



SAFED  
S.A. du Four Electrique Delémont  
Delémont, Switzerland

# Injector-M

## Gas atmosphere production system integrated to the furnace

A practical and reliable process. An interesting alternative to the use of a gas generator.

Controlled gas composition and reproducible quality guarantee the best treatment results (hardening, carbonitriding, carburizing, etc.).

- High carburizing power.
- High efficiency.
- Space saving.
- Flexible in use.
- No maintenance.
- Simple setting-up.

Dissociation of the methanol takes place in a retort mounted inside the furnace.

The methanol (and in some cases the nitrogen) are stocked externally and injected through a distribution circuit comprising control valves and flowmeters.

This atmosphere can be used for carburizing by adding propane gas ( $C_3 H_8$  or other  $C_x H_y$ ) as well as for carbonitriding by adding ammonia.

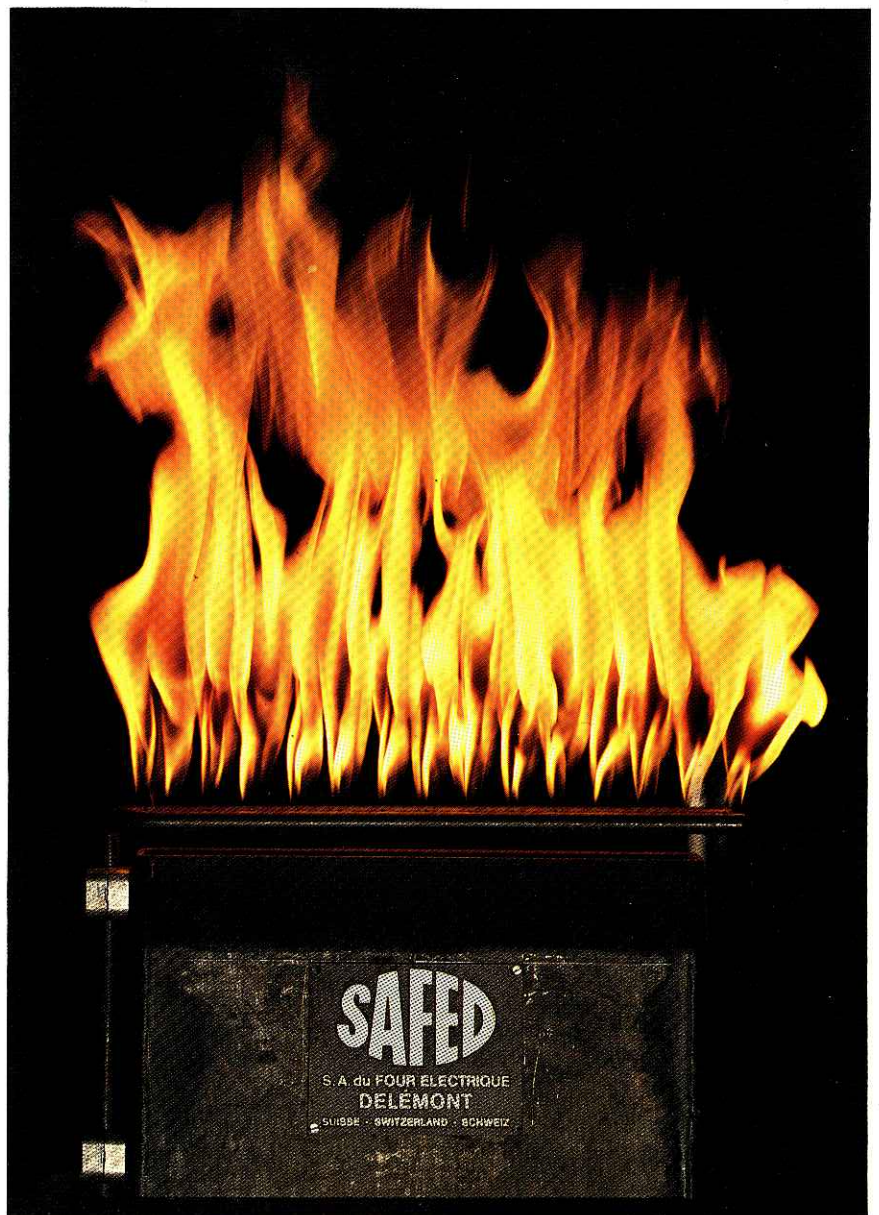
Heating of the retort is adjustable separately; it does not influence treatment temperature in the furnace.

The carbon potential can be controlled within strict limits and maintained at the required value.

### Application

The Injector-M system is fitted as an option on the SAFED continuous furnaces of types T and Vi, with or without turbo-circulation of the atmosphere.

The system capacity is adapted to the size of the furnace.



