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natural refrigerants
16-17 March 2015 in Brussels

NATURAL REFRIGERANTS

HEAT PUMPS

LINE UP OF NATURAL FIVE : NH₃ – CO₂ – HC – WATER – AIR

HOT WATER PRODUCTION NH₃ HEAT PUMP

by Jan Boone

DOC.2015-698 R2

LINE UP OF NATURAL FIVE

DOC.2015-698 R2

"Natural Five" Refrigerants and Product Solutions

Refrigerant (Natural Five)	NH ₃ R-717	CO ₂ R-744	HC Hydrocarbon	H ₂ O R-718	Air R-728
90°C	Utility hot water Heating	Utility hot water			
60°C			Utility hot water Heating HVAC	Heat recovery	
10°C	Chilled water Ice making	Chilled water Ice making		Chiller	
-15°C	Cold storage, Freezer, Fish boat				
-25°C	Specific Refrigeration needs				
-40°C	Freezer, Freeze-dry, Super Low temp storage				
-50°C			Cryogenics		Cryogenics
-60°C					
-100°C					
Notes	<ul style="list-style-type: none"> Conventional system 	<ul style="list-style-type: none"> HeatCO₂m 	<ul style="list-style-type: none"> Nat'l Proj. Butane + Propane 	<ul style="list-style-type: none"> Nat'l Proj. Adsorption Heat recovery 	<ul style="list-style-type: none"> Nat'l Proj. Air-cycle

FIELD CASE

HOT WATER PRODUCTION NH₃ HEAT PUMP

DOC.2015-698 R2

Ammonia heat pump

Reason for building a Heat Pump in Bakery Plant in Belgium
CONTRACTOR : COFELY AXIMA GDF-SUEZ Antwerp-Belgium



1. Extension of the production capacity
2. Reduction of energy consumption & energy costs
3. Contribution to the Sustainability Program

Ammonia heat pump

Hot water needs at 65°C

1. Heat recovery from the NH₃ refrigeration system : hot gasses
Water is preheated from 5°C to 25°C
by a condensation temperature of 25°C
2. In order to get water at a temperature of 65°C in an energy efficient way, we used an ammonia heat pump (ODP & GWP = 0)
with condensing temperature of 67°C (29,5 barg)

Ammonia heat pump

HEAT PUMP : using NH₃ refrigeration system condensor heat as heat source

1. Positive impact on condensor load
2. Recovery of residual heat for hot water production
 - > Sanitary hot water : 65°C
 - > process : dough proofer

