

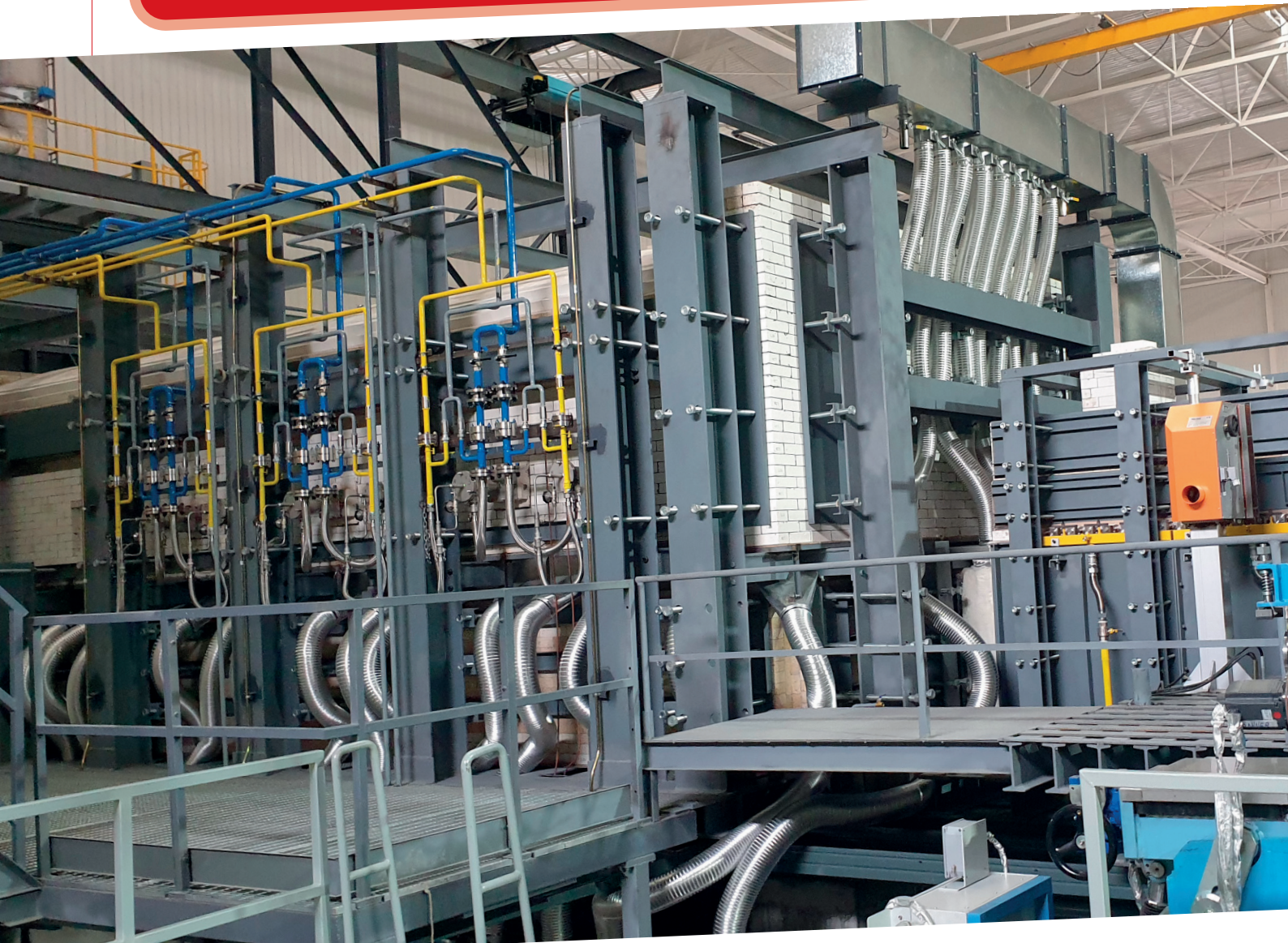
INNOVATION

Innovation

GLASS SERVICE

Stabilization of Wobbe Index in mixed air/natural gas fuel supplies

Glass Service Italy has developed an innovative solution to stabilize the Wobbe index when mixed air/natural gas is fed into the forehearth and distributor. In this article, the company takes us through the various steps and scenarios involved in solving the problems that can occur with this newly developed technology.



