Special gas combustion in Water Tube Boilers: Low LHV gas burners.
Low LHV gas

Blast Furnace Gas
Flow range from 2,000 to 40,000 Nm3/h per burner

Process Gas
Flow range from 2,000 to 40,000 Nm3/h per burner

Coke Oven Gas
Flow up to 6,000 Nm3/h per burner

Landfill Gas, Biogas
Flow up to 10,000 Nm3/h per burner

Gas from coal mines (firedamp)
Flow up to 5,000 Nm3/h per burner
Blast Furnace Gas

→ **Typical Composition ( % volume)**
  - CO: 26%
  - H2: 3%
  - CH4: 0,5%
  - N2: 57%
  - CO2: 13%
  - O2: 0,5%

→ **Features**
  - Toxic gas due to the high CO content
  - Low LHV, 650 to 850 kcal/Nm3
  - Low available pressure, 10 to 60 mbar
  - High flue gas flow at relatively low temperature

→ **Burners**
  - Very large gas circuits
  - Low NOx emissions, < 50 mg/Nm3
Process Gas

→ **Example (% volume)**
  - CO: 3,98%
  - H2: 25,56%
  - CH4: 0,53%
  - N2: 67,50%
  - CO2: 0,77%
  - Ar: 0,82%
  - H2O: 0,83%

→ **Features**
  - LHV from 650 to 2500 kcal/Nm3
  - Usually available at low pressure, 10 to 200 mbar
  - High flue gas flow and relatively low flame temperature

→ **Burners**
  - Very large gas circuits
  - NOx emissions depending on LHV and components
Fives-Pillard KFT type burners for Blast Furnace Gas and Process Gas (external scroll)
Fives-Pillard K type burners for Blast Furnace Gas and Process Gas
MAIN REFERENCES, of Blast Furnace Gas burner installations (KFT type)

EMA POWER Hungary - BOILERS 7 and 8 (tangential firing)
EMA POWER Hungary - BOILER 9 (front firing)
EDF DUNKERQUE : K TYPE Blast Furnace Gas burner
Development of Blast Furnace Gas burner for very low LHV: Improved air mixing

FLUENT CFD: Visualization of Air / BFG mixing

Contours of Mole fraction of O2

FLUENT 6.1 (3d, ε)
Development of Blast Furnace Gas burner for very low LHV: Improved air mixing
SRD Dunkerque Reference with new KFT development (2012)

Boiler capacity

- NG firing 60 t/h
- BFG firing 45 t/h
- 4 Burners 12 MW each

BFG LHV: 670 to 830 kcal/Nm3
Main Results

Boiler capacity
- NG firing: 60 t/h
- BFG firing: 45 t/h
- 4 Burners: 12 MW

NG firing:
- FGR 10%
- Ambient combustion air
- NOx 75 mg/Nm³

BFG Firing
- No FGR
- Combustion air: 200°C
- NOx 26 mg/Nm³
<table>
<thead>
<tr>
<th>End user</th>
<th>Richemont Power station</th>
<th>TOTAL-BP-MOBIL</th>
<th>ARCELOR MITTAL</th>
<th>SAINT GOBAIN (France)</th>
<th>ARCELOR MITTAL</th>
<th>EMA Power</th>
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<tr>
<td>Site</td>
<td>Richemont (France)</td>
<td>Dunkerque (France)</td>
<td>Ebange (France)</td>
<td>Pont à Mousson (France)</td>
<td>Fos/mer (France)</td>
<td>Dunaujvaros (Hungary)</td>
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<td>Number of boilers</td>
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<td>3</td>
<td>3</td>
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<td>40</td>
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<td>75</td>
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<td>2</td>
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<td>6</td>
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<td>BFG flow rate per burner (Nm3/h)</td>
<td>34 425</td>
<td>11 920</td>
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<td>20 000</td>
<td>35 520</td>
<td>10 800</td>
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<td>750 to 850</td>
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<td>600 à 900</td>
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<td>4300</td>
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<td>GN</td>
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<td>Combustion air temperature (°C)</td>
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<td>230</td>
<td>20</td>
<td>20</td>
<td>190 to 250</td>
<td>190 to 260</td>
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</table>
Coke Oven Gas

→ **Typical Composition ( % volume)**
  - H2: 50%
  - CO: 8%
  - CH4: 29%
  - CnHm: 4%
  - CO2: 2%
  - N2: 7%

→ **Features**
  - Presence of impurities such as tar and H2S
  - LHV 4500 kcal/Nm3
  - Available pressure from 50 mbar to several bars
  - Frequent use as additional fuel with BFG burners

→ **Burners**
  - Gas circuit dimension depending of pressure available
  - NOx emissions from 250 to 350 mg/Nm3 with standard burners
Coke Oven Gas Burners

Natural draught burner, Coke Oven Gas fired (Shanxi Cooking company – China)
Coke Oven Gas Burners

Natural draught burner, Coke Oven Gas fired (Shanxi Cooking company – China)
Coke Oven Gas Burners

Coke Oven Gas circuit on BFG burner (ARCELOR MITTAL Fos/mer)
Landfill Gas (and Biogas)

→ **Typical Composition ( % volume)**
  - CH4: 50% (variable from 20 to +50%)
  - CO2: 29%
  - N2: 18%
  - H2: 3%
  - H2S, benzene, toluene, ..... 

→ **Features**
  - LHV from 2000 to 5200 kcal/Nm3
  - Available pressure usually around 100 mbar

→ **Burners**
  - Large gas circuit
  - NOx emissions < 100 mg/Nm3
Fives-Pillard Bioflam® burner for landfill gas or biogas

Burner for LHV > 3000 kcal/Nm3
Scroll Burner for landfill gas:

Burner for LHV > 2000 kcal/Nm³ (South Korea Sudokwon Reference)
Fives-Pillard Bioflam® burner for landfill gas or biogas

Biogas fired burner on biomass dryer application
Gas from coal mines (firedamp)

- **Typical Composition ( % volume)**
  - CH4: 30% to 90%
  - Air

- **Features**
  - LHV from 2600 to 7800 kcal/Nm3
  - Available pressure usually around 100 mbar (sometimes around 1 bar)

- **Burners**
  - Large gas circuit when the pressure is low
  - NOx emission < 100 mg/Nm3
Burner for coal mine gas (scroll)

Burner for LHV > 2000 kcal/Nm3 (Elyo Forbach Reference)
Some references for landfill gas, biogas and coal mine gas

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<th>End user</th>
<th>ELYO</th>
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<td>20</td>
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