

NOX EMISSION
REDUCTION
CITY OF
BEIJING FROM
2017-04-01

Low NOx Action Plan

Regulation China and Beijing

China



Beijing

Unit: mg/m³

Blue : old std.

Red : new std.

() : key region



New built

Pollutants project 污染物项目	Emission Limits 污染物限值		
	Coal boiler 燃煤锅炉	Oil boiler 燃油锅炉	Gas boiler 燃气锅炉
Particulate matter 颗粒物	80 -> 50	80 -> 30	50 -> 20
Sulfur dioxide (SO ₂)	900 -> 300(200)	500 -> 200(100)	100 -> 50
Nitrogen oxides (NO _x)	not needed -> 300(200)	400 -> 250(200)	400 -> 200(150)

Pollutants project 污染物项目	Emission Limits 污染物限值	
	From July 1, 2015	From April 1, 2017
Sulfur dioxide (SO ₂)	10	10
Nitrogen oxides (NO _x)	80	30

Old boilers need to be updated to ensure NO_x declined to 80mg/m³ from April 1, 2017

Nationwide and Beijing released the new emission standard to push the low emission products development.



Facts on Emission Standards

What's the challenge

- According to the announcement of Beijing Municipality Environmental Bureau the Nox Flue Gas Emissions at Combustion of Natural Gas using commercial and industrial boilers shall be reduced as from April 1, 2017 to:
 - **Nox max @ 30 mg/cbm equivalent to 62 ppm**
- The existing Nox emission standard is @ 80 mg/cbm and can be achieved by the current boiler/burner units delivered by TTDI and/or TTCW using gas burners from Oilon, Weishaupt, and other international burner brands
- There is no limitation in thermal capacity of boiler/burner units at the current emission standards
- The new standard will be only valid for the city of Beijing

Facts on Emission Standards

What's the challenge

- ▶ The issue is dominantly a combustion issue, however, the boiler design has to be considered and adjusted when it comes to extremely low NOx emissions.
- ▶ In the EU a holistic approach is preferred for setting emission regulations considering all kinds of emissions and in particular maintaining the highest thermal efficiency of a boiler/burner unit.
- ▶ In USA and seemingly in Beijing highest significance is laid on NOx emissions which – if not correctly applied by the burner/boiler suppliers might cause a reduction in thermal efficiency and increased CO2 emissions.

Facts on Emission Standards

What's the challenge

- ▶ NOx emissions of that low level can technically be achieved, however, measures need to be split into 2 categories:
- ▶ Thermal capacity of boiler/burner unit < 2 MW – option 1 feasible
- ▶ Thermal capacity of boiler/burner unit > 2 MW – only option 2
- ▶ Option 1: by “surface burners” with slight adaptations of boiler doors
- ▶ Option 2: with flue gas recirculation slight impact on boiler design at extra costs compared to the current units.

Flue Gas Recirculation – how does it work?

Flue Gas Recirculation (FGR) for NOx Reduction

FGR by Air Vitiation

Flue gas recirculation (FGR) is a highly effective technology for lowering NOx emissions from burners, and it is relatively inexpensive to apply. Recirculating up to 25% of the flue gases through the burner could lower NOx emissions to as little as 25% of their normal levels.

- 1.) The cooled, relatively inert, recirculated flue gases act as a heat sink from the flame and lowering peak flame temperatures.
- 2.) When mixed with the combustion air, recirculated flue gases lower the average oxygen content of the air, starving the NOx-forming reaction for one of the ingredients they need.

