MICROWAVE TUNNEL 2.45 GHz + HOT AIR

LABOTRON TMW800 AC60 (4 x 2 kW, 2.45 GHz microwave)
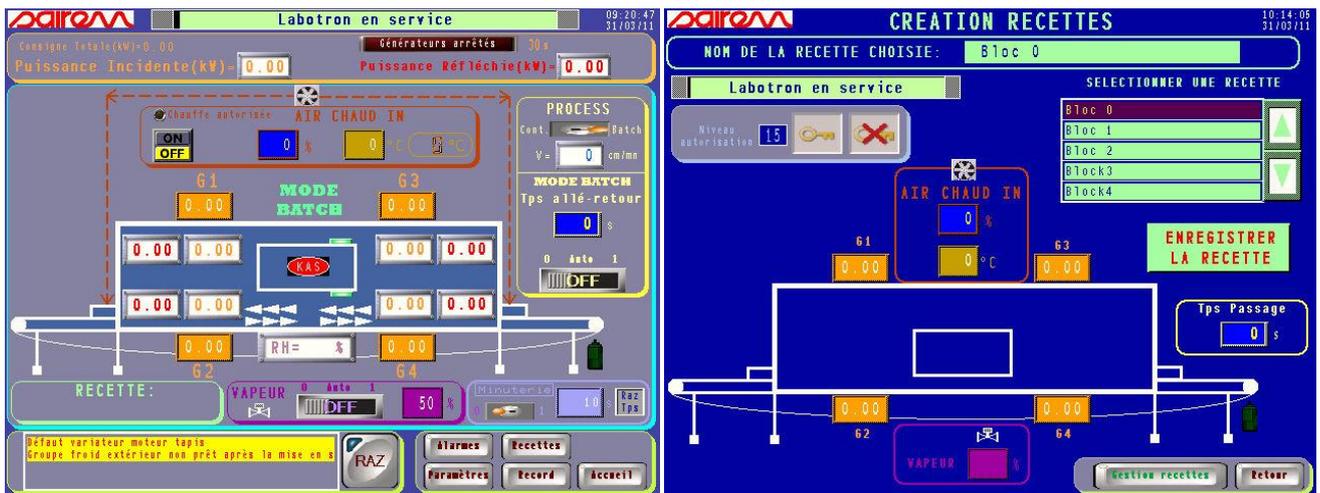## LABOTRON TMW480 AC60 (4 x 1.2 kW, 2.45 GHz microwave)

Fig. 1. Labotron TMW800 AC60

The TMW microwave tunnel has been designed for continuous cooking/pre-cooking/pasteurisation at small production flows of products packed in containers (pots or trays); the tunnel has been developed to help with the optimization of the process parameters, i.e. microwave power, treatment time, air flow & temperature to get the desired product quality.

The tunnel has a variable speed conveyor belt, a forced air system with variable temperature setting (up to 60 °C) and four (4) microwave generators distributed 2 at the lower side + 2 at the upper side of the microwave cavity (oven) which enables:

- The adjustment of the microwave power distribution & level from the top and from under the product. Depending on the shape of container (pot or tray) but equally on the product level inside the container, it may be also possible to heat different layers of product at different temperatures;

- The adjustment of the microwave power distribution along the tunnel, e.g. higher level at the inlet for fast heating of the product and lower towards the outlet to maintain the product's temperature;

- The adjustment of the microwave heating time from 40 s to 10 min. If longer treatment times are required, the conveyor belt can be programed via HMI to stop in the middle of the oven for a given time;

- The optimization of air temperature/steam temperature effect on the homogeneity of product heating depending on the container's material and equally, depending on the forced air temperature, speed & direction.

