INNOVATIVE DESIGN OF KALUGIN TOP COMBUSTION STOVES

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Hot Stoves with Internal Combustion Chamber

It is the main type of existing hot stoves worldwide. Checker chamber and combustion chamber are located in the same shell. The weakest part is the combustion chamber. This design requires frequent shutdowns for repair.

This design has 6 major drawbacks:
- “short circuit” (direct flows of gases between combustion chamber and checker chamber);
- “banana” effect (decline of the combustion chamber towards the checkerwork);
- deformation and breakdown of combustion chamber brickwork due to creep of refractory materials;
- uneven distribution of combustion products over the checkerwork up to ± 15% due to the side position of the combustion chamber;
- refractory cracking due to thermal shocks during changeover of blast and gas periods;
- flame pulsation during combustion due to acoustic excitation of the high combustion chamber.

Hot blast temperature during long-term operation is up to 1200°C
Hot Stoves with External Combustion Chamber

This design eliminates only two disadvantages: “short circuit” and “banana effect”

- stove dome design is much more complicated
- more space is required for stove arrangement
- susceptibility of the stove shell to intercrystalline corrosion
- complex system of temperature expansion compensations for the checker chamber and combustion chamber shells
- cost is 30-35% higher

Maximum hot blast temperature during long-term operation is 1250°C
It has no combustion chamber and disadvantages connected with it. Our first experience of top combustion hot blast stove construction in Russia.

The dome base has a low (1 m) circular pre-chamber. There are several dozens of ceramic burners of small size mounted at the bottom of the circular pre-chamber. The shaftless stove has a widened dome. The circular gas and air collectors are located inside the shell. The equipment applied is similar to that in the ceramic burners.

This stove was in operation for 27 years without major repairs at the temperature of 1200-1250°C and was decommissioned due to BF shutdown, though it was still in a perfect condition.

1500 m³ BF of NTMK, Nizhny Tagil, Russia
• The stoves fit well into available space.
• “Short-circuit” is missing.
• Flame pulsation is missing.
• Uniform distribution of combustion products over the checkerwork (95-97%).
• Concentration of carbon monoxide in waste gas is not more than 50 mg/m³.
• Hot blast temperature of 1300⁰C-1400⁰C can be achieved using ordinary refractory materials.
• Service life of KSS is 30 years without major repairs.
• Saving on refractory is 30-50% due to small dimensions of the stove.

Our Top Combustion Stove Design Kalugin Shaftless Stove (KSS)

Pre-chamber with jet vortex gas and air supply system is located at the dome top. Gas and air jet vortex in the pre-chamber provides a good gas combustion before the entrance to the checkerwork. The design is patented.
Emissions

KSS Unit at 3200 m³ BF No.4 of Jinan Iron & Steel Co.Ltd. (Jinan), China

KSS No.14 at 3200 m³ BF No.4 of Arcelor Mittal Temirtau, Kazakhstan

KSS Unit at 4150 m³ BF No.1 of Inner Mongolia Baotou Steel Union Co., Ltd, China

KSS No.2,3,4 at 907 m³ BF No.3 of Maanshan Iron & Steel (GROUP) Co. Ltd, China.
**Hexagonal Checker Bricks**

a) 40 mm channel diameter and heating surface area of 32.7 m²/m³ – it is a standard checker brick in Russia

b) 30 mm channel diameter and heating surface area of 48 m²/m³ – these checker bricks are used in KSS

c) 20 mm channel diameter and heating surface area of 64 m²/m³ – these checker bricks are used in KSS

Reasonable arrangement of different types of refractory materials along the height of the checkerwork, which was tested through practice, ensures operation of the checkerwork without clogging by dust and slag up to 30 years.
Checker support of Kalugin design allows operation with the maximum waste gas temperature of 500°C.
Heat Exchanger System for KSS
Combustion Air Preheaters (CAP) for KSS

KSS Unit + CAP System at 1160 m³ BF No.1 of Qinhuangdao Shouqin Metal materials Co. (China)

KSS Unit + CAP System at 4350 m³ BF No.4 of Taiyuan Iron & Steel Co. (TISCO), (Taiyuan, China)

KSS Unit + CAP System at 2580 m³ BF Angang Steel Co. Ltd (Anshan, China)
Construction of New Kalugin Stoves

KSS Unit at 3800 m³ BF No.1 of CSPEC EM STEEL PLANT (Fortaleza, Brazil)

Four KSS at 5050 m³ BF No.1 of Baosteel Group Zhanjiang Iron & Steel Co., Ltd. (China)
Modernization of Existing External Combustion Stoves with KSS installation (one by one)

One-by-one reconstruction of KSS No.3, No.4, No.1 and No.2 at 5500 m³ BF No.5 of Severstal Iron & Steel plant (Cherepovets, Russia)
Modernization of Existing Internal Combustion Stoves with KSS installation (one by one)

KSS No.12 at 3000 m³ BF No.3 of West-Siberian Iron & Steel plant (Novokuznetsk, Russia)

KSS No. 2,3,4 at 3000 m³ BF No.1 of West-Siberian Iron & Steel plant (Novokuznetsk, Russia)
Modernization of Existing Stoves with KSS installation (simultaneous construction)

Three KSS at 2300 m$^3$ BF No.1 of JSW Steel Ltd.

Simultaneous construction of three stoves was performed next to the existing stoves without interruption of blast furnace operation.
Kalugin Stoves in Russia

KSS Unit at 2200 m³ BF No.7 of NTMK (Nizhny Tagil, Russia)

KSS Unit at 2700 m³ BF No.4 of Severstal (Cherepovets, Russia)

KSS Unit at 1033 m³ BF of Tulachermet (Tula, Russia)

KSS Unit at 3800 m³ BF No.7 of NLMK (Lipetsk, Russia)

Low emissions

20 mm channel diameter
Kalugin Stoves in India

KSS Unit at 680 m$^3$ BF No.1 of JAYASWALS NECO INDUSTRIES LTD (India)

KSS Unit at 254 m$^3$ BF No.2 of Kirloskar Ferrous Industries Ltd. (Hospet, India)

KSS Unit at 254 m$^3$ BF No.1 of MUKAND Ltd. (Hospet, India)
Kalugin Stoves in China

KSS Unit + CAP System at 4747 m³ BF No.3 of Anyang Iron & Steel INC (Anyang, China)

KSS Unit at 4150 m³ BF No.2 of Inner Mongolia Baotou Steel Union Co., Ltd. (Baotou, China)

KSS Unit at 3200 m³ BF No.4 of Magang (Hefei) Steel & Iron Co. (China)
KSS Unit at 254 m³ BF No.2 of MFCL (Kurashiki, Japan)

KSS No.3 at 4300 m³ BF No.3 of JFE Steel Corporation (Fukuyama, Japan)
KSS Unit at 1650 m3 BF No.5 of Kardemir A.S. (Karabuk, Turkey)

KSS Unit at 3800 m3 BF No.1 of KRAKATAU, POSCO Steel Works (Cilegon, Indonesia)

KSS Unit at 250 m3 BF No.1 of Hi HMISHO Steel S.A. (Syria)
Kalugin Stoves in Other Countries

Construction

Operation

Třinecké železárny (Trinec, Czech Republic), KSS No.64 at BF No.6 of 1372 m³ capacity
The advantages of Kalugin stoves have been appreciated by experts from many countries.

219 stoves - in operation
34 stoves – in designing and construction

Total: 253 Kalugin Shaftless Stoves
Thank you!

С нами - к высоким температурам!

To high temperatures - with us!

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