Fact sheet **with compliments from ...**

CHINCO FIRESIDE TREATMENT cc 1995-056226

CHINCO COAL CATALYST

Chinco improves combustion of coal by acting as a catalyst that lowers the reaction time thus reducing the ignition temperature to enable lower activation/ignition temperature.
Reduction in smoke, particulates and smut, tars and hydrocarbons that would previously evaporate (wet) at lower temperature (before actual ignition) and then leave via the stack, or sticking to the boiler tubes, are now combusted/ burnt due to the lower ignition temperature created by the catalyst. This creates new additional fuel/heat when burnt, instead of escaping through the stack as particulates and soot. Carbon in ash is reduced by 20% and more!

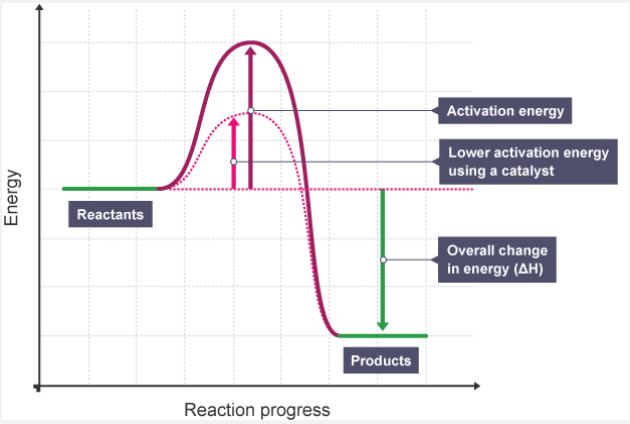
Chinco reduces coal consumption by at least 3%
The additional heat obtained by normally unutilized /unburnt soot and hydrocarbons that are now actually combusting due to the catalytic reaction and lower ignition temperatures. This increases available 'fuel', improves the total heat generation, and improves steam to coal ratio.

Chinco creates soft and friable build-up and not the hard carbon build-up on the steam tubes and interior of the boiler. This hard build-up is due to wet sticky tars and hydrocarbons that normally evaporate and not burn-out at the lower temperatures before ignition. This hard build-up causes constant shuts of the boiler to chip and clean off hard build-up. Now the soft buildup creates much longer service times and easier cleaning of the tubes eventually.

Chinco reduces NOx and SOx compounds
The sulphur and phosphor impurities are removed from the exhaust gasses to form complex sulfates in the ash instead of the dangerous chemicals escaping through the smoke stack.

Chinco reduces greenhouse gas emissions such as carbon monoxide CO, particulates, soot/char, and complete combustion takes place.

FACTS, CITATIONS, and REFERENCES REGARDING COAL CATALYSTS!



https://www.researchgate.net/publication/257643581

*By means of thermo gravimetric analysis, the catalytic effect of metallic oxides in the combustion behavior of coal was investigated under non isothermal conditions. Experiments were conducted from ambient temperature to 1000 °C at a heating rate of 20 °C·min^{-1}. The ignition temperature, burnout performance, and exothermic behavior were used to evaluate the catalytic effect. Moreover, the kinetics parameters (activation energy and pre-exponential factor) were determined using the Coats–Redfern method. It is indicated that, compared with the combustion characteristics of coal, the **ignition temperature** of the samples with metallic oxides **decreases** by 8–50 °C. Metallic oxides can **speed up the combustion rate** and burnout of the fixed carbon. The exothermic values of samples incorporating metallic oxides increase by 15–30%, which was due to the catalytic effect of metallic oxides on fixed carbon combustion. The **activation energies of the***

samples decrease, *and there is a linear connection between the activation energies and pre-exponential factors (ln A = 0.2683 × E-12.807).*

https://www.researchgate.net/222851234 .of all the kinds of the methods for intensifying combustion behavior, the **catalytic combustion** is an effectual one, which has been successfully applied in the power stations, cement industry and other civil utilization [20][21][22]. Catalytic combustion of pulverized coal has the following features:
(1) Increases the combustion reactivity, due to a **reduction of the ignition temperature** and **increase of the combustion rate** [23,24],
(2) Improves combustion efficiency by **decreasing the unburnt carbon in ash** and promoting the heat release [25], and
(3**) Reduces the pollutants** in the exhaust gas, such as NO x , SO 2 , CO and PM [26][27][28]. Catalytic combustion of pulverized coal has been extensively studied in recent years,

: *Catalysts have been shown to enhance coal pyrolysis and char oxidation at **low to moderate** temperatures and heating rates (< 1250 K and 1–1000 K/s). Such catalytic activity has also been demonstrated at high heating rates and temperatures approaching pulverized coal combustion applications. The effect of an additive on coal pyrolysis and char combustion was studied in a flat-flame burner system at high particle heating rates using a Kentucky bituminous coal. Pyrolysis and char reactivity of two treated coals with different catalyst loadings were studied and compared with the untreated coal. The total volatiles yield for the treated coals increased between 14 and 18% (absolute) on a dry ash-free basis compared to the untreated coal in experiments conducted at 1300*

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6083348 Air pollution reduction Release of carbon monoxide, sulfur dioxide, and micro particles to the environment during coal combustion causes air pollution. In addition, the generation of carbon monoxide is an indicator of incomplete combustion. The concentration equivalents of carbon monoxide and oxygen in the exhaust gases with or without CC in Taixi coal clearly show that the addition of CC **significantly reduced the generation of carbon monoxide**, Fig. 3(a) .