Ammonia heat pump

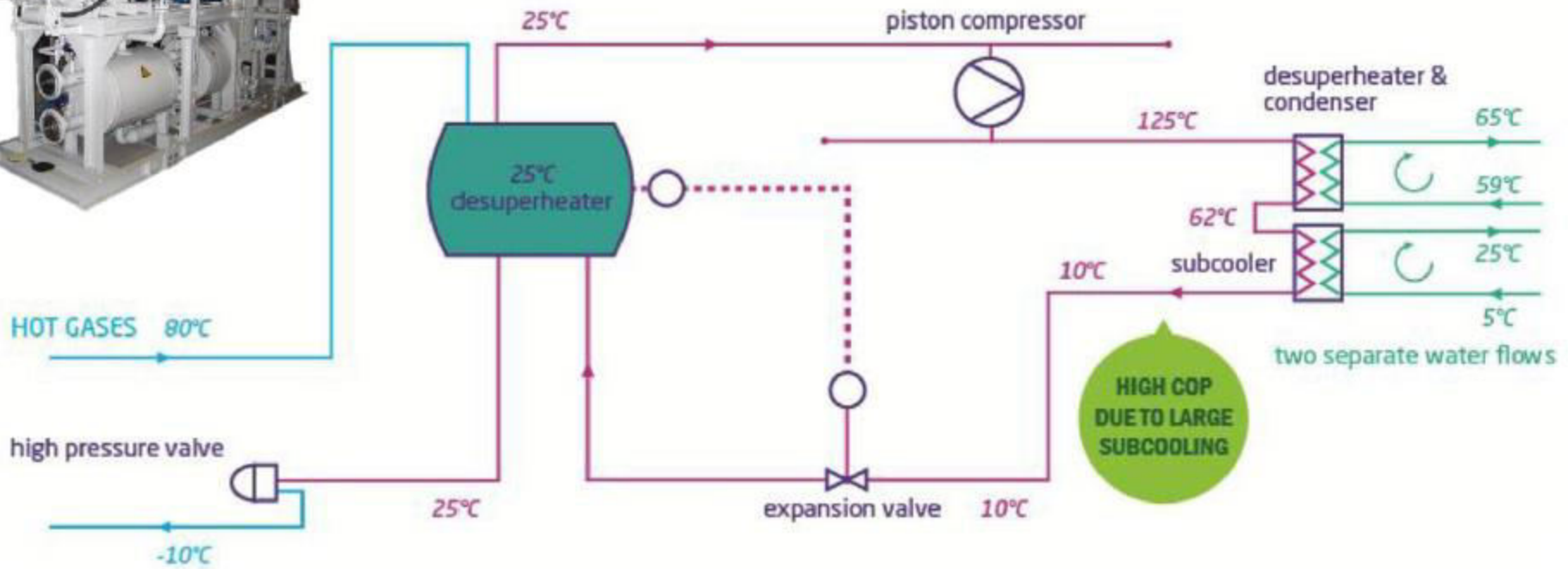
DEMANDS

1. WATER TEMPERATURE 65°C
heat demand : 300 KW (hot water 1000 m³/day)
2. WATER TEMPERATURE 25°C
heat demand : 65 KW (process water 70 m³/day)
3. COOLING DEMAND : 2,5 MW

-> NH₃ pump circulation refrigeration system (NH₃ at -30°C) & direct expansion (-30°C & -10°C)

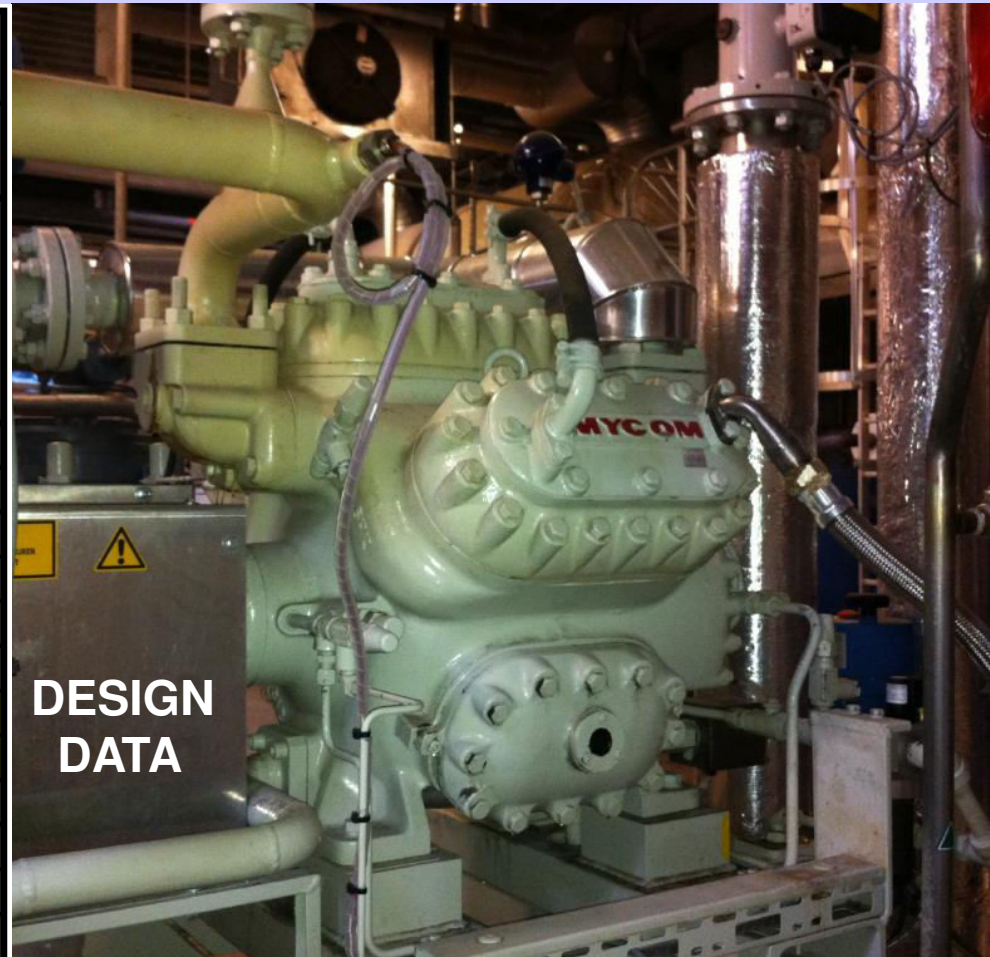
-> Cold and freezing rooms (t° : -30 & -10°C)

