Experimental Characterization of an Active Thermal Wall based on Thermoelectricity (ATW).

Caracterización Experimental de un Paramento Transparente Activo Termoeléctrico (PTA)

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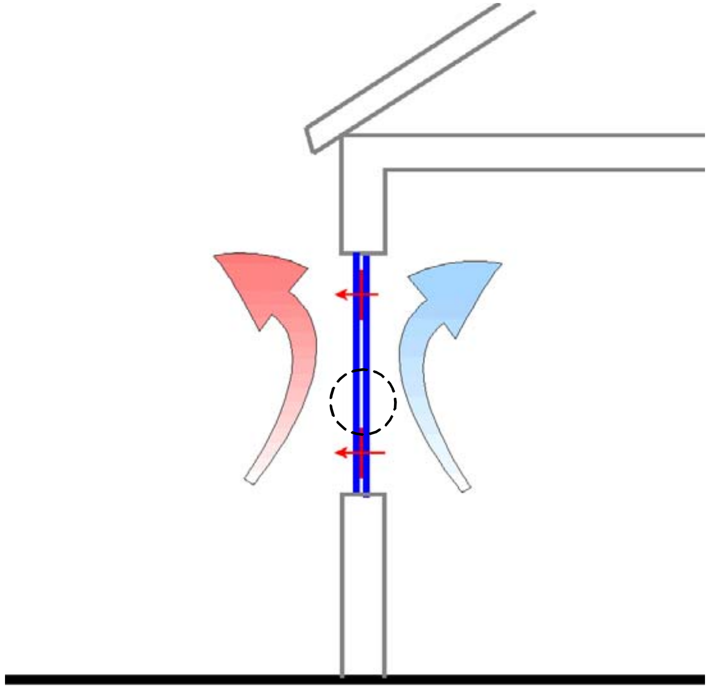
Active Thermal Wall based on Thermoelectricity (ATW)

- Active Thermal Wall
  - Is a heat pump system that uses Peltier effect
  - TE elements are embedded into the panel
  - If the panel is transparent (glass/Plexiglas) it can replace windows

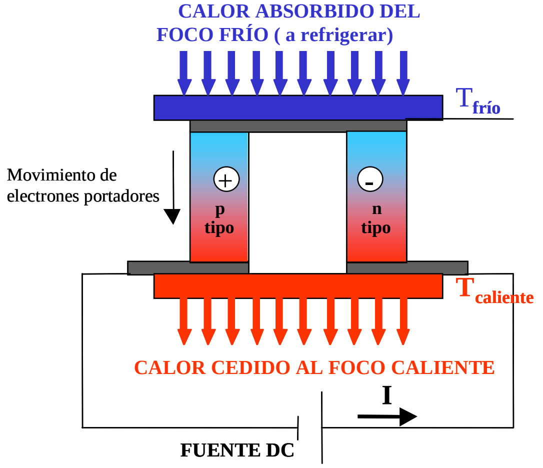


*US and Eurpean Pattent

Background

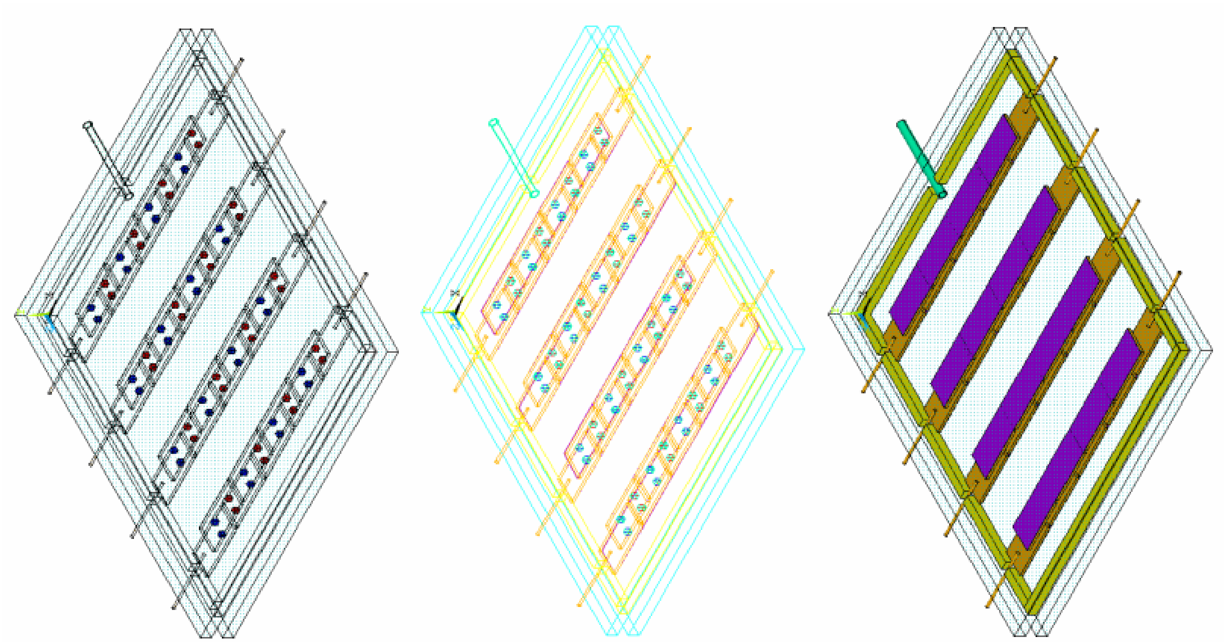
- Thermoelectric material are semiconductors that transfer heat if supplied with DC current.