The market for natural gas (NG) has numerous different sources with different chemical compositions, calorific power energy (PCI) and, consequently, Wobbe Index. The source of NG is nowadays increased by the development of Liquefied Natural Gas (LNG). See Figure 1

WHAT IS THE WOBBE INDEX?

The Wobbe Index (WI) or Wobbe number is an indicator of the interchangeability of fuel gases such as natural gas.

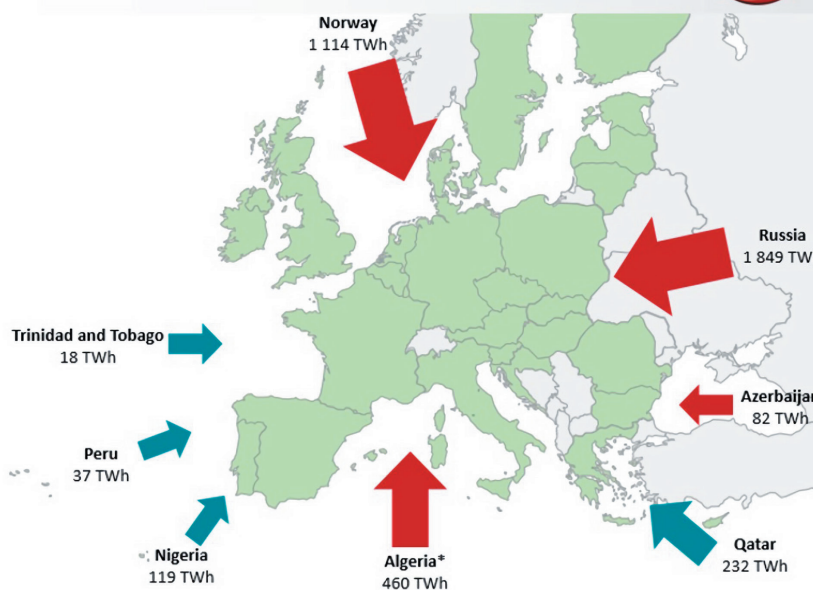
If V_c is the higher heating value, or higher calorific value, and G_s is the specific gravity, the Wobbe Index, WI, is defined as:

$$I_W = \frac{V_c}{\sqrt{G_s}}$$

Figure 1

Supply

European Union natural gas main imports

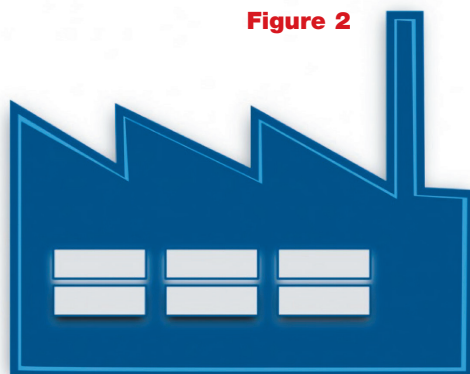


Source: BP Statistical Review of World Energy (June 2018)

Figure 2

The consequence of mixed NG sources, leads to a weekly or daily changes in the quality of NG.

The quality of NG supply is unstable



Two different gases with the same Wobbe index can be interchanged without any modification of combustion parameters, e.g. combustion ratio, burner pressure and energy power emitted.

PROBLEM

NG suppliers do not, at present, guarantee the constant quality of NG. Variation in chemical composition is usually weekly and sometimes even daily. The variability of NG's chemical composition leads to a variety of technological prob-

lems in the glass melting furnace and its forehearth. In this article we will introduce a piece of equipment developed by Glass Service, necessary to stabilize the Wobbe index. See Figure 2.

