMENTAL CHARACTERIZATION OF THE THERMAL BEHAVIOUR OF AN "IMPROVED INVERTED COOLING TOWER"

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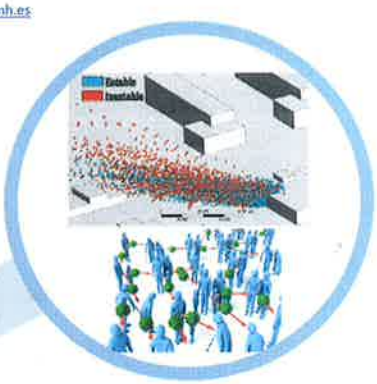
SUMMARY

Cooling towers could have an important atmospheric impact. One of these risks is related to the emission of droplets to the atmosphere. These droplets can be a vector for the dispersion of pollutants and infectious agents. The most important, due to its frequency and importance of the outbreaks, is Legionella. In this work, it is presented a new design of mechanical draft cooling tower that limits the emission of droplets to the exterior and prevents the dispersion of Legionela bacteria. This new design is based on drastically lowering the flow velocity at the exit of the tower in order to reduce its capacity to drag drops to the exterior and to keep small droplets generation out of the outlet. To analyze the behavior of this new design, a real prototype has been constructed. It is designed to be able to dissipate a thermal load of 45 kw. The sensitive paper technique is employed to test the capability of this prototype to prevent the emission of droplets to the ambient. Several tests were carried out and no significant emissions were detected. With respect to its thermal behavior, experimental results show similar values of NTU to commercial mechanical draft cooling towers.

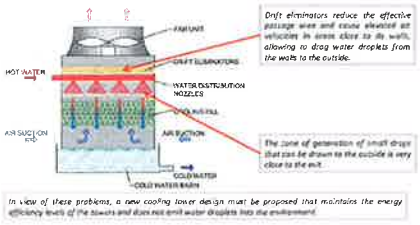


1. BACKGROUNDS

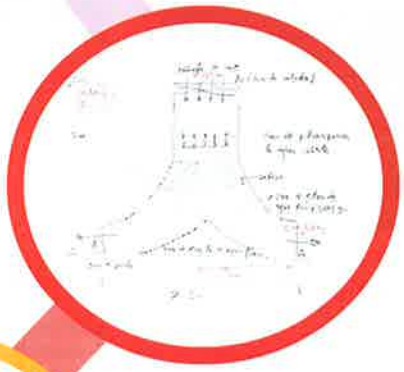
During the last ten years, different outbreaks of legionella have taken place in southern Spain. For infection by legionella, four steps should take place: the breakthrough in the cooling tower, the proliferation with this device, the emission and dispersion in the urban area, and the exposure by humans. We may reduce the possibility of infection by acting on all these steps. This work is focused on the third one: emission and dispersion.

2. DRIFT ELIMINATORS

Drift eliminators at the exit of the cooling tower are designed to avoid the escape of droplets (drift) by inertia phenomena. However, it has been detected that many times they cannot prevent the emission of these droplets. For this reason, other alternatives should be considered.



3. ORIGINAL IDEA



A new prototype of cooling tower was designed to avoid the escape of droplets. The main differences with respect to commercial ones are:

1)the air flow direction is the opposite. Air go in at the upper part of the tower and exit at the bottom part. In this way, we can put an exit area twenty times the inlet area, and we can reduce the air velocity in the same ratio.

2)To be able to take advantage of the whole exit section in order to get uniform velocity at the exit, the filling should be well placed.

3)The sprayers are placed far away from the outlet. In this way, the smallest droplets can evaporate, or stick to the walls or can coalesce with others with other drops, increasing their diameters and finally falling by gravity to the water tank.

4. GEOMETRY OPTIMIZATION

To get the final prototype there were some parameters that should be defined: the height of the tower, the dimensions of the inlet and of the outlet, the diameter of the bottom, the shape, among others. We carried out a numerical study to optimize these parameter.

5. FINAL PROTOTYPE

According to the previous studies, the new prototype of cooling tower was constructed.
The technique of the hydrosensible paper showed that in the tests carried out, the new prototype does not emit drops of water to the outside.
The thermodynamic characteristic of the new prototype appears to be somewhat similar than that of a conventional tower.

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