- Advantages over other conditioning technologies:
  - Simple electronic control
  - Absence of fluids, pipes and pumps (just requieres electricity)
  - Small size (cooling system embedded in windows/walls)



Prototype

- Small prototype: 105x120mm
- 4 TE chain comprising 16 pellets each
- Chain 10mm, spaced once every 30mm

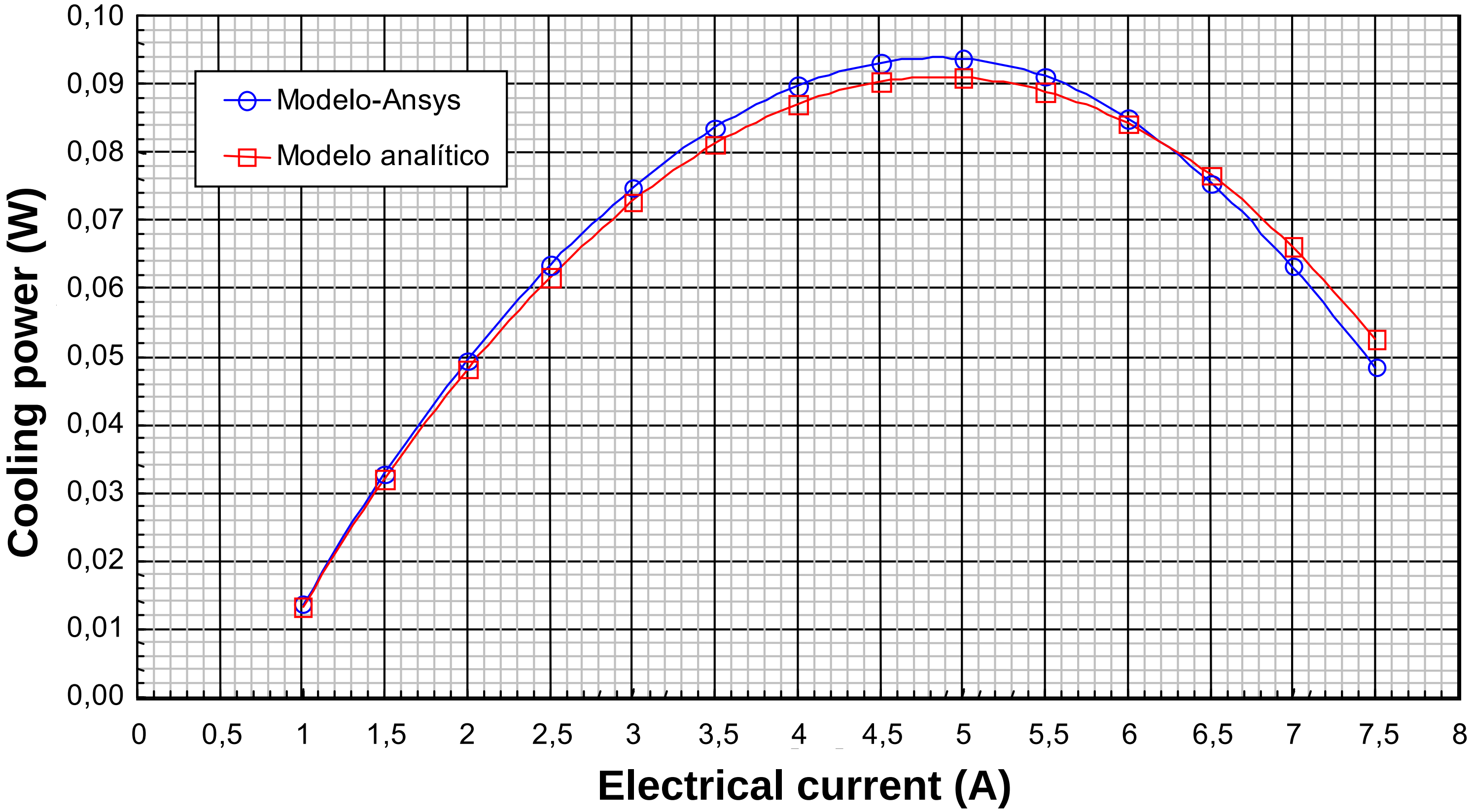


Numerical Results

- Analytic solution
  - Based on mathematical equations
  - Problem solved using Matlab

- Numerical simulation
  - Based Finite Element models
  - Solved using Ansys

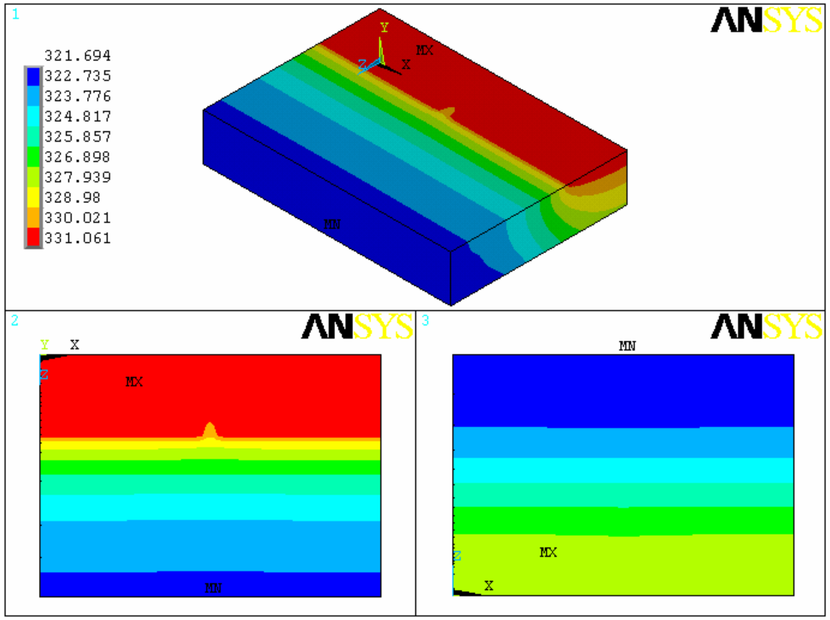
Numerical Results



- Cooling power as a function con electrical current
- Performance of one single pellet at Tc=20ºC and Th=40ºC
- Maximum power for the whole prototype is 0.09x16x4=5.76W