SOLUTION

Glass Service Italy has developed an innovative solution to stabilize the Wobbe index when mixed air/NG is fed into the forehearth and distributor; as previously stated, two different gases with the same Wobbe index can be interchangeable. See Tables 1 and 2 (next page).



TABLE 1 • Technological problems in the glass melting furnace and forehearth.

PROBLEM	SOLUTION	AREA OF USE
Unstable chemical composition of NG. Unstable value of calorific value Unstable combustion redox index Unstable combustion ratio required	Stabilizer equipment for the Wobbe index	Premixing of air/NG in the combustion area; Forehearth and distributor combustion system

WOBBE INDEX STABILIZER (Figure 3)

This equipment mixes an amount of compressed air with NG and reduces the Wobbe index

to the minimum value of NG available from the gas company.

The output is a mixture of NG+air with a stable Wobbe index value. The quantity of air in the

mix changes automatically with air and gas flow measurements and compressed air flow automatic regulation, see Figure 4.

The compressed air is intro-

Figure 3

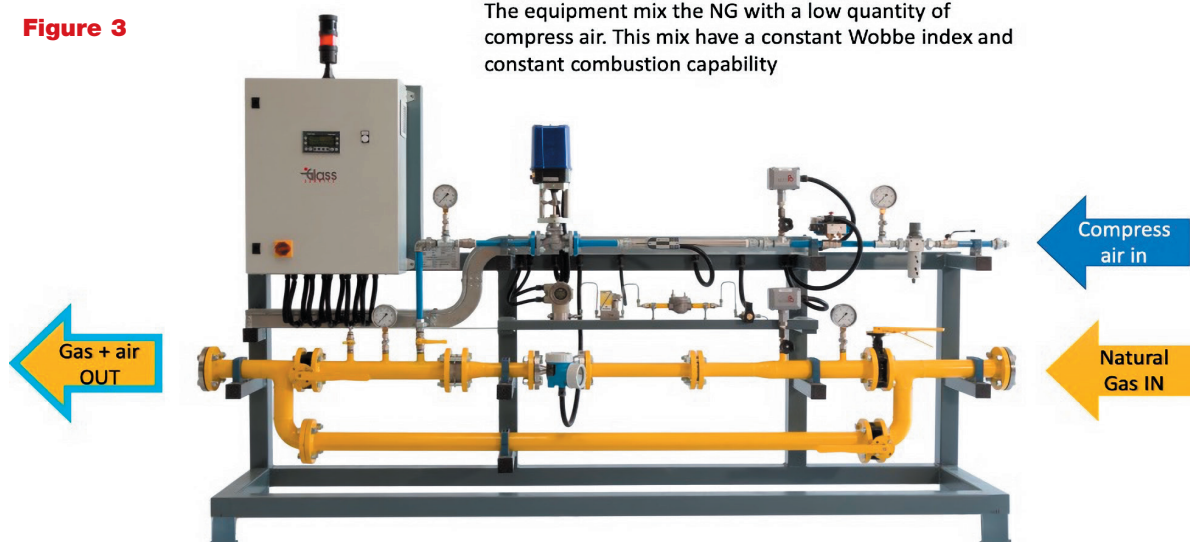
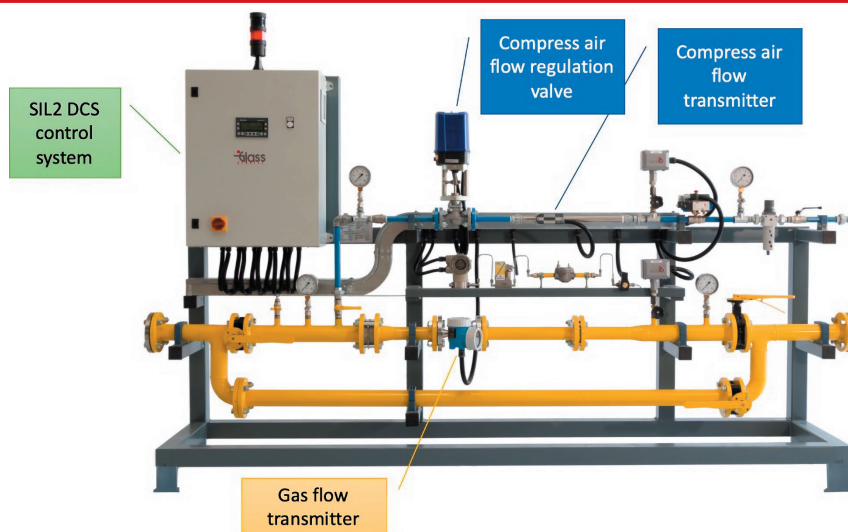