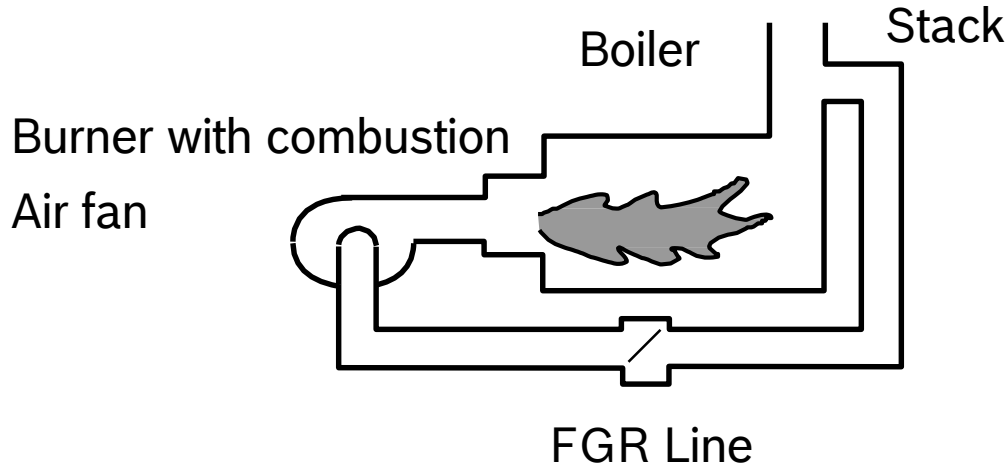
Flue Gas Recirculation – how does it work?

The simplest way is to use the combustion air blower to suck the flue gases out of the stack and blend them with fresh air before they go into the burner.

This technique is also known as air vitiation, and it can be applied to many types of burners without any other modifications.

The second way is to use a separate blower to pull the flue gases from the stack and push them through some sort of manifold or bustle ring into the flame. This normally requires factory-modified burners. Both methods can be equally effective, although certain burner designs may respond better to one method than the other.

FGR Basic Scheme



Major advantage of FGR system is – almost -no impact on thermal efficiency and CO2 emissions, however, needs more components to install.

Facts on Emission Standards

What's the challenge

- ▶ Basic information about “surface burners”:
- ▶ Need a Lambda (combustion air/gas ratio) of exactly 1,6
- ▶ Thus are limited in size and length of combustion “cylinder”
- ▶ Require advanced air – and gas-filtering of combustion air- and gas-inlet particularly at Beijing with high content of air-dust and coal residues in the gas pipeline system from the formerly used coal gas (Stadtgas).

Technical features of surface burners

- Surface burners are functioning through fan supported combustion air/gas mixture which is blown in to a wire mesh formed “tube”. The gas/air mixture is ignited on the entire surface of the wire mesh tube. In order to safeguard a stable combustion on the mesh surface the combustion air/gas mixture requires an extremely high air surplus (Luftueberschuss) as the flame temperature needs to be “cooled down” in order to reduce NOx emissions.
- As air pressure and velocity of the air/gas mix is limited inside such flame tubes the thermal capacity is limited, too as otherwise the mesh tubes would burst.

Technical features of surface burners

Continuation slide 6

- Suitable material of such wire mesh would be a special stainless steel material which is rather expensive and needs to be replaced after a period of time.
- The Lambda value of combustion process needs to be kept at exactly 1,6 which includes the surplus of air by appr. 7 %, thus reducing thermal efficiency of the boiler by a maximum of 3 - 5 % and increase of CO₂ emissions in the flue gas.

Technical features of surface burners

Continuation slide 7

- The Lambda value is extremely sensitive to filthy air- and gas-supply which needs to be considered in particular for Beijing city as the air contains high volume of dust and sand and the natural gas purity is not safeguarded as the Beijing gas pipeline infrastructure was dominantly installed decades ago for the supply of cooking gas which was at those days coal gas (Stadtgas) which was distributed at much lower supply pressures and velocities than the now used natural gas. Thus the Beijing gas pipelines have internal layers of coal residues accumulated which is now dissolved and transported to the points of use. As a result highly sophisticated air filters for combustion air as well as gas filters need to be installed and maintained constantly.

Johnson Burners USA

Technical Data - Extract



- NOXmatic® RF-series: 800-1200 boiler HP
- NOXmatic® A-Series: 50-800 boiler HP

NOxMatic A-Series 50 – 800 equivalent to 150 – 1125 KW

Using MFT material for the tubular surface burner which is known having a very limited life time expectancy. Johnson claims 9 ppm = 18 mg Nox, no values given on CO and reduction of thermal efficiency.

RF series: Johnson claims 30 ppm Nox = 62 mg, can be achieved by conventional gas jet burners.

Weishaupt gas jet burners



By using FGR system the conventional gas jet burners can still being used