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**DUAL INDIRECT CYCLE AIR-CONDITIONER USES HEAT  
CONCENTRATED DESICCANT AND ENERGY RECOVERY  
IN A POLYMER PLATE HEAT EXCHANGER**

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**ABSTRACT**

This desiccant technology removes compressor-based air-conditioning's dependence on fossil fuel generated electricity, which wastes most of the fuel's energy as greenhouse gas. Instead electricity is limited to circulating air and minor liquids. Cooling and heating require only heat such as from gas, cogeneration or solar sources. Demand management is by storing desiccant.

The technology also removes potential corrosion and health hazards of the desiccant air conditioning that allows carryover of desiccant and volatile organic compounds such as formaldehyde in building supply air. Additionally, its energy recovery facility allows filtered air to be economically provided from outside.

This air-conditioner's first cycle uses energy recovery and indirect evaporative cooling (IEC) in a polymer plate heat exchanger (PPHE), having fully separated flow passages. In the PPHE, dry or wetted building exhaust air cools, indirectly, supply air drawn from outside.

In the second cycle, exhaust air is dried by concentrated liquid desiccant in a second PPHE section. Heat of moisture absorption and condensation is coincidentally removed by IEC using outside air treated by the same process. Dried exhaust air then enters the first cycle, is wetted, and cools and dehumidifies, by IEC, supply air to provide ideal indoor conditions in temperate and tropical climates. Uncooled dried exhaust air indirectly heats supply air in cold climates.

The lithium and calcium chloride desiccants used are natural refrigerants, which are concentrated by 85°C heated air in a third PPHE section.

This technology substantially reduces greenhouse gas emissions, facilitates energy demand management, and its high ventilation rate maximises indoor air quality.

**Key words:** Air-conditioning, liquid desiccant, plate heat exchanger, energy recovery, natural refrigerant, gas cooling, desiccant concentration, energy storage, temperate and tropical areas, indoor air-quality.