



UNIVERSITATEA TEHNICA DE CONSTRUCTII BUCURESTI  
DEPARTAMENTUL DE CERCETARE SI PROIECTARE IN CONSTRUCTII  
Bd. Lacul Tei 124 \* Sect. 2 \* RO-020396 \* Bucuresti - ROMANIA  
Tel.: +40-21-242.12.08, Tel./Fax: +40-21-242.07.81, [www.utcb.ro](http://www.utcb.ro)  
Functionare conform HG nr. 223/2005, cod fiscal R13726642



# ***Theoretical Comparative Study Case, DME and HFC Mixture Alternatives Retrofit***

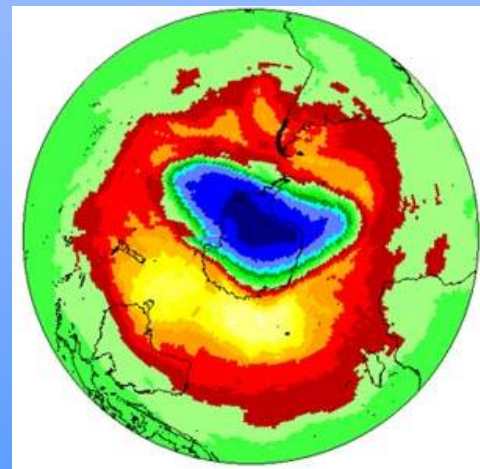
**Tarlea, G. #1,\*2, Vinceriu, M. #1,\*2,, Tarlea A #1**

**#1Romanian General Association of Refrigeration**

**\*2Technical University of Civil Engineering, Bd. Pache Protopopescu nr. 66,**

**Bucharest, 021414, Romania,**

**[vinceriu@gmail.com](mailto:vinceriu@gmail.com);**



# Introduction

- To eliminate several type refrigerants CFC, HFC and HCFC synthetic substances which nature can not dissociate rapidly and accumulate contribution to global warming and ozone depreciation was made an intense research activity, which analyzes various alternative mixtures.
- DME's is one of refrigerants used in the past but that was dropped at some point because the main disadvantage (flammability). However due to its qualities (low saturation pressure, high latent heat of vaporization) but mostly green (no emissions and does not destroy the ozone layer) using DME's and its mixtures as heat thermodynamic systems work is great interest.
- DME is the ecological refrigerant that can be replaced in small and medium refrigeration systems (refrigerators, air conditioning, etc.) having a lower boiling point, a better vaporization and a lower priced. Another goal is to reduce the amount of refrigerant for convenient operation of the system and intended use refrigerants with low global warming potential.

# Introduction

In Table 1 and the graphs in Figures 1, and 2, one can see both the critical and substitute refrigerants molar mass and the advantages of the two alternatives proposed: Alternative 1, Alternative 2 (such as low pressure and higher heat latent vaporization).