This is in agreement with the results in Fig. 2, where the larger peak areas with the additives implied the **more complete burning of the coal.** The oxygen level in the exhaust gas which can be used to monitor the burning process of coal in situ is shown in Fig. 3 (b) . for CC mixed with Taixi coal (1. 5%), the sharp increase in the oxygen level at about 750 °C indicates the early completion of the combustion process at that temperature, in comparison with about 850 °C without CC. (a) Carbon monoxide 1000 77 °C (b) Oxygen Fig. 3 Concentrations of carbon monoxide and oxygen in the exhaust gases of Taixi coal Sulfur-containing gases, such as SO2, are the main source of acid rain. CC agents were found to reduce the release of such gases by binding chemically with SO2, in addition to their ability to improve the combustion characteristics. The sulfur reduction ability of CCS agents was studied using a mixture of equal mass of Taixi coal and Yibin coal, containing 1.74% sulfur. The data in Table 3 illustrates the sulfur-removing effect of CC added to the coal mixture- More than half of the sulfur was removed when only 5% CC was added to the coal mixture. Table 3 Sulfur-removing effect of CC at 900 °C CCS content/% Sulfur removing (%) 1 28 2 36 3 42 4 48 5 52 T h e addition of CC agents to raw coal not only reduced the level of carbon monoxide in the exhaust gas, but also reduced the release of carbon micro particles to the environment, as evidenced by the **decreased blackness of the exhaust gas**. An example is shown in Fig. 4 for Taixi coal. The decreased soot actually results from the complete combustion with CC.

https://www.osti.gov/servlets/purl/826191
Certain catalysts have shown promise in reducing the amount of char nitrogen (nitrogen present in devolatized coal) under pyrolysis conditions. It is proposed that the **catalysts drive more of the nitrogen from the coal matrix** into the gas phase in heated environments where little or no oxygen O is present. This process could aid greatly in **reducing production of NOx emissions by converting the fuel nitrogen to harmless N_2 gas!**

https://www.scientific.net/AMR.113-116.1766
Pulverized coals are widely used by injection into the blast furnaces in order to replace expensive cokes. In this paper, a new catalytic combustion promoter, containing manganese dioxide with other oxides (or

carbonates) of rare earth metals and alkali earth metals, was developed to enhance the combustion of pulverized coal. The effects of addition amount on the ignition temperature and the combustion efficiency were investigated. With more promoters added, the ignition temperature dropped, whilst the combustion efficiency increased significantly. Industrial test showed that, with the addition of 0.4% of the promoter, the coke consumption reduced to 26.7 kg/t ·Fe (equivalent to 7.5 million US dollars per blast furnace per year), and the carbon contents in the fly ash dropped to from 43.1% to 32.4%, which suggests great economic and environmental benefits

Reference: Handbook of Preparative Inorganic Chemistry, 2nd Ed. Edited by G. Brauer Page 368)

Carbon monoxide is the number one killer emission gas that the entire World needs to target but it is often wrongly described and banded around as CO2. Carbon monoxide (CO) levels drop during use of a catalyst containing manganese/magnesium/copper, showing improved combustion efficiency in converting carbon to the more oxidized carbon dioxide combustion product. CO2 is in fact Carbon Dioxide and is a colorless, odorless gas, vital to life on Earth. This naturally occurring chemical compound is composed of a carbon atom covalently double bonded to two oxygen atoms. Trees and plants take in carbon dioxide and release oxygen, retaining the carbon for growth. If we have enough trees and plants, we can clean up the atmosphere because they will pull the carbon out of the air and put it back in the ground.

***Extract from REPORT EUR14893 EN* :**

Ash fusion temperatures can be increased by changes in ash composition. In dry bottom combustors burning sodium rich lignite and sub-bituminous coals whose ash composition constitutes >50% basic oxides *Slagging problems can be effectively reduced* by the addition of additives such as ***manganese*** and magnesium oxides. Mn/Mg changes the *Base to acid ratio* (B/A) of the coal ash, to the extent that there is a reduction in the formation of slag deposition on the furnace walls and convection surfaces. One will also see a reduction in tube plate deposits at the entry to the tube passes. In addition, the product will reduce fouling, and leave a softer (and easier to remove) phosphate deposit, when it exists. Slag viscosity reducing catalysts which lower ash fusion temperatures are occasionally used in boilers in order to maintain the flow of molten slag. The slagging characteristics of a bituminous coal ash can are estimated. Components which are reported to be fluxing agents include *iron* ore, fluorite (CaF2), and boron containing compounds.
However, FE203 (*iron) can produce iron-rich slag* which are highly reactive and can attack refractory linings whilst fluorite and boron compounds can yield environmentally unacceptable products.