Reference	**Labotron TMW800AC60: 8 kW microwave power, 4 off x 2 kW generators** **Labotron TMW480AC60: 4.8 kW microwave power, 4 off x 1.2 kW generators**
Construction	Insulated 1-block microwave cavity, stainless steel 304 L, door with ¼ wave choke. Air- & water-proof electrical cabinet at the rear of the tunnel containing all microwave generators, etc. Integrated PLC/HMI with 7" color touch screen located above the oven's access door. Tunnel mounted on wheels for easy moving; mains connections via socket, no-drip quick release connectors for cooling water
Microwave generators	4 microwave generators, 2450 MHz. Power level of each generator is adjustable separately or together with the other 3 generators from 100 W to 1200 W (TMW480 AC60) or from 200 W to 2000 W (TMW800 AC60) via the HMI. Reflected power is displayed for each generator. Total reflected power for all four generators is also displayed.
Microwave coupling	2 inlets at the top and 2 inlets at the bottom of the microwave cavity, protection against no-load operation via isolator, measurement of reflected power for absorbed energy balance.
Forced air system with variable temperature and flow	Temperature adjustable up to 60 ^{0}C via the HMI, the air is not recycled, the air intake from atmosphere is filtered before heating. Air speed is adjustable up to 1.5 m/s via HMI by adjusting the speed of the fan. Air flow direction can be changed between concurrent and counter current; max. hot air power 4 kW.
Conveyor belt	Modular flat top PP belt, width 250 mm. Microwave heating time adjustable from 10 min to 40 s, i.e. conveyor belt speed from 0.1 m/min up to 1.5 m/min
Steam inlet	It is possible to diffuse steam over the total length of the microwave treatment zone via 2 nozzles. A solenoid valve controlled through HMI opens or closes to allow steam inside the tunnel. Steam generator not supplied.
Product input/output	Operating max. height 100 mm, width 250 mm, access for cleaning from the ends of the tunnel and through the access door. Adjustable shutters height to reduce air flow and microwaves leakage depending on the container dimensions.
Access door to the microwave cavity (oven)	The oven can be used as a batch system if long treatment time is required. Wide door allowing easy cleaning. Door with ¼ wave choke + silicone o-ring for hot air; sight window with LED lighting; 2 safety interlocks
HMI control & display	7" colour touch screen allows for control & reading of microwave power level, forced air speed and temperature, conveyor belt speed; up to 99 recipes can be stored. Oven status, faults history, etc. Emergency stop. Data transfer via USB and Ethernet ports.
Mains electrical power & consumption	3 x 400 V + earth, no neutral, 50/60 Hz, 20 kVA (TMW480AC60) or 27 kVA (TMW800AC60)
Cooling water	Min. 10 L/min, pressure 4 bars, water temperature between 18 ^{0}C and 22 ^{0}C, power to evacuate 5 kW (TMW480AC60) or 10 kW (TMW800AC60); water inlet/outlet 1" GF OPTIONAL: integrated air/water chiller.
Cleaning	Inside the tunnel: with pressurized water, drain hole at the lower part of the oven, Outside the tunnel: with soft cloth, sponge
EC norms	89/392, 91/368, 73/23, 89/336, 92/31, 519-6 CEE/EWG EN55011 (specific)
Size, weight	See drawings on page 4, weight 950 kg

Examples of HMI screens

Maximum production capacity calculation

The maximum performance of the oven can be calculated as follows:

$$P(kW) = \frac{m(kg) \times Cp\ (J\ kg^{-1}\ C^{-1}) \times \Delta T(°C)}{t(s)}$$

Where:
P = microwave power in kW;
m = mass of product in kg;
Cp = product specific heat in J kg^{-1} ^{o}C^{-1};
ΔT = temperature difference in ºC ($T_{final} - T_{initial}$);
t = time of microwave treatment in s.

If we consider a microwave efficiency of 90 % the maximum production capacity is:

$$capacity\ (kg\ h^{-1}) = \frac{P(kW) \times 3600}{Cp\ (J\ kg^{-1}\ C^{-1}) \times \Delta T(°C)} \times 0.9$$

Example TMW 800: when P = 8 kW, ΔT = 70 °C (T_{final} = 85 °C, $T_{initial}$ = 15 °C), Cp = 3.7 J g^{-1} C^{-1}, the maximum production is 100 kg h^{-1} (kg/h).

If lower microwave power is used the production flow reduces proportionally.

Using the Labotron TMW for microwave pre-cooking
When the Labotron TMW is used for pre-cooking of food, in order to optimize the cooking time the final cooking ought to be carried out outside the TMW using conventional techniques e.g. hot air, steam, etc.
Once this optimization has been done, e.g. known values of microwave treatment time and power, conventional technique type and time, an industrial hybrid equipment (microwave precooking + conventional cooking) can be developed.

Ecran tactile de commande
Control toutch screen

Alimentation électrique
Mains power supply

Sonde d'humidité
Humidity probes

Entrée vapeur
Vapoor in

Entrée/Sortie d'eau
Water in/out

3822
611
100
1700
800
611
120 MAX
900
529
376
250
935
598
826
268
313
1962
1448

INDICE	DATE	DESSINE	VERIFIE	APPROUVE	MODIFICATION DU DESSIN
A	22-03-11	BDE			EMISSION ORIGINALE