CONDENSATE RECOVERY FROM AIR HANDLING UNITS AND FAN COIL UNITS TO REDUCE THE WATER CONSUMPTION BY THE AIR CONDITIONING SYSTEMS

S.Ragulakeethan

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ABSTRACT

This study investigates the potential for reduction of makeup water consumption by recovering condensate captured from Air Handling Units (AHUs) and Fan Coil Units (FCUs) of central chilled water system in hot and humid climatic conditions. In conventional air conditioning systems, significant amounts of condensate is generated at different components and typically discharged as waste. The cooling towers are used to enhance the heat rejection efficiency of the condenser of the chilled water systems. Usually, it requires a significant amount of makeup water (2% of nominal flow rate) to replenish the regular water losses, mainly due to the evaporation. Therefore, the condensate collected from the AHUs and FCUs can be routed through the cooling tower, resulting in the reduction of potable water usage and to improve the quality of the cooling tower water. This paper presents a method to collect the condensate water and store it in a holding tank for later use in offsetting the cooling tower makeup water requirement. The analysis was performed by collecting the condensate from AHUs/FCUs of five different types of buildings in three different weather zones in Sri Lanka with varying climatic conditions. The findings demonstrate that condensate recovery can be an effective strategy to reduce the water consumption in central air conditioning systems, especially in regions facing water scarcity or high-water costs. The potential benefits of this approach include decreased water consumption, lower water bills, and a reduced environmental impact and eventually the overall energy consumption of the system.

Keywords: *Water conservation, Hot and humid climate, Condensate recovery, Makeup water, Central air conditioning system*

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Abbreviation	Description
AHU	Air Handling Unit
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BREEM	Building Research Establishment Environmental Assessment Method
CAP AHU	Condensate Assisted Pre-Cooling Air Handling Unit
LEED	Leadership in Energy and Environmental Design
NTU	Nephelometric Turbidity Unit
T	Temperature range of condenser/cooling tower (◦C)
WPU	Water Production Unit

Superscripts	Description
°C	Degree Celsius

Subscripts	Description
C_p	specific heat capacity of water (kJ/kg K)
m_{con}	production of condensate flow rate (l/s)
m_{amb}	outdoor air flow rate (m^3/s)
Q_{con}	condenser capacity (kW)
w_{amb}	outdoor air absolute humidity (kg/kg)
w_{off}	off-coil air absolute humidity (kg/kg)
W_c	condenser/cooling tower water flow (l/s)
W_m	make up water (l/s)
W_e	water loss due to evaporation (l/s)
W_b	water loss due to drift (l/s)
W_d	water loss due to blow down (l/s)