Clean Coal Technology

Asia Coal Catalyst Company

# ACCC CONSIDERATIONS & CHEMICAL PRINCIPLES OF "88" COMBUSTION CATALYSTS

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CC-88: Helping to Green the World

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## Introduction

Combustion of fossil fuels will remain for the foreseeable future the principal source of energy for industrial applications. In recent times, the thoroughly efficient use of fossil fuels has become a matter of conservation concern and global economics. An important role, therefore, exists for catalytic chemical agents that permit fuels to be utilized more efficiently in existing equipment.

## Combustion Theory Considerations:

The complete oxidation (combustion) of one pound of a given hydrocarbon fuel releases a fixed amount of energy. The exact amount of energy may be calculated by theoretical considerations from knowledge of the composition of the fuel. No chemical can alter the thermodynamics involved. From a fixed amount of given fuel, only a fixed amount of energy can be derived in the complete oxidation of the fuel to carbon dioxide and water.

## The Chemistry of Combustion

Combustion is technically an oxidation process that occurs at a highly accelerated rate giving off both heat and light. In ordinary terms, oxidation of fossil fuels is the combination of carbon and hydrogen of the hydrocarbon with oxygen to give as ultimate products, carbon dioxide and water. The processes that occur between unburned fuel and final products are multi-step and complicated, but all of them in¬volve free radicals: i.e., atoms or molecules having an unpaired electron.

Combustion begins when the hydrocarbon encounters an oxygen molecule (a natural diradical) with enough threshold energy to cause a chemical reaction. The reaction releases much more energy than is required to activate further reactions, and so the process is self-propagating once it is started.

The rate of intensity of the process is proportional to the concentration of oxygen and fuel able to burn:

rate = (02) (FUEL)

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The proportional constant, k, reflects the threshold energy for reaction since collisions of oxygen and fuel that occur with insufficient energy do not lend to useful reaction.

There are three areas in which chemical catalysts may be of important benefit:

1) One important role is to utilize the fuel completely and to complete the burning process in a time frame in which the combustion is useful in the system. Most, if not all, combustion equipment currently in use emits unburned hydrocarbons in the exhaust gases. In addition, burning that is carried on in the exhaust consumes fuel with no useful work. It is clear that there are important inefficiencies that might be helped by selected catalysts.

2) Increases in the flame temperature improve upon heat transfer so that more of the available energy becomes useful work. Catalysts that contribute in this area generally perform in the first area, as well.

3) On the practical side, chemical additives can reduce the wear and tear on com¬bustion equipment and, thereby, help it operating at design efficiency. Still other chemicals reduce deposits that interfere with heat transfer from the flame to the working medium.

It is clear that no - single chemical combination can cover the entire range of require¬ments in boilers, diesel engines, turbines, etc.

The "88" series of combustion catalysts incorporate chemical components as required by the application and in all cases these catalysts improve the efficiency in the combustion process itself.