Utility Experience with SCR in Germany

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The selective catalytic reduction (SCR) technology was primarily developed by Japanese industry for the reduction of NO_x concentrations from power plants flue gas emissions. The first commercial Japanese DeNO plant began operation in 1981 while the first German plant started up in 1985.

Two Germany environmental resolutions (GFAVO of June, 1983 and UMK of April, 1984) enhanced the adaption of the SCR technique in German power plants. From the end of 1984 to 1987 most German utility owners ran pilot plants in order to become acquainted with this technology and to determine whether there are special deterioration mechanisms. The first full scale plants started operation at the end of 1985. Since then, around 120 SCR plants have been installed on utility coal, oil and gas fired power plants. The application of SCR technology for NO_x control has also been made on waste-to-energy plants, sintering plants, wood fired boilers, chemical plants, sewage sludge incinerators, and cement plants. In addition, a special catalyst was developed to control dioxin emissions.

The German NO_x emission limit for utility power plants is 200 mg/Nm^3 at 5%O_2 for dry bottom boilers and 6% O_2 for wet bottom boilers or about 86 ppm NO_x at 3% O_2. This is approximately 0.1 lbs/MMBtu. Many German SCR units achieve high online availability on an annual basis.

In the following paper we will emphasize some aspects of the SCR process:

a) The chemical and physico chemical properties of the catalyst
b) The chemical engineering design of the catalyst volume
c) The deterioration of catalytic activity with time
d) The effect of NH_3 slip (caused by catalyst deterioration or inhomogeneous NH_3 distribution) and of side reactions

The basis of the SCR technique is described first and then each of the above areas is discussed.

In extrapolating the German SCR experience to U.S. applications, one of the most significant factors will be catalyst deactivation due to the differences in some U.S. coals with high alkaline metals and others with high sulfur and SO_3 contents.

Deactivation can be caused by:

- Excessive heat
- Erosion and pluggage
- Pore blockage
- Plant operations
- Accumulation of catalyst poisons
- Prevention of gas diffusion by the formation of surface layers

KWH and PreussenElektra have lead many developments in the German SCR industry over the past 15 years. Some of the advancements include:

- Development of new derivative structures of titanium base
- Development of new erosive resistant materials
- Optimization of the catalyst pitch
- Development of regeneration programs
- Institution of coal blending programs to extend catalyst life
- Development of catalyst maintenance programs
- Development of improved flow modeling techniques

These improvements have led to an extended catalyst life for many facilities. The paper will discuss the German SCR experience and how it is being extended to the U.S. power industry.