LOW POWER HEATING SYSTEMS BASED ON JOULE EFFECT FOR EV APPLICATIONS

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JOSPEL Fact Sheet

- **Title**:
  - "Low energy passenger comfort systems based on the joule and peltier effects"
- **Starting / ending (duration)**:
  - May 2015 / October 2018: 42 months (currently in M30)
- **Funding**:
  - This project is funded under the European Call H2020-GV-2014, Topic GV-2-2014 Optimized and systematic energy management in electric vehicles.
- **Budget**:
  - EC Contribution € 6,668,288.00
- **Consortium**:
  - 14 Partners from 9 countries

JOSPEL

PARTNERS INVOLVED

CTAG

AIMPLAS
INSTITUTO TECNOLÓGICO DEL PLÁSTICO

Atos

CIDETE
EL ARTE DE REFRIGERAR

TERMOELECTRICIDAD

durplastics
Technical Plastics Manufacturing

Fraunhofer ISE

alkè
high performance utility vehicles

INSERO
E-MOBILITY

GRUPO Simoldes
Plastic Division

ARKEMA
INNOVATIVE CHEMISTRY

AMV DESIGN

DOK-ING

European Thermodynamics Limited
Intelligent Thermal Management

cleancarb

JOSPEL OBJECTIVES

The main objective of Jospel is the reduction of:

- At least 50% of energy used for passenger comfort (<1,250 W)
  - ➢ 30% from Joule heating devices

- At least 30% for component cooling in extreme conditions

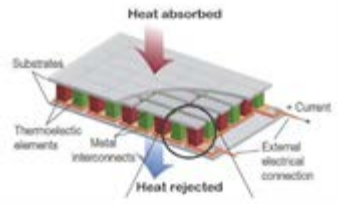
All with reference to electric vehicles from Alkè and Dok-ing

ALKE ATX210E

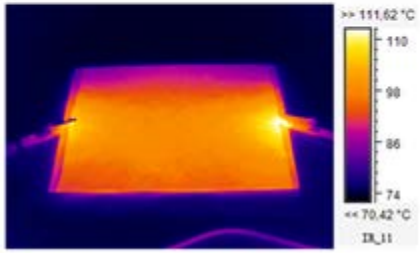
DOK-ING LOOX

JOSPEL CONCEPT

Development of a novel **energy efficient cooling system** based on Peltier cells technology



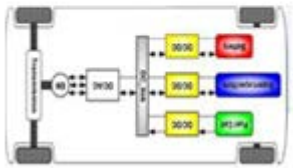
Development of a novel **energy efficient heating system** based on Joule effect



Improvement of **vehicle insulation**

Improve **energy recovery** from heat zones and increase **battery life**

Innovative and **eco-driving strategies** and electronic control of power flows



JOSPEL Improvements

Improvement	% Energy reduction
Heating system based on Joule Effect	30%
Cooling system based on Peltier cells	25%
Battery consumption due to their optimal thermal management	15%
Thermal management of other EV components and eco-driving technologies	12%
Weight reduction and better insulation of the cabin	3%

Joule Heating (or resistive heating)

Joule effect: Process by which the passage of an electric current through a conductor releases heat.

Task Objective:

- Development of a novel and innovative heating system based on the use of Joule Effect in thermoplastic sheet and thermoset coating.
- Reduction of energy consumption of at least 30% in comparison with current PTC heaters (installed in case vehicles)

Means of verification: Maximum power installed 800W

Joule Heating (or resistive heating):

Two systems are developed:

1) **Rigid multilayer sheets in a thermoplastic matrix**:

- Recyclable
- Fast and cheap production process

2) **Fabrics with a heating coating in a thermoset resin**:

