

Endothermic gas generator

Type PROP: from propane or propane-butane

Type NAT: from natural gas

Production of protective furnace atmospheres for metal heat treatment: case hardening, carbonitriding, austenitizing prior to hardening, etc.

- Uniform and determinable gas composition
- Adjustable gas flow (no excess gas burning)
- Reliable operation, simple maintenance
- Low operating costs

Principle of endothermic gas generation

In a retort, a mixture of hydrocarbon gas and air, controlled in respect to flow and mixing ratio is brought into contact under absolutely safe conditions with a catalyst heated to approximately 900° C. This results in a *combustion* reaction taking place *with air deficiency* in which the hydrocarbon gas (fuel) is oxidized by the atmospheric oxygen (oxydant).

The air deficiency results in a gas mixture with a high CO and H₂ content. In addition to these two gases is the atmospheric N₂.

The ratio «R» between the air and hydrocarbon gas flows is optimized to produce - without sooting - a maximum CO content and residual CO₂ and H₂O constituents resulting in a carbon potential of approximately 0.6% C at around 900° C.



Fig. 1

Generator type PROP 32

Technical data

TYPE		PROP/NAT 17	PROP/NAT 25	PROP/NAT 32	PROP/NAT 52	PROP/NAT 65
Maximum gas output	m ³ /h	3	7	20	40	60
Outlet pressure	mm WG	300	300	300	300	300
Rated heating power	kW	4.5	10.5	10.5	20	30
Weight	kg	350	700	1200	2000	2700
Dimensions:	width	mm	1200	1300	1800	1900
	height	mm	1500	1800	2300	2400
	depth	mm	600	800	900	1100

Subject to changes

Typical composition of endothermic gas

		Type PROP (propane)	Type PROP (butane)	Type NAT (natural gas)
CO	(%)	23	24	20
H ₂	(%)	31	29	40
N ₂	(%)	46	47	40
R air/gas, typical		7.5	10	2.5
Consumption in litres for 1m ³ endo.		76	59	200

(The values can vary depending on the composition of the hydrocarbon gas)



Fig. 2 Generator type PROP 17

Carbon potential

The fine adjustment of the ratio «R» about the average value ($\pm 5\%$) permits the setting of all carbon potential values used in practice for heat treatments. The available range extends from 0.2 to 1.0% C at temperatures from 800 to 930° C. The carbon potential can be estimated by measuring the CO₂ content or the dew point.

Conditioning the endothermic gas

After leaving the retort the gas is cooled and filtered.

Application

- The gas produced by the generator may be used unchanged in the heat treatment furnace. Where necessary it can be dried or the carbon content reduced.
- *Drying option:* Used for this is an adsorption drier type DES which has two dehydration columns with automatic regeneration. (Dew point up to -35° C).
- *Low carbon potential option:* For low temperature treatments (<600° C), it is necessary to reduce the gas's potential to prevent soot-ing. Carbon reduction can be achieved either by introducing water, by dilution with nitrogen or by conversion of the gas. This conversion can be performed with the CONVEX appliance (SAFED technique). The resulting gas has the following composition:
CO₂ approx. 11%, CO approx. 11%,
H₂ approx. 31%, N₂ approx. 46%,
H₂O approx. 0.5%.

Limitations

Hydrocarbon gas:

- The presence of *unsaturated hydrocarbons* is to be avoided or must be a maximum of 0.5% (e.g. propylenes).
- The maximum permissible *sulphur* content is 25 ppm. Sulphur can destroy the catalyst and render the generator uncontrollable. De-sulphurization towers must be employed if the gas contains in excess of the permissible sulphur content.
- The presence in the gas of *oil* or other fluids must be avoided.

Air:

- Variations in air *humidity* cause the dew point of the endothermic gas to fluctuate about the setpoint value.



Four Electrique Delémont S.A.
36, rue Emile-Boéchat
CH-2800 Delémont
Phone +41 (0)32 421 44 60
Fax +41 (0)32 421 44 64
e-mail contact@safed.ch
website www.safed.ch