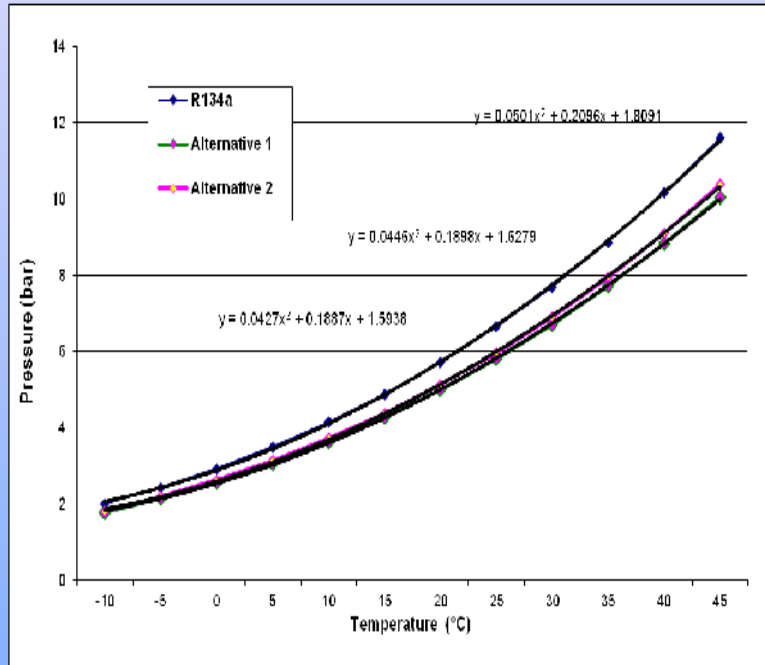


Fig.1 Vapor pressure refrigerants vs. temperature

Refrigerant	R134a	Alternative 1 R134a /DME (60/40%)	Alternative 2 R134a /DME (80/20%)
Critical temperature [°C]	101.06	119.11	112.89
Critical pressure [bar]	40.59	48.001	45.077
Critical density [kg/m <sup>3</sup> ]	511.9	383.09	440.1
Molar mass [kg/kmol]	102.03	68.66	82.088