PRINCIPLE SCHEME



EQUIPMENT

MODEL		N6HK	
QTY		1	
SITE LOCATION		BELGIUM	
COUNTRY		MOUSCRON	
TOWN			
REFRIGERANT		NH3	
TE	°C	30	25
TC	°C	67	67
PS	barg	10,7	9,0
PD	barg	29,9	29,5
RPM	rpm	1000	1150
QC	kW	375	375
BKW	kW	48	55
COP-H		7,7	6,8
OPERATING HOURS		21/01/2015	
HP	hrs	7186	





Installation date :
February 2013

Operating hours per year
 ± 7000 hrs

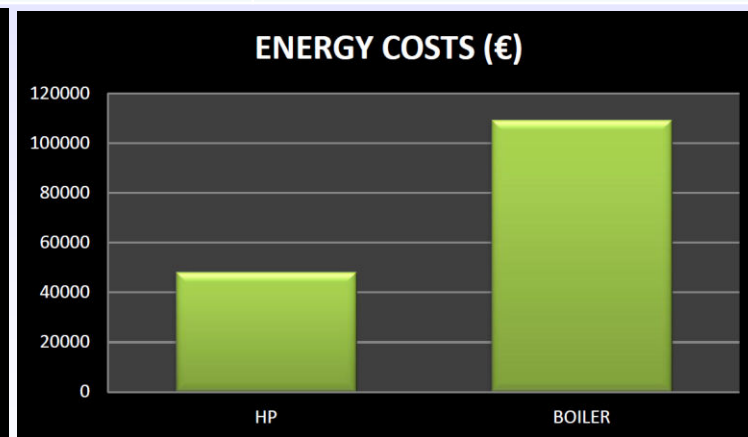
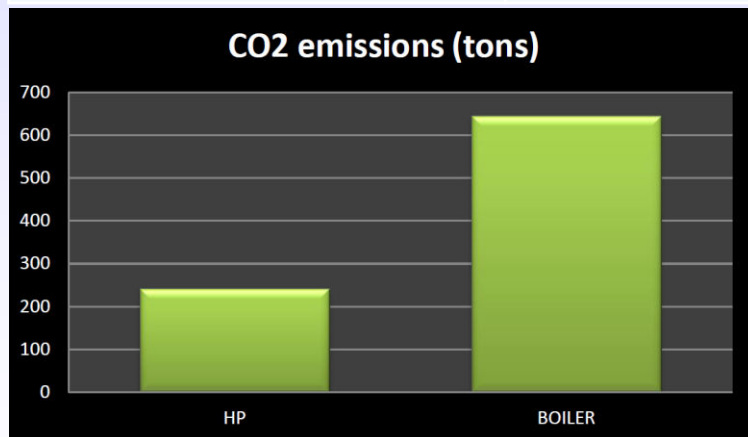
Calculation detail :
POWER DRIVE
Efficiency =
97~98%

DRIVE MOTOR
WEG 315S/M 75kW
 $\cos\varphi = 0,87/0,75$
efficiency =
93,7/93,2
(100%/50% load)

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OPERATION SAVINGS

	HEAT PUMP	BOILER
Performance (COP)	7,7 (-20%→6,16)	0,9
Hot water	375 kW	375 kW
Energy consumption primary (8760 hrs/yr)	533 MWh	365000 m3 natural gas
Energy prices	€ 100/MWh	€ 0,30 /m3
Energy costs	€ 53.300,-	€ 109.500,-
CO2 emissions	267 tons	645 tons



CONCLUSION :

ANNUAL SAVINGS :