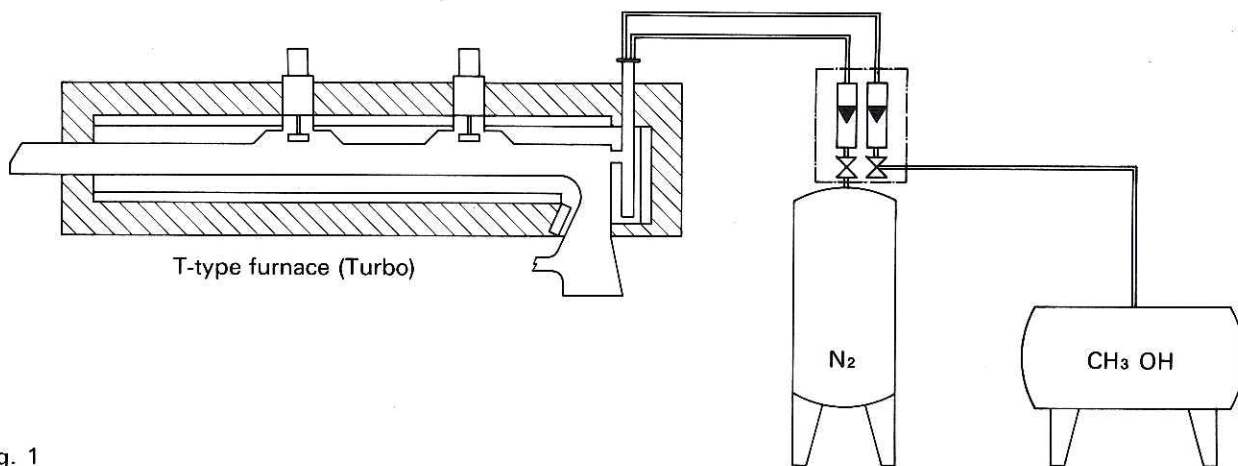


Fig. 1

### The methanol (methyl alcohol)

This alcohol is obtained by catalytic oxidizing of natural gas or by monoxide catalytic reaction of carbon-hydrogen.

These processes have greatly improved the purity and the regularity of the product quality, which was previously obtained by distillation of wood. A typical analysis now shows purity values up to 99.98%.

After dissociation a perfect stable gas composition is obtained, ideal for the protection of metals against oxidizing or decarburizing, as well as for carburizing.

### Characteristics

Formula: CH<sub>3</sub> OH  
 Molecular weight: 32.04  
 Density (20 °C): 0.792 kg/l  
 Boiling temperature at one bar: 64.7 °C  
 Vapour pressure at 20 °C: 96 Torr

### Dissociation: CH<sub>3</sub> OH → CO + 2H<sub>2</sub>

1 kg methanol (= 1.2 l):  
 2,250 l of gas  
 1 l methanol: 1,700 l of gas  
 Analysis of the gas:  
 CO = 33.3% + H<sub>2</sub> = 66.7%

### Control of the atmosphere

The Injector-M system is compatible with all the systems usually used for measuring the carbon potential.

In conjunction with a T-type furnace with turbo-system and controlled by microprocessor with an oxygen probe, the Injector-M offers the optimum conditions of accuracy and reproductibility necessary for carburizing or carbonitriding. The differential regulation of the carbon potential is obtained by localized injection of the additional gas.

### Dilution of the atmosphere by nitrogen

Dilution by nitrogen lowers the carburizing power of the dissociated methanol atmosphere. However, nitrogen can be used as an addition for heat treatments without significant exchange of carbon. Note (fig. 2) that the capacity to transfer the carbon to the part, and the effective availability of C are considerably reduced with nitrogen.

Nitrogen is abundantly available in the air, from which it is directly extracted.

It is stocked in liquid form in a container; a fairly important installation is necessary.

Purity required for applications in SAFED furnaces: 99.8%.

### Reaction of the dissociation of methanol in nitrogen:

$2 \text{ N}_2 + \text{CH}_3 \text{ OH} \rightarrow 2 \text{ N}_2 + \text{CO} + 2 \text{ H}_2$   
 Combined with nitrogen in a 40:60 ratio, the methanol forms a synthetic atmosphere, similar to endothermic gas composition, with the following composition:

H<sub>2</sub> = 38–40%, CO = 18–20%,  
 CO<sub>2</sub> = 0.1–0.7%, N<sub>2</sub> = 40%.

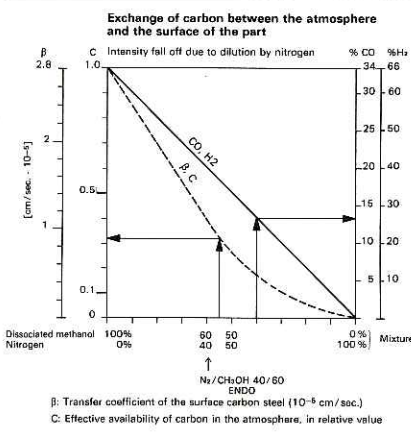


Fig. 2

With the Injector-M system, the intrinsic carbon content of the atmosphere is of approximately 1.15% C at 900 °C. It can easily be reduced to 0.4% C by the addition of water.

The use and stocking of methanol entails that safety rules and regulations are respected. Detailed information on this subject is available from the suppliers.



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