Table 1. Thermodynamic properties of R134a and proposed ecological alternative

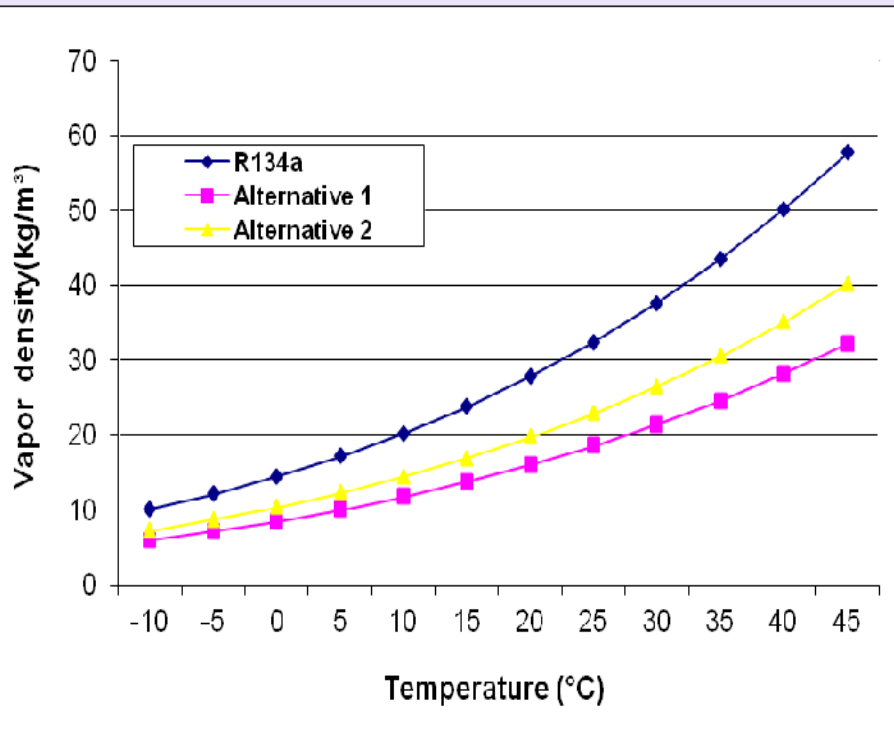


Fig. 2 Vapor density refrigerants vs. temperature

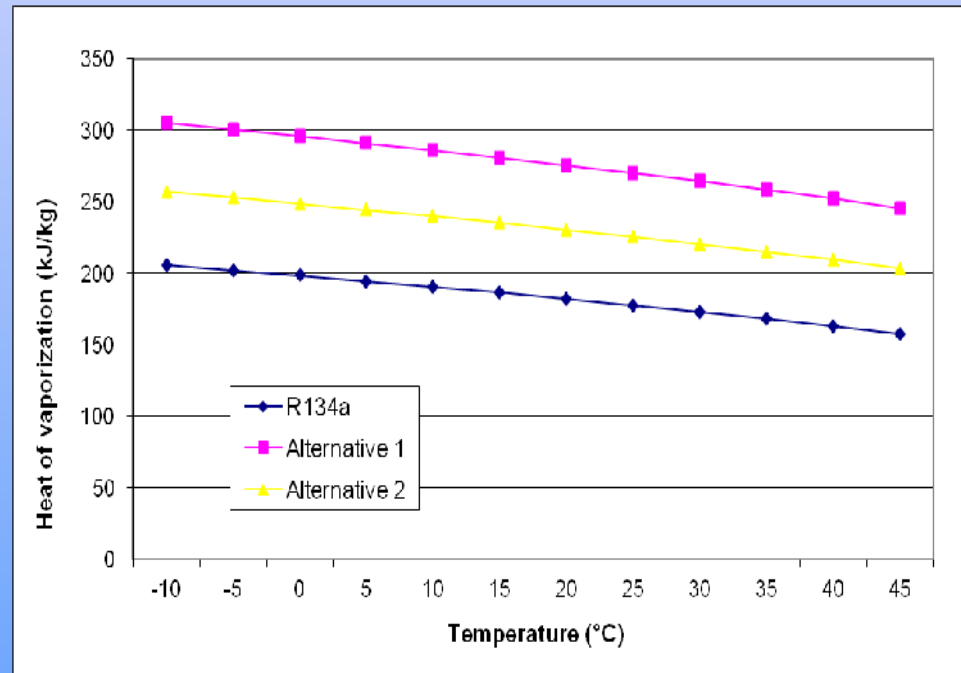
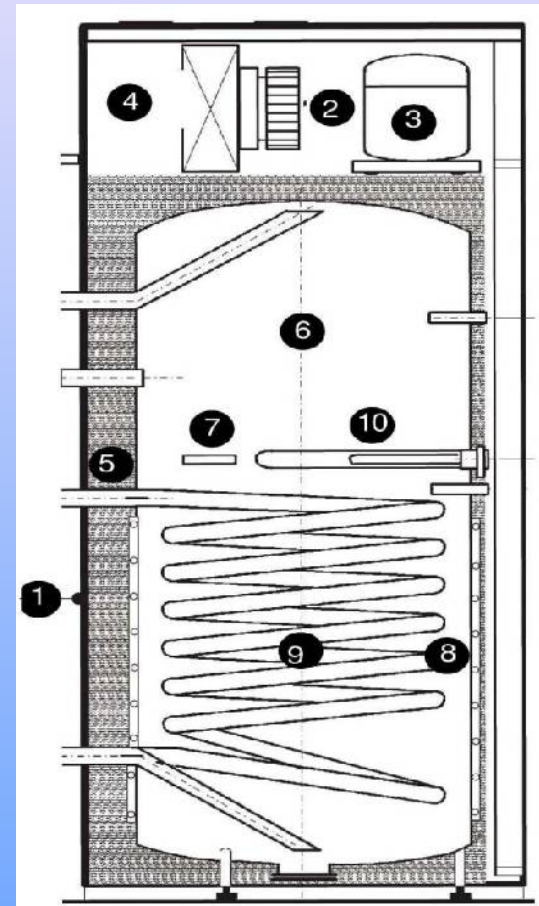
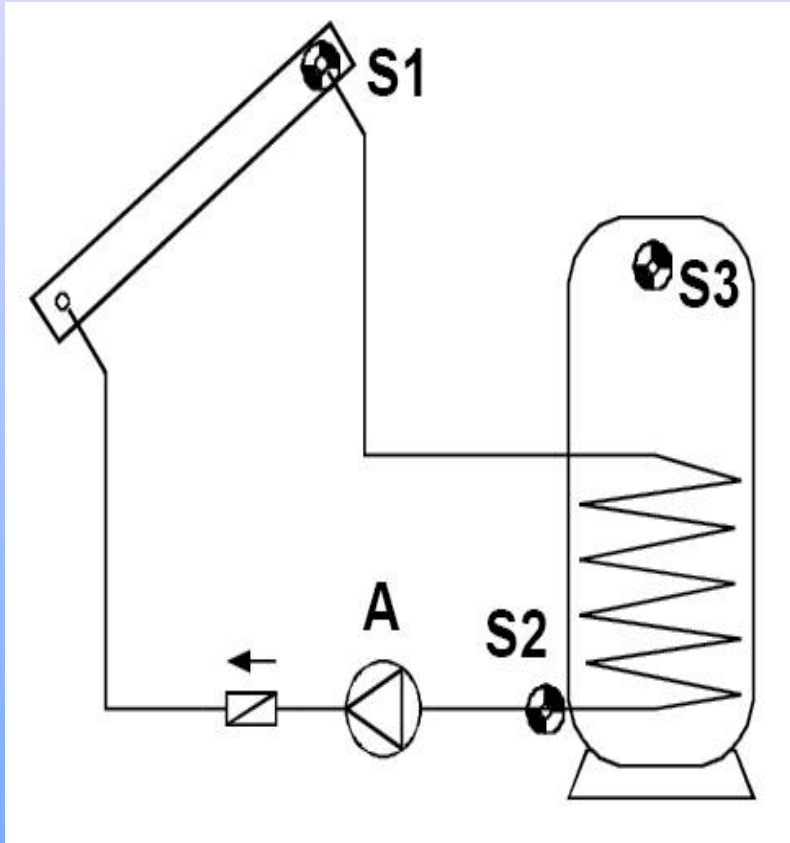