Figure 4



duced into the gas stream. Figure 5.

Down-flow from the mixing point, a gas chromatographer controls the mix ratio and transmits the Wobbe index to the The risk is that the mix of air and NG can be explosive. Figure 6

The air and NG mix can be explosive only in a short range: with a value of NG/air of 5-15 per cent. The lower explosion limit is called LEL, the Upper explosion limit UEL.

Over or under this value range

TABLE 2 - Issues and solutions caused by the risk that the air and NG mix can be explosive

PROBLEM	SOLUTION
Explosion risk of air/NG mix	Flow control of NG Flow control of compress air
EU standard rules for safety	SIL2 flow control device SIL2 safety parts (pressure switch, flow transmitter, safety shut off valve, etc.) SIL2 control system by Honeywell SIL2 HC900 SIL2 DCS controller

Figure 5

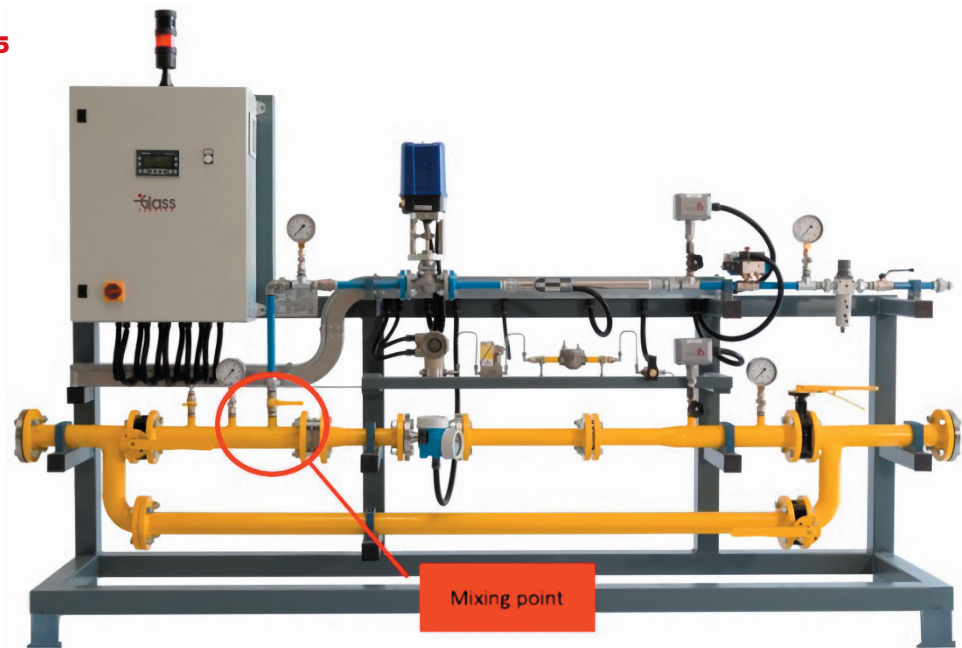
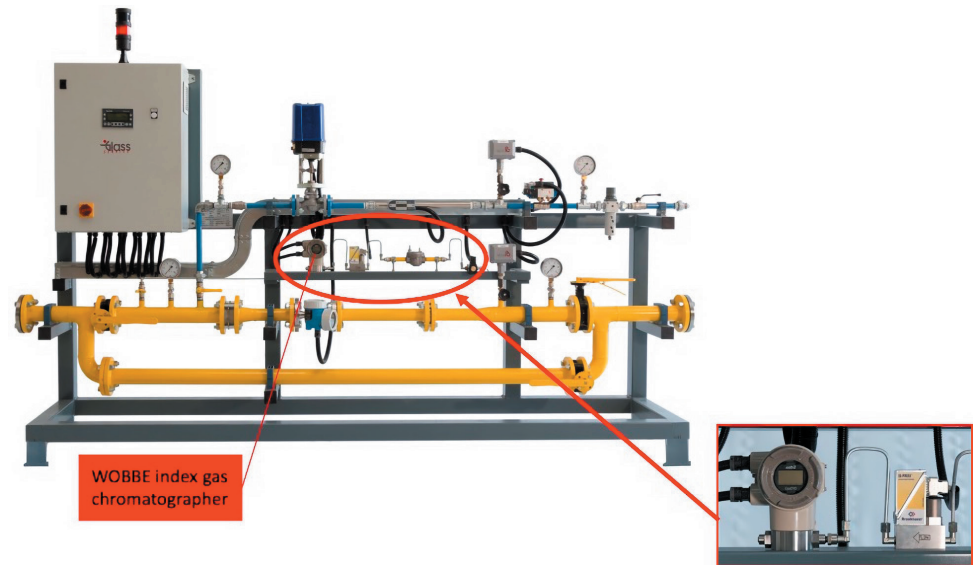