https://www.lenntech.com/periodic/elements/s.htm

Sulphur: Melting Point: **119°C -** Vapor Pressure**:** 0mmHG **at 140°C** - *Auto-ignition Temp:* ***266°C*** - *Flashpoint:* ***207.2°C***
At **160ºC** and higher, the eight-member-ring sulfur molecule is energized and ruptures. The open-chain sulfur molecule that takes shape combines to make long un branched polymer chains by a free radical mechanism. At high temperatures, crystalline patterns are established by the polymer as the long chains frequently orient into a coiled helix similar in bond angle to the eight-member ring. The polymeric allotrope of sulfur is insoluble in organic media, natural and synthetic rubber as well as in carbon disulfide. Because of this insolubility, polymeric sulfur is referred to as insoluble sulfur. CAS Number: 7704-34-9 - Appearance: Yellow colored lumps, crystals, powder
Family Name: Element – Sulfur - Chemical Formula: S_8 - Physical State: Solid - Specific Gravity: 2.07 @ 22°C
Odor: Odorless, or faint odor of rotten eggs if not 100% pure - Purity: 90% - 100%
Formula: S_8 (Rhombic or monoclinic**) - Molecular Weight (G):** 256.50 **- Vapor Density (Air = 1):** 1.1
Solubility In Water: Insoluble - Boiling Point: 444°C - Bulk Density: Powder 33-80 lbs./ft^3 - Flammable Limits: LEL: 3.3 UEL: 46.0

https://www.askpowerplant.com/what-is-soot-blowing-in-boiler-operation-their-operations

Sootblowing is an easy method of keeping the Boiler tubes clean. Regular and correct use of soot blowers can maintain the efficiency of the Boiler and lengthen the periods between cleaning.
PROCEDURE ; Check Boiler load before sootblowing. Open soot blower drains.

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Crack open soot blower master steam valve to warm up lines for about 5 minutes to remove condensate.
Place Boiler on manual control and set furnace on maximum suction without tripping the ID fan.
Close soot blower drain valves and open master steam valve to blowers fully.
Operate one soot blower at a time by opening the soot blower operating valve slowly till full open and close again slowly. Repeat this 3 times. Start from the front of the Boiler, ending at the rear. With Fire tube Boilers open rear soot blower first, then the front. On completion shut off the master steam valve to soot blowers.
Finally set the Boiler back on balanced draught, then on automatic control.
Empty all fine ash hoppers. Ideally Sootblowing should be done once per 8 hour shift.

https://www.ch302.cm.utexas.edu/kinetics/catalysts/catalysts-all.php

Catalyst**,** in chemistry it is a substance that increases the rate of a reaction without itself being consumed. Most solid catalysts are metals or the oxides, sulphides, and halides of metallic elements and of the semi metallic elements boron, aluminium, and silicon. A catalytic action is a chemical reaction between the catalyst and a reactant, forming chemical intermediates that are able to react more readily with each other or with another reactant, to form the desired end product. During the reaction between the chemical intermediates and the reactants, the catalyst is regenerated. The modes of reactions between the catalysts and the reactants vary widely and in solid catalysts are often complex. Typical of these reactions are acid–base reactions, oxidation–reduction reactions, formation of coordination complexes, and formation of free radicals. With solid catalysts the reaction mechanism is strongly influenced by surface properties and electronic or crystal structures. Certain solid catalysts, called poly-functional catalysts, are capable of more than one mode of interaction with the reactants.

https://www.sciencedirect.com/science/article/pii/0004698170900065

Chinco creates an effective catalytic process and the opacity of the plume of the smoke stack indicates how clean and complete the plant is burning its coal. Chinco coal catalyst, with enhanced combustion technique, is able to completely combust the black “soot,” carbon monoxide CO, mercury and carcinogens.

- ## CHINCO COMBUSTION CATALYST.

- **Chinco Coal catalyst** is inexpensive and more than **pays for itself** in real coal cost savings of **3%+** on coal bill.
- Reduces **smoke, particulate matter and smut and improving the opacity of smoke.**
- Reduces **deposits on combustion surfaces**. Far **less wasted carbon in dumped ash**.
- Reduces **exhaust temperature.** Reduction in **excess air** and oxygen.
- Reduction in **both SOx and NOx**.
- Reduces **ignition temperature** of **even poor quality coal to allow quicker easier ignition.**
- Reduces **coal consumption of 3% min through Increase in efficiency and steam to coal ratio.**
- Reduces **deposits** on and **heat transfer areas, and boiler remains clean for extended periods**.
- Removes **poisonous CO (carbon monoxide) in combusting it** and so become harmless CO2**.**
- Encourages **OH ions** to combine with Carbon to form **CO** which **combusts** to form CO2.
- **Increases** Ash fusion temperature **to avoid ash fusing at low temperature and formation of clinker.**

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