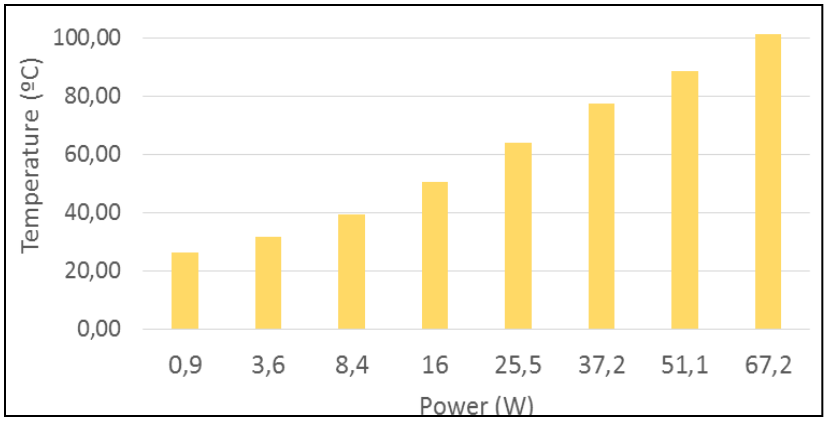
- Flexibility
- Higher heating capacity

1) Thermoplastic conductive panels

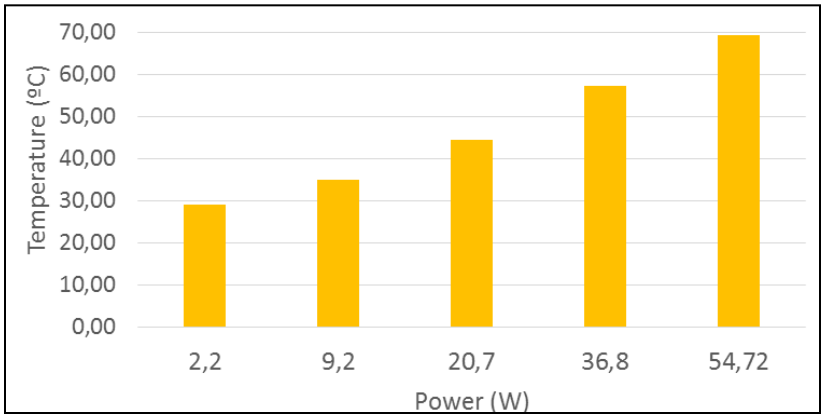
Production and preliminary studies

- Conductive particles are dispersed in a thermoplastic polymer matrix.
- The panels are produced via cast extrusion process
- Uniform and fast heating
- Upper service temperature of 70ºC
- Customizable heating performance varying plastic formulation and panel geometry.