Figure 6



UEL Upper Explosion Limit

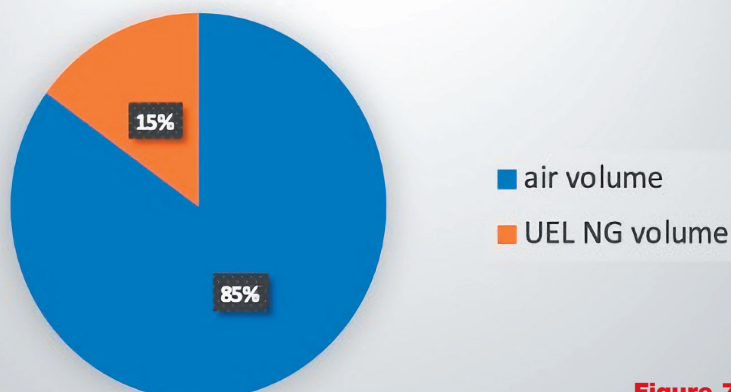


Figure 7

LEL Lower Explosion Limit

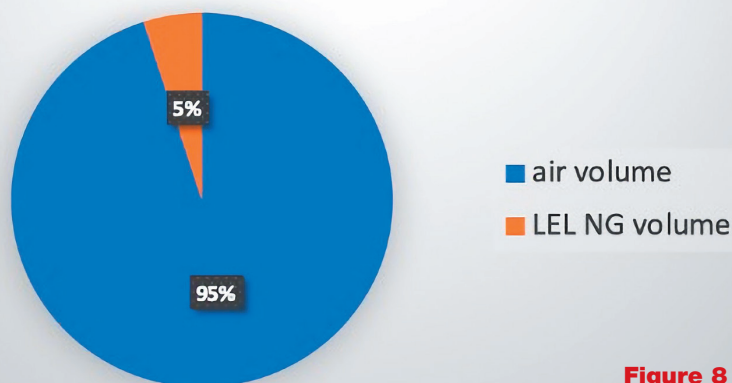


Figure 8

TABLE 3 - Case 1

NG density	0.717 kg/Nm ³
NG Vc , higher calorific value, max value	38.9 MJ/Nm ³
NG Vc , higher calorific value, min value	33 MJ/Nm ³
WI, Wobbe index, max value	52.22 MJ/Nm ³
WI, Wobbe index, min value	44.39 MJ/Nm ³

the mix is not explosive, e.g. case 1. (Figs 7 and 8)