OPERATION 56.200 € (51%)
CO2 EMISSION 378 tons (42%)
CONDENSOR-WATER + treatment
NATURAL WASTE HEAT
CONDENSOR

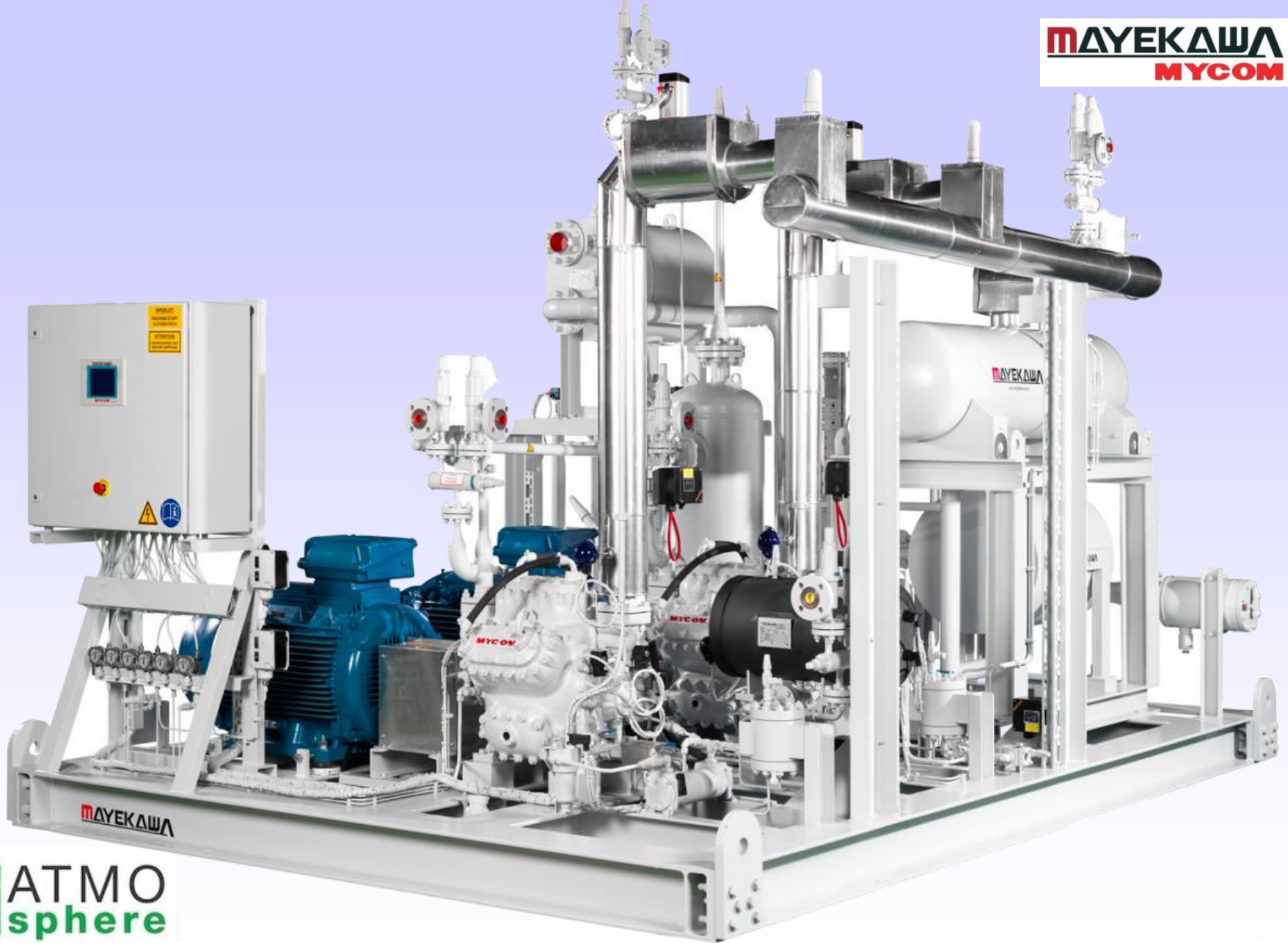
INVESTMENT : €150.000
RETURN OF INVESTMENT < 3 YRS

HIGHER EFFICIENCY THAN COMPARABLE
TECHNOLOGIES

LONG LIFE TIME (>25 YEARS)

MAINTENANCE LOW-COST

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HOT WATER PRODUCTION AMMONIA HEAT PUMP

THANKS FOR YOUR ATTENTION ! special thanks to :

COFELY AXIMA
GDF SUEZ

Slachthuislaan 23 - 2060 Antwerp - BELGIUM
tel. +32 3 235 11 44 - fax +32 3 235 87 46

Nijverheidslaan 61 - 8560 Wevelgem - BELGIUM
tel. +32 56 41 41 37 - fax +32 56 41 41 73

Boulevard de la Technicité 24 - 7110 Houdeng - BELGIUM
tel. +32 64 23 78 80 - fax +32 64 26 76 35