15x15 cm



15x30 cm



1) Thermoplastic conductive panels

2 min to heat up

1) Thermoplastic conductive panels

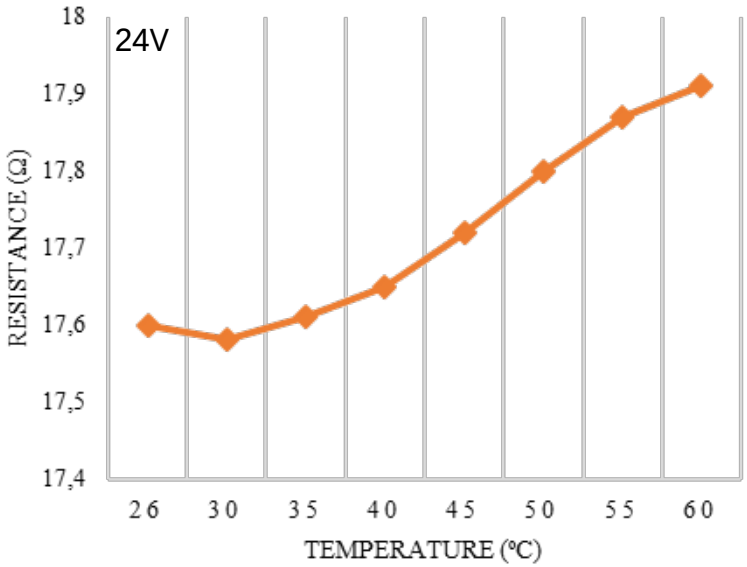
Production of prototypes

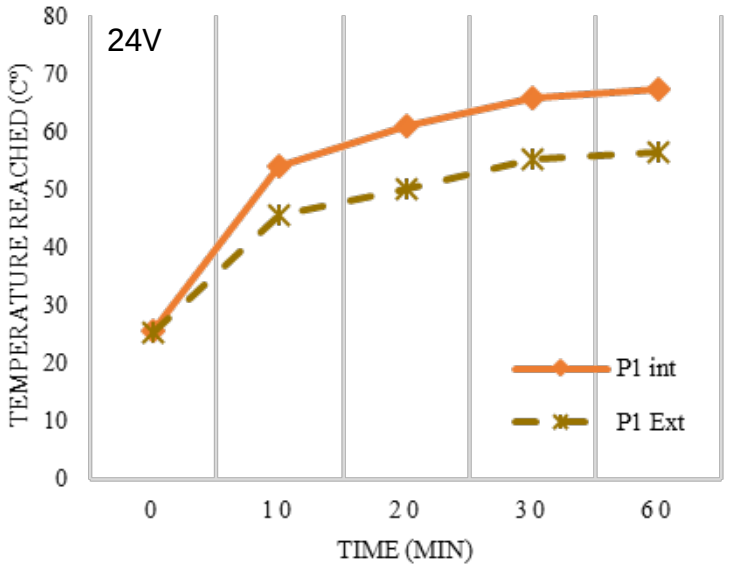
- Alkè design: heating panels of 200x350mm
- Multiple upholstery study: selection of polyester fabric and semi-leather (no foam).
- Temperature sensor incorporated

1) Thermoplastic conductive panels

Properties

- PTC behaviour: self regulating heating at fix voltage
  - ➢ No need for thermostats
- Thermoformable, without loosing electrical resistivity (non-flat geometries)
- Recyclable, in the same or different applications





1) Thermoplastic conductive applications

Installation (Alkè)

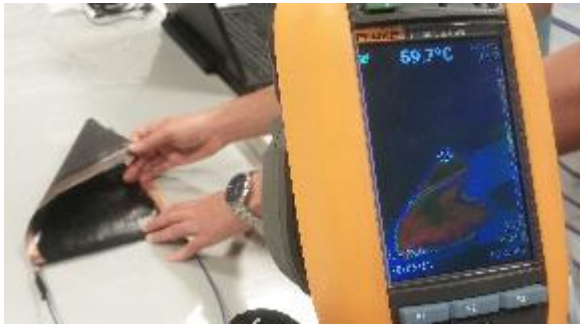
- Two panels in doors (visible)
- Panel under seat (hidden)

Technical specification	Value
Total Resistance [ohms]	18,25
Voltage [Volts]	24
Power [Watts]	31,6
Dimensions [m2]	0,07
Power/square meter [w/m2]	451,1

2) Heating fabrics

Production and preliminary studies

- Nanoparticles are transferred to the fabric through a coating process by means of a colloidal dispersion specially designed.
- Customizable heating performance, fine-tuned through specific formulation of the conductive dispersion
- Uniform and fast heating
- Upper service temperature of 100ºC



2) Heating fabrics - Heating up behavior

24 Volts

30 Watts

1) Thermoplastic conductive panels

Production of prototypes

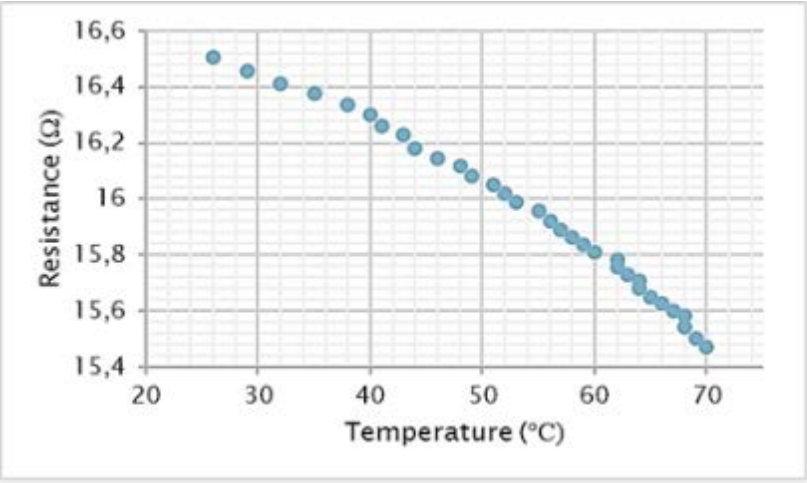
- Alkè design:
  - Roof heating panels of 250x200mm (hidden)
  - Floor heating panel of 950x270mm (hidden)

