ABSTRACT

In a tropical country like India, industrial sheds are constructed with masonry walls and asbestos cement sheet roofs, which have higher cooling load. Air conditioning such sheds using conventional Mechanical Vapour Compression type air conditioning systems are practically difficult and hence not practiced. Evaporative cooling will be a suitable alternative. The commercially available wetted pad type evaporative coolers are capable of cooling smaller air volumes and hence are not suitable for cooling large industrial sheds, which require large cold air volumes. In this context, the present research work aims to develop a centrifugal atomizer type evaporative air cooler suitable for large industrial sheds located in tropical climates and to carry out performance improvements.

An experimental facility has been developed which has a centrifugal humidifier type evaporator capable of cooling an industrial shed of 10 m × 3 m floor area having an asbestos cement sheet roof. The evaporative cooler has a centrifugal atomizer, a water supply system, an evaporation chamber, a droplet eliminator, a fan, an air filter and flow straighteners. With necessary instrumentation, DBT and WBT of outside atmospheric air, at evaporative cooler inlet, at test space inlet, 27 locations within the test space and at test space outlet are measured. Air flow rate at test space inlet and at
test space outlet and solar radiation incident on the roof surface are also measured.

Using the facility, effect of spinning disc diameter, its speed, breaker strip geometry, length of evaporation chamber, air flow rate and supply water flow rate are tested. Experiments are carried out from 6.00 AM to 6.00 PM during May 2009, and data from 7.00 AM to 5.00 PM are used for calculations. Then using Taguchi method, optimization of parameter settings has been carried out.

The research work has shown that the centrifugal atomizer type evaporator is capable of cooling large air volumes and is suitable for cooling large industrial sheds. The drops in average interior DBT when compared to the corresponding outside DBT over a day obtained are 8-12 °C. Rectangular shaped breaker strips are found to provide higher performance, when compared to triangular and circular ones. Increase in disc diameter, disc speed and evaporation chamber length increases the humidification efficiency. For the given set up, optimum values exist for air flow rate and supply water flow rate. The optimization study has shown that disc speed, air flow rate and supply water flow rate influence the system performance by 33 %, 21 % and 19 % respectively, whereas the influences of other parameters are less than 5 %. With optimized settings, about 32 % higher performance is obtained when compared to the initial parameter setting.