



## Air conditioning systems with gas absorption heat pumps

Natural gas/LPG fired

Messaggerie del Garda S.p.A.  
Castiglione delle Stiviere (Mantua), Italy

### **Saving energy with gas absorption heat pumps: it's now possible!**

Although certifications confirm high performance standards, the quality and the effectiveness of innovative applications are not easily demonstrable, because of difficulties in measuring overall efficiency. In the following case, a comparison between a former air-conditioning system and a new highly efficient plant was carried out, highlighting differences in energy consumption.

### **The former plant**

The former system, installed at the "Messaggerie del Garda S.p.A." (a company located in the city of Castiglione delle Stiviere, province of Mantua), supplied heating and cooling to the glass walled 3-floor building and to the keeper's house included. For heating an oil boiler with a capacity of 90 kW was installed. For cooling a water-cooled electric chiller was installed in the boiler room, while the evaporative tower was placed on the flat roof.

A primary manifold, linked to both the electric chiller and the oil boiler, supplied thermal energy with 4 pumps for different water circuits, one for each floor and one for the keeper's house. Fan coils, provided with clock controllers as well as room thermostats for temperature control, were installed in each room and supplied heating and cooling according to room size.

### **A necessary change**

The change from oil to natural gas-fuelled boiler was necessary. Taking into consideration economic and performance factors, the engineering "Studio Tecnico Associato Zanchi" has developed a highly efficient system, thus optimising energy consumption and integrating heat pumps and chiller units with low impact on the previous water system. The change from oil to natural gas fuelled boiler turned out to be difficult, since the boiler

room did not fulfil fire prevention requirements. A solution ought to be found, since the air-conditioning system was outdated and in need of considerable new investment.

### The technology

The research carried out leads to an innovative heating and cooling system: gas absorption heat pumps.

These chiller-heater units are able to supply simultaneously heating as well as cooling energy in form of hot and cool water, using natural gas or LPG as primary energy, with heating efficiency up to 140%.

Thus, 3 Robur gas absorption heat pumps, GAHP-AR type, (figure 1 and 2) have been installed.

Main advantages:

- hot water up to 60 °C with nominal thermal capacity up to 105.9 kW;
- chilled water down to 3 °C with nominal cooling capacity of 50.7 kW;
- no additional boiler room is required, since the units are designed for outdoor installation;
- reduction in energy consumption and fixed charges;
- a better energy management, thanks to the use of modular units.

Taking into consideration the addition of new units to an existing system, the feasibility of the project has been determined by Mr Zanchi, civil engineer. In particular, an evaluation of the capability of the heat exchange surface

has been carried out, since heat pump operating temperatures are typically lower than those of traditional boilers (60 °C compared to 70/80 °C).

Fan coils size turned out to be adequate for the system load, although thermal energy would be provided at a lower temperature.

Thus, no change to the whole indoor plant was required.

Just a manifold linking the heat pumps on the roof top to the boiler room has been installed.

### An excellent choice

After a year of complete operation (winter and summer included), energy advantages have been proved by a practical test: electricity and gas bills of different years have been compared.

The result confirms the projections of reduction in energy spending (see table). Electricity consumption is strongly reduced, while gas consumption is increased, because of the use of gas absorption heat pumps in winter as well as in summer. According to the profit and loss statement, energy cost savings are estimated at 10,000 €, a figure confirming the right choice. Making this decision, the company has been rewarded for its efforts.

Fig.1 - Front view of Robur GAHP-AR gas absorption heat pumps.



Fig. 2 - Robur GAHP-AR gas absorption heat pumps installed on roof with no need of boiler room.



**BUILDING DESCRIPTION**

Floors	nr. 3-floor building: basement, ground level and first floor
Surface	a 800 m <sup>2</sup> building plus a 60 m <sup>2</sup> keeper's house
Former heating system	oil boiler, located in the boiler room in the basement
Former system heating capacity	90 kW
Former cooling system	water-cooled electric chiller unit evaporative tower on the roof
Former system cooling capacity	30 kW
Type of heating and cooling energy distribution	nr. 4 circuits (3 floors building plus keeper's house) with 4 different pumps in each room, fan coils provided with room thermostat
New unit installed	nr.1 RTAR 180-360 (nr. 3 reversible gas absorption heat pumps GAHP-AR)
Heating capacity of the new system	105.9 kW
Cooling capacity of the new system	50.7 kW

**ENERGY SPENDING - YEAR 2004**

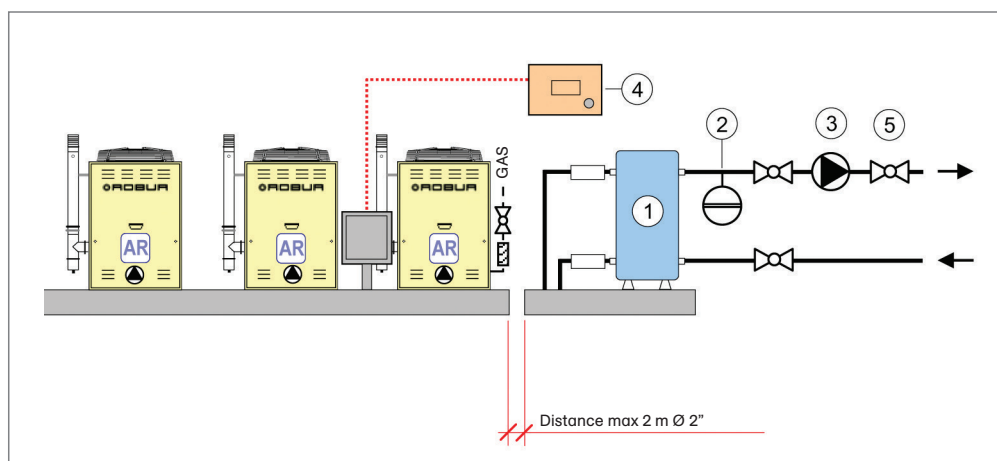
Electricity consumption per year	24,000 €	referred to the entire electricity consumption of the site (electric chiller included)
Oil consumption per year	10,000 €	for the supply of the 90 kW oil boiler
Total energy consumption per year	34,000 €	

