Fuel Flexibility During SCR Operation

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Introduction

In today's deregulated market, utilities count on maximum flexibility in fuel purchase options. The multitude of fuel sources contains an extremely broad range of fuel constituents. These constituents directly impact SCR catalyst life. The constituents of selected domestic coals are examined and relationships to catalyst life drawn. Specific focus is given to arsenic and calcium oxide.

US coals

A survey of regional coals reveals a wide diversity in coal constituents. The change in physical properties of the coal impacts both the selection of catalyst pitch (cell opening) and the chemical properties i.e. allowable SO2 oxidation rate. Coals with relatively high CaO content (i.e. PRB) or high total ash loading are best managed by the use of large pitch catalyst (8mm or greater). For high sulfur coals, catalyst SO2 oxidation should be minimized to <1% to minimize the impacts of elevated levels of SO3 on both the air heater and stack opacity. Depending on the boiler exit SO3 content, coals with low sulfur can be designed for SO2 oxidation rate of >1% without negative impact on plant operations.

Arsenic and CaO content are the predominant SCR catalyst deactivation agents in US coals. The coal survey highlights the large variability of As and CaO in coals. It is important to understand the range of these constituents that may be used at a given boiler since these constituents impact required catalyst volume in design phase and catalyst life in operation.

Eastern coals tend to have higher arsenic content and lower CaO content. Therefore the primary deactivation mechanism is due to arsenic. For PRB coals, the primary mechanism is due to CaO poisoning. Due to the interaction of CaO and As, a blend of eastern coal and PRB may result in a relatively low deactivation rate. Under this scenario, the arsenic reacts with the calcium oxide in the furnace significantly reducing the gaseous arsenic concentration. Since the gaseous component of arsenic causes the deactivation, the increased CaO content effectively improves the catalyst deactivation rate. Therefore, in many cases, fuels with low CaO content should be supplemented with additional CaO (limestone) to improve catalyst life by reducing the gaseous As content of the flue gas. This fuel treatment is recommended provided the impact of limestone addition on slag formation and ESP operation has been properly evaluated and deemed acceptable.

Evaluation Tools

Using a proprietary model based on actual deactivation data from full and pilot scale SCRs in Japan, Germany and United States, Cormetech can illustrate the impact of various fuels on catalyst life. Based on the survey of US coals, the catalyst life can vary significantly. Of the bituminous coals, those with

high arsenic content (>20 ppm in coal) and low CaO content (<1.5% in ash) have greater deactivation rates than those with lower arsenic content and higher CaO content. The deactivation rate of PRB is expected to be similar or greater than bituminous coals with high arsenic and low CaO content.

The information above can be used to assist fuel purchasing decisions. Cormetech provides utilities predicted life under various fuel firing scenarios for specific boilers to allow for evaluation of fuel savings versus total catalyst lifecycle costs.

Summary

A utility with a wide range of fuels (HS, LS, & PRB) under study must consider the economic trade offs of the catalyst specifications and operations. A specification that requires a wide range of fuel options, produces a design with large catalyst pitch and low SO2 oxidation at increased costs. Fuel specification also impacts catalyst design and life. Cormetech provides tools to help assess the impacts of various fuels on long-term catalyst cost.