Abstract of the XERIC keynote presentation

The 3-Fluids Combined Membrane Contactors as new climate-control units for more energy-efficient electric vehicles: an outline of H2020 XERIC project

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Session

ENERGY SUPPLY FOR INTENSIFIED PROCESSES

Time: Wednesday, 06/Jun/2018 _ 2:00pm - 3:30pm ; *Session Chair:* Denis Bouyer Thesis Room

KEYNOTE Presentation

THE 3-FLUIDS COMBINED MEMBRANE CONTACTORS AS NEW CLIMATE-CONTROL UNITS FOR MORE ENERGY-EFFICIENT ELECTRIC VEHICLES: AN OUTLINE OF H2020 XERIC PROJECT

Charpentier, Jean-Claude, Université de Lorraine, France

According to the recent trends in scientific research, automotive market leanings and grants by European Commission, a wide diffusion of Battery Electric Vehicles (BEVs) is highly investigated and promoted, since it can noteworthy help improving energy savings and environmental sustainability. However, as known, the limited capacity of electric batteries combined with the substantial amount of energy needed to run auxiliary equipment dramatically affects the range capability of BEVs. One of the main energy-consuming onboard systems is the climate control system, which in summer conditions can absorb up to 60% of the available energy. The EU-funded H2020 XERIC project (www.xeric.eu) is aimed at developing an innovative climate-control system for BEVs capable to increase BEVs autonomy thanks to its high-energy efficiency and thus, to reduce by more than 50% the energy used for passenger comfort all over the year.

Currently, air is dehumidified and cooled through a Vapor Compression Cycle (VCC), which cools air below its dew-point. Alternatively, solid or liquid desiccants are used in direct-contact air-liquid desiccant plants to dehumidify air without cooling it below its dew-point; this allows controlling air temperature and humidity independently. However, these desiccant systems cannot be used in vehicles due to some issues mainly related to droplets carryover, size and vibrations.

The XERIC system combines a traditional VCC with a Liquid Desiccant Cycle (LDC), by taking advantage of an innovative component, called Three-Fluids Combined Membrane Contactor (3F-CMC). In this patented component, three separated fluids work simultaneously: the process air, the liquid desiccant and the refrigerant, derived from the VCC. In detail, the process air is dehumidified and partially cooled while flowing over a hydrophobic membrane, which can be crossed by water vapor but not by liquid desiccant (LiCl aqueous solution). On the other hand, since during the dehumidification process the temperature of the desiccant would raise leading to lowered performance, the refrigerant is adopted to maintain this temperature almost constant throughout the whole 3F-CMC. As well as the refrigerant, also the liquid desiccant undergoes a cycle: indeed, a second 3F-CMC is adopted to re-concentrate the weak solution coming from the first 3F-CMC, by releasing vapor to an external air flow. The desiccant regeneration process is realized by exploiting the thermal energy given by the refrigerant exiting the compressor of the VCC. Within the project, many activities were performed and/or are in progress, ranging from CFD modeling to help designing the 3F-CMC and predicting its performance to membrane development and scale-up, from electronic control system implementation to system architecture optimization, from 3F-CMC prototypes manufacturing to full system assembling and testing in the laboratory, from dissemination activities to Intellectual Property Rights (IPRs).

The communication presents and comments some of the main results obtained so far and leading to the design of a small-scale prototype of an energy-saving climate control system for electric vehicles currently on the market.