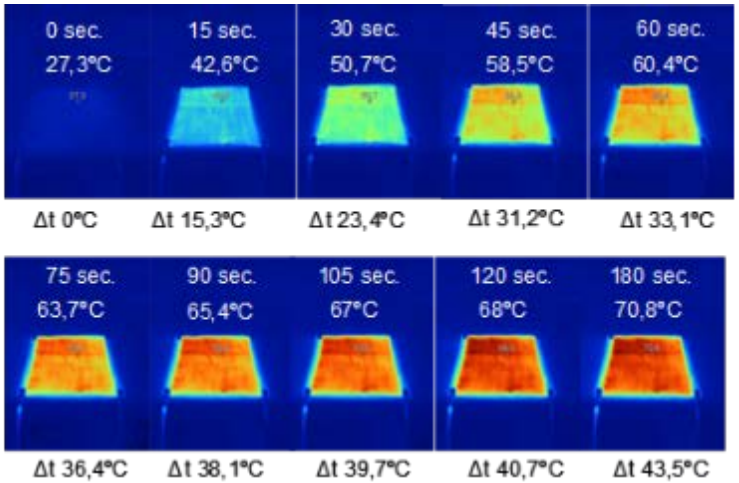
- Selection of insulating materials, electrodes type, and composition and number of layers of conductive coating to optimize heating behaviour.

2) Heating fabrics

Properties

- NTC behaviour: fast heating and high temperatures reached.
- Flexible electrodes, keeping electrical and structural stability.
- Possibility of non-flat surfaces
- Thermoset: high durability and mechanical resistance



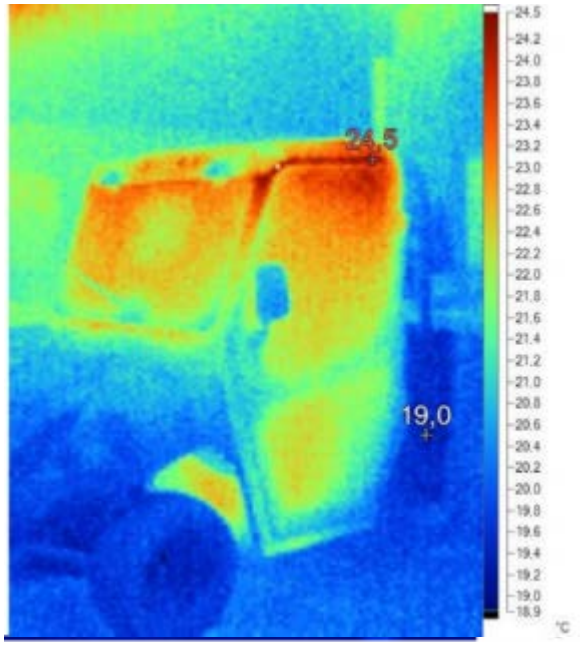


2) Heating fabric aplications

Installation (Alkè)

- Roof heating panels (2 sections)
- Floor heating panel (1 section)

Technical specification	Floor	Roof panel
Total Resistance [ohms]	45,6	51
Voltage [Volts]	48	48
Power [Watts]	50,5	45,2
Dimensions [m2]	0,083	0,039
Power/square meter [w/m2]	606	1156



Heating of cabin after 30 minutes

Joule Heating power consumption

Total power consumption of currently developed Joule heating systems is:

Heating Element	Power [Watts]
Door panels (4 rigid heating sheets)	126,3
Floor panel (1 sections)	151,5
Roof panels (2 sections)	90,4
Total	368,2

The total power reduction achieved with Joule effect heating systems is **63%**, respect to power consumption of current ceramic PTC heaters (1000 watts) used in Alkè vehicle.

Summary and conclusions

- In JOSPEL project the development of a novel and innovative heating system based on the use of Joule effect in thermoplastic sheet and thermoset coating is being carried out.
- Important reduction of energy consumption of HVAC systems (in comparison with current PTC heaters) has been achieved. 63% reduction with new heating elements
- Currently, final prototypes are being integrated in Alkè vehicle, and proximately in Dok-ing vehicle

More information

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Thank you!!

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