Fig. 3 Heat of vaporization vs. temperature

# Theoretical Study

- A study compared the air-water heat pump in terms of contribution to global warming. The analysis is performed for two ecological alternative refrigerants mixtures (with ODP and low GWP) as a replacement for R134a.
- Comparative analysis was done TEWI factor for air-water heat pump which is working with R134a and ecological alternatives (Alternative 1 - 60/40% and Alternative 2- 80/20%).
- Heat pump which has a theoretical study was made of cooling power, a vaporization temperature  $t_0 = -10 \text{ }^\circ\text{C}$  and a condensing temperature  $t_c = +45 \text{ }^\circ\text{C}$ .
- The TEWI factor was determinate taking account of the Standard SR EN 378-1
- The paper was calculated (depending on the amount of refrigerant and power consumption) total equivalent warming impact of refrigeration system that works with refrigerants R134a, Alternative 1 and Alternative 2 .

# Air-Water Heat Pump



# Theoretical Study

Refrigerant	R134a	Alternative 1 R134a /DME 60/40	Alternative 2 R134a /DME 80/20
Refrigerant charge [kg]	0.780	0.583	0.670
ODP	0	0	0
GWP	1300	780	1040
TEWI Tons of CO <sub>2</sub>	31192.98	22991.81	26423.83

Table 2. The theoretical results

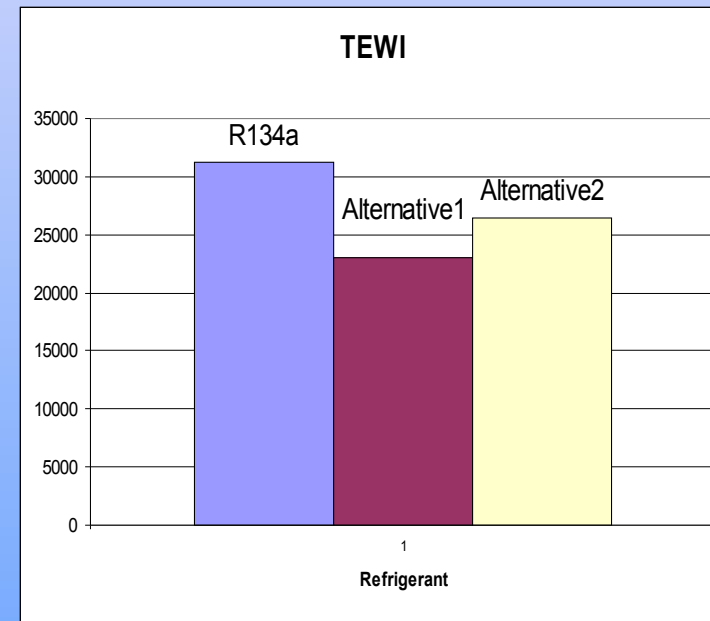


Fig. 4 TEWI factor was shown in study case

# CONCLUSIONS

- Comparative study of air-water heat pump pursued obtaining viable alternative refrigerants.
- From ecological point of view Alternative 1 (R134a/DME) has the best TEWI factor (GWP = 780).
- A disadvantage of this mixture of DME is the place in group component safety A3 in terms of flammability.
- In terms of the latent heat of vaporization Alternative 1 (60%R134a / 40%DME) has advantages.
- In terms of costs, in comparison with R134a, the refrigerant mixture (Alternative 1) is more convenient.



# BUCHAREST

## REGULATION (EU) 517/2014





ROMANIAN GENERAL ASSOCIATION OF REFRIGERATION

**THANK YOU FOR YOUR ATTENTION!**  
**A HAPPY NEW YEAR 2015!**

gratiela.tarlea@gmail.com

[www.agfro.ro](http://www.agfro.ro)