Avenue de l'Indépendance 21 - 4020 Liège - BELGIUM
tel. +32 4 370 05 05 - fax +32 4 370 04 74

Rue de Koerich 66 - L8437 Steinfort - LUXEMBOURG
tel. +352 39 95 171 - fax +352 39 95 29

info@cofelyaxima-gdfsuez.be
www.cofelyaxima-gdfsuez.be

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Europe Organization

GERMANY

Süd
Untere Bahnhofsstrasse 38a
82110 Germering
Tel. +49 89 552 79890

Außenstelle Nord
Tel. +49 151 42520055

Service-Werkstatt
Zum Bluckesch 7a
48336 Sassenberg Föchtort
Tel. +49 170 2963409
Fax. +49 89 552 798910
<http://www.mayekawa.de>
E-mail: info@mayekawa.de

SWITZERLAND

Florenbergstrasse 31
6300 Zug
Tel. +41 41 7268626
Fax. +41 41 7268620
<http://www.mayekawa.ch>
E-mail: info@mayekawa.ch

ITALY

Milan Office
Via Riccardo Lombardi 19/12
20153 Milano
Tel. +39 2 49093218
Fax. +39 2 4531728

Bologna Office
Via Praduzzo 7 40012
Calzarea di Reno
Tel. +39 51 726364
Fax. +39 51 726804

UNITED KINGDOM

16 Oakhurst Gardens
DAY 5/1P Bexleyheath, Kent
Tel. +44 1322 433558
Fax. +44 1322 433164

FRANCE

East Branch Office
9, Rue Michel Faraday
78180 Montigny-Le Bretonneux
Tel. +33 1 30 582800
Fax. +33 1 30 581937

ARTIC (representative agent)
8, Plus des Fontenelles
44140 Le Bignon
Tel. +33 2 85 522170
Fax. +33 2 85 522178
E-mail: contact@artic-industrie.com

SPAIN

Calle Montevideo 5, Nave 13
Pol. Industrial Camporazo
28906 Alcalá de Henares, Madrid
Tel. +34 91 8300392
Fax. +34 91 8300397
<http://www.mayekawa.es>
E-mail: mayekawa@mayekawa.es

BULGARIA

Kamen Andreev Str. 24
1303 Sofia
Tel. +359 2 8910130
Fax. +359 2 8910131

EGYPT

New Cairo
5th Settlement
North 90th St.
The 47th Building
Tel. +20 22 5062925
Fax. +20 22 5032901

POLAND

ul. Oruskenickas 8/10
60-478 Poznan
Tel. +48 61 8420738
Fax. +48 61 8485837

MOROCCO

6, Allée des Cypres
20250 Casablanca
Tel. +212 600 041241

RUSSIA

Office 228, Korovy Val St. 7
119049 Moscow
Tel. +7 499 2330178
Fax. +7 499 2332112
<http://www.mayekawa.ru>
E-mail: info@mayekawa.ru

DUBAI

P.O. Box 61349, W+HOUSE
No. F3A-08-UQ05
Jebel Ali Free Zone Dubai, UAE
Tel. +971 4 8886363
Fax. +971 4 8886373

REPUBLIC OF SOUTH AFRICA

West End
Unit 3 Prime Park
Printers Way
Montage Gardens 7441
Tel. +27 21 5511434
Fax. +27 86 5463618

HUNGARY

2049 Dözd
P. 29
Tel. +36 23 545712
Fax. +36 23 545715

TURKEY

Dünya Tıparr Merkezi
A/2 Blok Kat: 10 No. 325
Yeşilköy
İstanbul
Tel. +90 212 465363134
Fax. +90 212 4653635

ABU DHABI

Ali & Sons Business Center Office No. 201
Al Khalifa Rashid Al Mutawa Al Dhahiri Bldg.
Plot no 29, Al Ain Road, Umm Al Nar
Tel. +971 2 5102151
Fax. +971 2 5102571

JAPAN HEAD OFFICE

3-14-15 Botan Koto-ku
Tokyo 136-8482, JAPAN
Tel. 81 3 3642 8181
Fax. 81 3 3643 7004
E-mail: e-public@mayekawa.co.jp

MAYEKAWA Europe m/f/as

Leuvensteenweg 605
1930 Zaventem - Belgium
Tel. +32 2 7570075
Fax. +32 2 7570023
<http://www.mayekawa.eu>
E-mail: info@mayekawa.eu

Global web site <http://www.mayekawa.com/>

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