

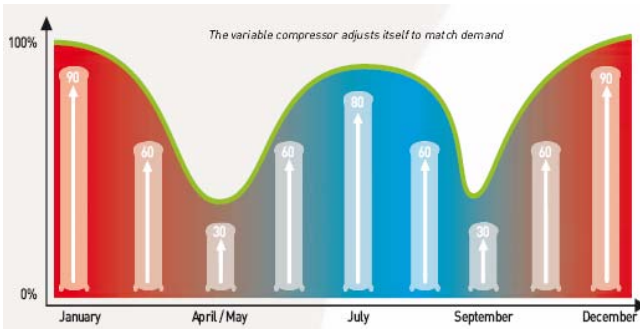
General information:

- Name of technology: **Variable speed in a reversible air to water heat pump**
- Technology developer: **CIAT – BP 14 – F- 01350 CULOZ (France)**
- Date of issue (year): **2008**

Aims and Objectives

Design and sizing of reversible air conditioning/heating systems (heat pumps) are often based on the full load performance, in order to respect thermal comfort at extreme conditions. However, the HVAC industry is switching to design based on improved seasonal performances at part load.

The principal aim of this project is to show that it is possible to design high energy efficiency heat pump. In order to improve the seasonal performances of these products, the main design works are on the optimisation of running at part load.



A Short Description of the Technology

The design and the sizing of the heat pump are made in collaboration with the mines school of Paris (ARMINES). The performances of the heat pumps were studied in five different climates: Nancy (East French Area); Trappes (North French Area); Rennes (West French Area); Macon (Central French Area) and Nice (South French Area). The aim of the model is to determine the reduced load curve for these five climates.

Many options are modelled like:

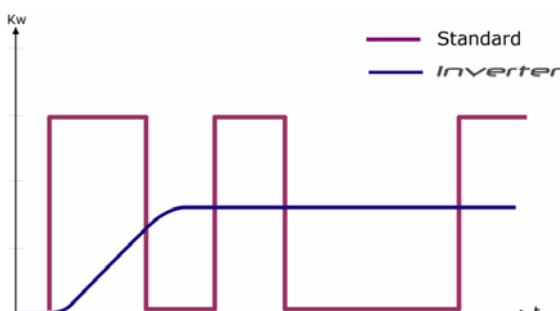
- ✓ A variable speed compressor;
- ✓ A variable speed fan;
- ✓ An electronic expansion valve;
- ✓ The heat exchangers;
- ✓ An optimised defrosting.

The used refrigerant is the R410A.

The principal component of this unit is the **inverter scroll compressor** (frequency range: 30 to 90 Hz). It is the first time that such compressor will be used on this power range (around 50 kW).

It presents the following advantages:

- ✓ A reduction on an electricity bill of up to 26 % compared to a standard machine.
- ✓ The amplitude of the oscillations of water temperature is divided by 3 with a better comfort and a reduction of electric consumption.
- ✓ The continuous adjustment with the installation real needs which are 95 % on time at part load capacity.

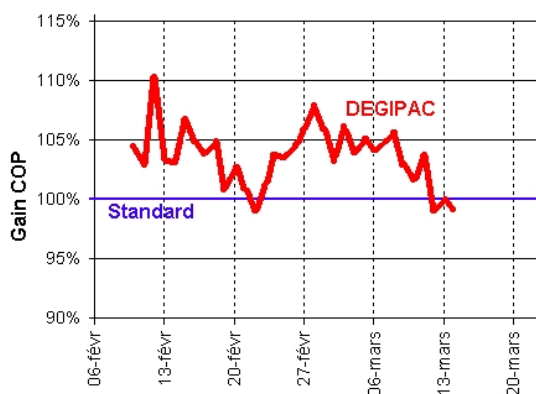


Another important component is the fan. **The fan's motor with the continuous variable speed** is particularly quiet because the heat pump has less on/off cycle (fan and compressor) than a standard heat pump. The noise level is halved.

The variable speed auxiliaries using follows a reduction on an electricity bill up to 30%. The control of such equipments is ongoing today.

Variable speed in a reversible air to water heat pump

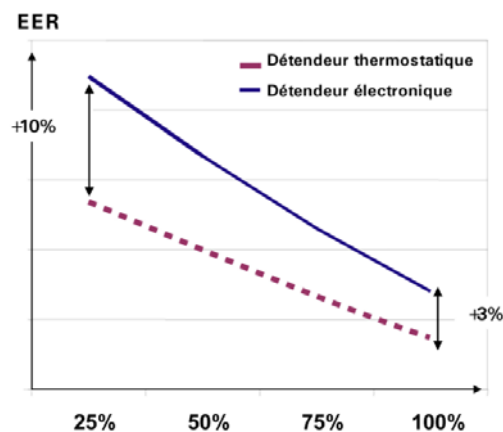
Developed during "le bâtiment à l'horizon 2010" – ADEME 2003



The **optimized defrost** called "DEGIPAC" is a special development which can detect the presence of ice on the coil. It will only defrost when necessary and only when the coil's performance will be affected. The system can have a longer of the useful heating time because the defrosting is shorter and their number is halved therefore an increase of the seasonal COP of 5%.

The heat pumps are equipped with CONNECT controller which allows the following choice of mode: **low noise or high efficiency**. These choices are made with an electronic expansion valve and the variable speed fan.

The electronic expansion valve can improve the performances of the heat pump by 10 % when the compressor runs at 25% of the capacity in comparison with a thermostatic expansion valve. At full load, the improvement can be 3 %.



Results and Achievements:

- ✓ A demonstration site located in Culoz (France) has been equipped in January 2008 with such heat pump. The first results of the annual performances will be available at the beginning of 2009.
- ✓ In parallel to this project a range of two heat pumps has been developed by CIAT named "**the AquaCiat Grand Inverter**". The first has an ESEER (European Seasonal Energy Efficiency Ratio) of 3.97 and the second has an ESEER of 3.87 at standardised conditions (EUROVENT conditions). This can represent an improvement up to 13 % compared to a standard heat pump.



Possible application area:

- ✓ Heating and cooling of offices, administrative, commercial, hotels collective and residential buildings
- ✓ Refurbishment and new building

References:

The APACHE project's aim (high energy efficiency heat pump), funded by ADEME in the following program "le bâtiment à l'horizon 2010", is to decrease the annual electricity consumption of the heat pump (annual performances).

The principal aim is to show that:

- ✓ It is possible to design and sizing heat pumps and chillers with a high energy efficiency. In order to increase the seasonal energy efficiency, the design and the sizing of the main components must be realised at part load conditions.
- ✓ The performances increasing can be realised with a limited increase in the cost in order to have an investment return acceptable.

Partners involved in the project are: ARMINES (leader), CIAT, GRETHE

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- energy efficient building materials, components and systems not yet introduced into the building market or in their first market phase;
- innovative applications of heating/cooling and power supply technologies, combined with the use of renewable energy sources, in building sector;
- best EU demonstration eco-building projects.