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# ANALYSIS OF AN AIR CONDITIONING SYSTEM USING UNDERGROUND THERMAL ENERGY STORAGE COMBINED WITH CHEMICAL DEHUMIDIFICATION

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**Abstract:**

An Underground Thermal Energy Storage (UTES) could provide a suitable thermal source for heat pump systems in building HVAC plants. Due to the seasonal energy storage, summer operation is improved by the cooling phase of the UTES during the winter operation and free-cooling is allowed. Chemical dehumidification on a suitable ventilation airstream could perform humidity control, avoiding additional cooling power.

In the present paper a HVAC plant of an office building with primary air and fan-coils is considered. The system is equipped with a heat pump whose source is an UTES with borehole heat exchangers (BHEs). As the temperature of the BHEs water is usually well above the air dew point, free-cooling on the fan-coils side can only satisfy the sensible cooling load. Humidity control is then separately obtained by a ventilation airstream on which chemical dehumidified is performed by liquid desiccants in a packed column.

A parametric study is carried out varying the size of the BHEs, the ground type with reference to a Southern Europe climate where the HVAC plant winter or summer operations are required for a large extent over the year. The described free cooling operation is compared to a conventional system operation with a compression heat pump satisfying the whole load, sensible and latent. Having a potential strong influence on the heating mode heat pump COP, the thermal levels of the UTES are evaluated on a ten year period basis. The system configuration and operation mode are optimised both from an energy and economic point of view. The specific contribution of chemical dehumidification to the plant configuration and performance is shown, reducing the typical UTES system pay-back period.