**ENERGY SPENDING - YEAR 2005**

Electricity consumption per year	9,000 €	referred to the entire electricity consumption of the site (Robur RTAR gas absorption heat pump included)
Gas consumption per year	15,000 €	for the supply of the Robur RTAR gas absorption heat pump
Total energy consumption per year	24,000 €	

**SAVING PER YEAR**

Saving per year	10,000 €	taking into consideration the variation in energy costs per year as well as variation in heating and cooling power demand per year
-----------------	----------	---



GAHP-AR preassembled unit  
Each module provided with independent  
circulators

- LEGENDA
- 1- GAHP-AR unit hydronic kit provided with hydraulic pipes for primary circuit (inertial tank with 4 connections and a 300l capacity, anti-vibration flexible hoses, pressure gauge, flow regulating valve, water filter)
  - 2 - Expansion tank
  - 3 - Circulating water pump
  - 4 - Direct Digital Controller (supplied with pre-assembled multiple unit)
  - 5 - Shut-off valve

RTAR <sup>(1)</sup>  
180-360

**OPERATION IN HEATING MODE <sup>(2)</sup>**

Heating capacity <sup>(3)</sup>		kW	105.90
G.U.E. heating efficiency based on gas consumption			1.40
Water flow rate	nominal ( $\Delta T = 10\text{ }^{\circ}\text{C}$ )	m <sup>3</sup> /h	9.12
	maximum	m <sup>3</sup> /h	15
	minimum	m <sup>3</sup> /h	4.2
Pressure drop at nominal flow rate		kPa	31
Outside air temperature dry bulb	maximum	°C	35
	minimum	°C	-20
Inlet water temperature	maximum	°C	50
	minimum	°C	2
Maximal outlet water temperature ( $\Delta T = 10\text{ }^{\circ}\text{C}$ )		°C	60

**OPERATION IN COOLING MODE <sup>(4)</sup>**

Cooling capacity <sup>(5)</sup>		kW	50.70
G.U.E. cooling efficiency based on gas consumption			0.67
Water flow rate	nominal ( $\Delta T = 5\text{ }^{\circ}\text{C}$ )	m <sup>3</sup> /h	8.7
	maximum	m <sup>3</sup> /h	9.6
	minimum	m <sup>3</sup> /h	7.5
Pressure drop at nominal flow rate		kPa	33
Outside air temperature	maximum	°C	45
	minimum	°C	0
Inlet water temperature	maximum	°C	45
	minimum	°C	6
Minimum outlet water temperature		°C	3

**BURNER FEATURES**

Nominal heating input		kW	73.6
Gas consumption	natural gas G20 <sup>(6)</sup>	m <sup>3</sup> /h	8.01
	natural gas G25 <sup>(7)</sup>	m <sup>3</sup> /h	9.05
	LPG G30/G31 <sup>(8)</sup>	kg/h	5.88

**ELECTRICAL DATA**

Required voltages <sup>1</sup>		400 V 3N - 50 HZ	
Nominal electrical power <sup>(9)</sup>	standard version	kW	3.21
	low noise version	kW	3.3

**INSTALLATION DATA**

Weight in operation		kg	1.450
Sound pressure at 10 meters <sup>(10)</sup>	standard version	dB(A)	59
	low noise version	dB(A)	54
Dimensions	width	mm	3610
	depth	mm	1240
	height - standard version	mm	1400
	height - low noise version	mm	1650

<sup>(1)</sup> Values for CC version (with independent circulation).

<sup>(2)</sup> Nominal conditions according to EN 12309-2 norm, table 12.

<sup>(3)</sup> Features under nominal conditions: outside air temperature dry/wet bulb 7/6 °C - outlet water 50 °C.

<sup>(4)</sup> Nominal conditions according to EN 12309-2 norm, table 5.

<sup>(5)</sup> Features under nominal conditions: outside air temperature 35 °C - outlet water 7 °C.

<sup>(6)</sup> Lower heating value 34.02 MJ/m<sup>3</sup> (9.45 kWh/m<sup>3</sup>) at 15 °C - 1013 mbar.

<sup>(7)</sup> Lower heating value 29.25 MJ/m<sup>3</sup> (8.13 kWh/m<sup>3</sup>) at 15 °C - 1013 mbar.

<sup>(8)</sup> Lower heating value 46.34 MJ/kg (12.87 kWh/kg) at 15 °C - 1013 mbar.

<sup>(9)</sup> ±10% tolerance to allow for different electrical voltage and power absorption of the electrical motors.

<sup>(10)</sup> Free field, frontally, direction factor 2.

**Due to continuous product innovation and development, Robur reserves the right to change product specifications without prior notice.**