In the example as per table 3, the equipment that we developed will stabilize the Wobbe index to 44 MJ/ Nm³ introducing 13.8 per cent of compressed air (percentage by volume) in the stream. This value is much lower than the explosion point (Fig 9). The system is equipped with several safety devices in order to eliminate the explosion risk.

The main concept is to guarantee that the air/gas mix level is lower than the minimum injection point value.

European safety standards require that safety equipment must be SIL2.

The unit is designed for:

- NG max flow according to the plant requirement;
- NG input pressure, max and min, according to the plant requirement.



The equipment is made up of the following devices installed on a skid (Figure 10):

Gas section (Table 4)

Compressed air section (Table 5).

- Electrical control board including:
 - WOBBE index calculation loop
 - Alarm management
 - Alarm list and historical
 - Local touch screen display
 - Safety SIL 2 device

All equipment is installed on a metal frame and is supplied ready for installation with an electrical cabinet. ■

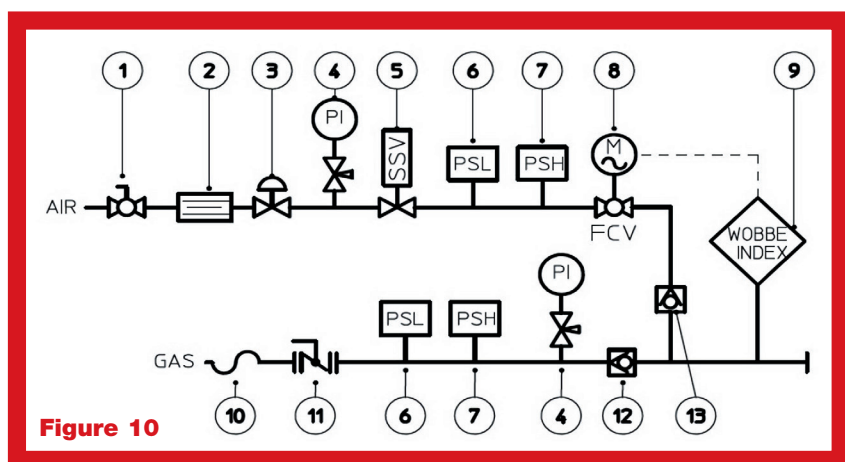
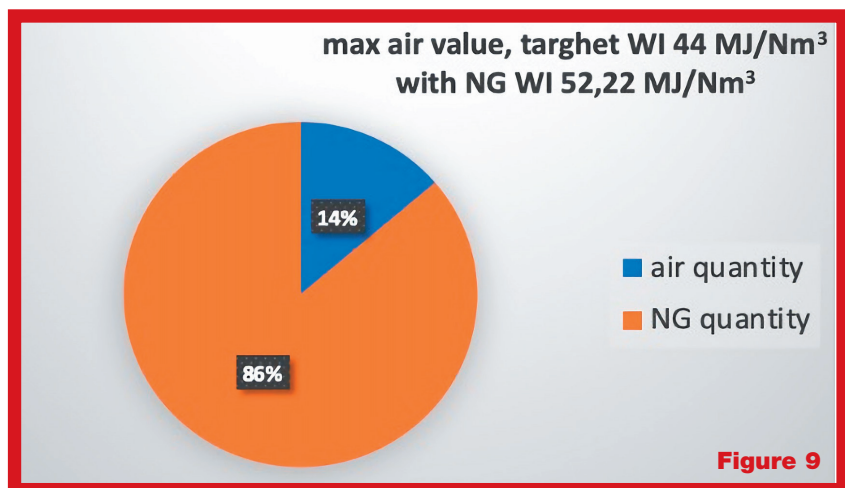
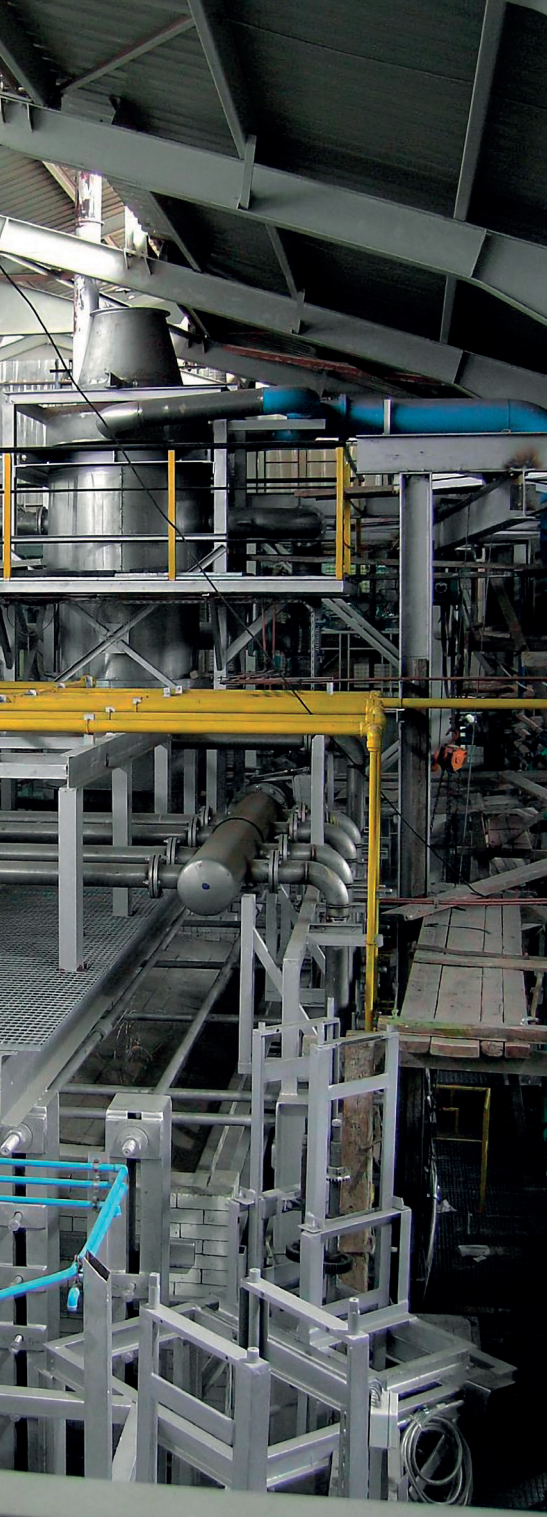


TABLE 4 - Gas Section - Devices List

ITEM	DESCRIPTION
10	N.1 Flex joint
11	N.1 manual valve shut off set
6	N.1 low pressure switch SIL2 safety standard
7	N.1 high electronic pressure switch high accuracy, SIL2 safety standard
4	N.2 NG pressure gauge and relative cock valve
12	N.1 NG gas no return valve
9	WOBBE INDEX, NG calorimeter analyzer, including onboard computer

TABLE 5 - Compressed Air Section - Devices List

ITEM	DESCRIPTION
1	N.1 manual valve shut off set
2-3	Compressed air pressure reducer including filter and liquids separator
4	pressure gauge and relative cock valve
5	N.1 shut off electrovalve SIL2 safety standard
6-7	N.2 pressure switch SIL2 max and min pressure
8	Flow regulation valve with integrated electrical servomotor
13	No return valve

glass
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