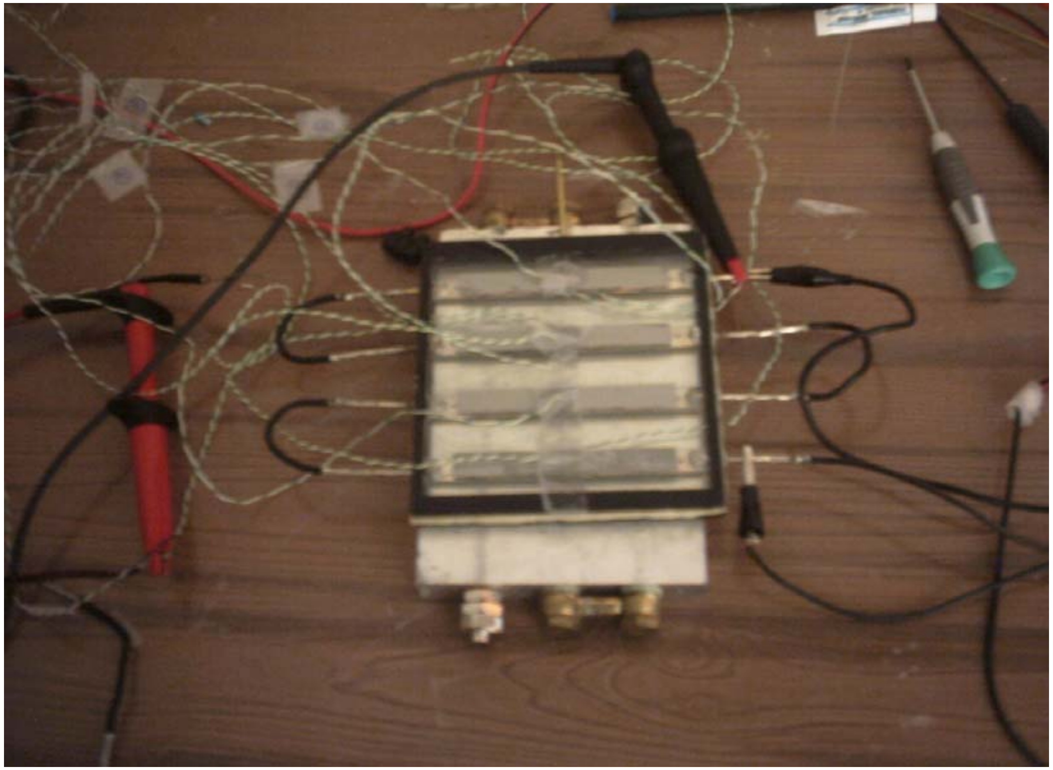
Numerical Results

- The main problem is how to transfer heat from a flat surface to the air
- Thermoelectric power is higher that the natural convection heat transfer
- Conventional glass conductivity is very low



Experimental Results

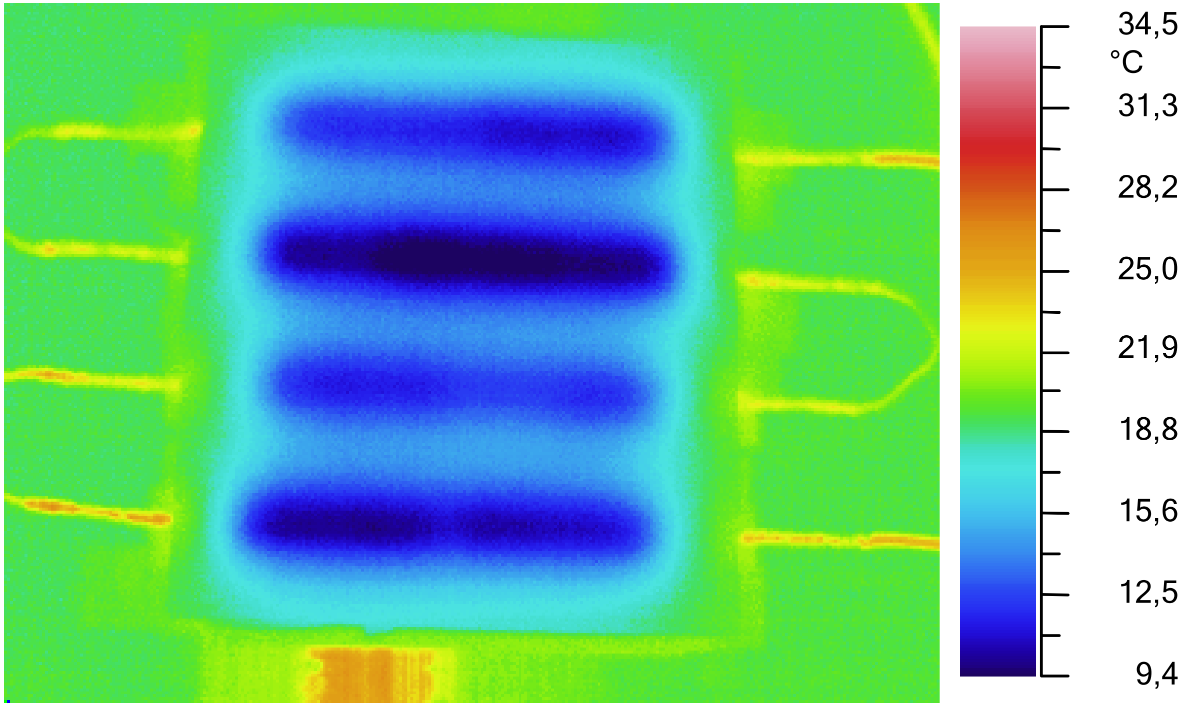
- A prototype was built and tested at our laboratory
  - Several sensors were installed
  - An IR camera was used



Experimental Results

- External surface of the cold side
- Experimental conditions: Th=25ºC, I= 4.5A
- Main results: Temperature on the glass ranging from 9.4ºC to 17ºC

Temperature map as obtained with the IR camera.



Conclusion

- A small prototype of ATW has been built.
- Numerical tools have been developed to estimate the behavior of larger elements.
- Experimental tests show that the prototype is working properly (ΔT_{max} = 15ºC at 4.5 A).

- Promising technology mainly where installation of conventional equipment is problematic
  - Historic buildings
  - Technical difficulties
  - Esthetic or size restrictions