EFFECTS OF FUEL CHARACTERISTICS ON SCR INSTALLATIONS

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SUMMARY

The recent implementation of SCR technology to various combustion processes has demonstrated the strong effect that fuel characteristics have on the SCR installation. The general fuel selection, such as gas, oil, or coal will influence the basic design of the facility in terms of ability to cope with ash, soot, sulfur etc., thus affecting parameters such as catalyst pitch, materials of construction, and general size and layout. Specific fuel parameters such as the presence of catalyst poisons, unusual trace elements, or unfavorable particulate will strongly affect the specific facility design. Alternate fuels, even though combusted for a relatively short period of time, may govern the overall design of an SCR facility due to the strong adverse impacts during their short burn durations. Traditionally, clean natural gas has represented the least demanding fuel case for an SCR, with installation difficulty increasing as fuels become heavier, progressing through light to heavy fuel oil, residual refinery fuels, high rank to low rank coals, and finally special solid fuels such as municipal wastes, industrial wastes, or biomass. These ranks of difficulty are not strict, however, as the adverse characteristics of one particular fuel may outweigh the adverse impacts of another fuel that generally represents a more difficult application. For instance, a coal-fired installation with high-rank, low-poison coal may actually be less demanding than an installation burning a heavy fuel oil with high contaminant and particulate levels. For convenience, the discussions are divided three categories; 1) gaseous fuels, consisting of natural gas and various process gases, 2) liquid fuels, consisting of various ranks of refined petroleum fuels and residual distillation products, and 3) solid fuels, consisting of cokes, coals, wastes, and biomass.

Gaseous fuels have traditionally consisted primarily of clean natural gas, but in recent years process or syn-gas installations have become more common. These installations may present a variety of problems for SCR technology due to fuel constituents such as sulfur, fine particulate, and various heavy metals. These applications must be treated on a case-by-case basis to fully determine the potential for adverse impacts on the SCR catalyst. In many cases insufficient information is available to fully determine the impacts and testing may be required to determine parameters such as trace flue gas constituents and total particulate levels.

Various ranks of fuel oils are combusted in both conventional boilers and gas turbines. As with process gases, these fuels may range widely in terms of sulfur content and metals content. In addition, the particular fuel and combustion process will determine the amount of fine particulate or soot that may be formed, thus dictating catalyst geometry and the need for sootblowing. Vanadium content in fuel oils is of special concern due to the high SO_2 oxidation rates that may occur with the build-up of vanadium on the catalyst. This phenomenon, along with fuel sulfur level, will impact the acceptable ammonia slip level and minimum operating temperature for any given facility.

SCR applied to coal-fired facilities has traditionally been an area of focus for the industry. Coal characteristics such as ash content, sulfur levels, and trace metals content will influence the specific catalyst design and overall installation design greatly. As more detailed operating histories are gained for various coals, optimum SCR specifications are being developed which minimize the cost of NOx removal. Currently the most crucial coal parameters evaluated are ash content, sulfur concentration, and arsenic and calcium levels. These parameters, along with operating temperature and gas velocities, will dictate the catalyst formulation and geometry. The coal characteristics will also influence parameters such as specified maximum ammonia slip, ductwork design, and equipment design for corrosion resistance.

Specialty fuels such as waste or biomass present a challenge for SCR technology due to the relatively little worldwide experience on these unusual fuels. Materials such as municipal solid waste will contain a wide variety of potential catalyst poisons, both known and unknown. This limits the ability to predict catalyst life and to properly compare the economics of SCR technology to other NOx reduction technologies. Biomass, due to high levels of constituents such as sodium and potassium, has been problematic in terms of catalyst poisoning and the resulting shortened catalyst life. Blending of various specialty fuels with traditional fuels such as coal has been proposed as an advantageous solution, but little long-term data is available to fully assess the impacts of these fuel blends. As with many fuels, the exact impact of specialty fuels on SCR must be evaluated on a case-by-case basis, and in many circumstances the exact effects on the SCR process may be unknown.