



MMR-20-003 - Additional Data

The equipment was operational but did not fit the Seller's application and COGEN. The equipment will require modifications for other applications or COGENs.

DeNOx process performance is dependent on the catalyst properties. Topsoe has substantial resources in fundamental research on the DeNOx reaction mechanism at the surface of the catalyst. This work has led to a titanium-tungsten-vanadium based catalyst that is highly reactive to NOx, resistance to thermal shocks with a high tolerance for common poisons. Topsoe's (DNX®) catalyst is unique in its design, structure and manufacture. It is based on a corrugated fiber-reinforced TiO2 carrier impregnated with active components. The manufacturing process generates a catalyst with a large reactive surface area based on a diverse tri-model pore volume. Due to the flexible fiber structure, the catalyst is suitable for high-temperature operation and offers a high resistance to thermal shocks. The diverse tri-model pore volume gives the catalyst an unmatched tolerance for commonly found catalytic poisons. The DNX® catalyst formulations are tailored for each specific SCR application. The catalyst is also selective by reducing NOx, while restricting the oxidation of NH3 to NOx or SO2 to SO3.

SCR Process Description

The DeNOx process is a Selective Catalytic Reduction (SCR) of nitrogen oxide (NOx) in a combustion flue gas into harmless nitrogen (N2) and water (H2O) without forming any secondary pollutants. Nitrogen oxide (NOx) breaks down when it reacts with a reducing agent, usually ammonia (NH3) on the surface of a catalyst. The NH3 is mixed thoroughly with the flue gas by means of an injection grid, with or without static mixers, prior to the catalyst. The mixing ensures even distribution of the NH3 and NOx components. The NOx reduction efficiency depends on the amount of NH3 added (NH3/NOx molar ratio). At high NH3/NOx ratios, a high degree of NOx removal can be obtained. A fraction of the NH3 remains unreacted. The amount depends on the NH3/NOx mal-distribution present in the exhaust gas prior to the catalyst along with the NOx reduction efficiency and the service life of the catalyst. This unused NH3 in the exhaust gas at the DeNOx unit outlet is known as the ammonia slip. The catalyst, by providing active reduction sites, allows the NOx reduction reaction to occur at temperatures between 400oF – 1,050oF. NH3 diffuses into the catalyst pore structure and is adsorbed onto an active catalyst site. The NOx then reacts with the adsorbed NH3, completing the reduction reaction. The reaction potential depends primarily on the availability of active sites (a function of geometric surface area, pore distribution and volume, and diffusion along with the concentration of the active catalyst components), flue gas temperature and reducing agent concentration and distribution. This catalyst is based on a corrugated fiber-reinforced titanium dioxide (TiO2) carrier plate. The plates are homogeneously impregnated with the active components, in that

the entire ceramic plate is composed of a uniform distribution of tungsten trioxide (WO_3) and vanadium pentoxide (V_2O_5). The unique manufacturing process produces a catalyst with a very porous structure. This allows the active components to be finely dispersed on the entire surface area which results in generating a large number of active sites. The low specific mass of the catalyst obtained from this highly distinct pore structure significantly minimizes the catalyst SO_2 -oxidation activity while the fine dispersion of active components increases DeNOx activity, the result is a catalyst with a remarkably low SO_2 oxidation to SCR activity ratio.

The low SO_2 oxidation activity has been demonstrated in both USA and European installations on a broad number of applications. During performance test runs on coal-fired installation, the measured SO_2 oxidation has in all cases been significantly below the expected values. The large porous structure also increases the catalyst's tolerance to common catalytic poisons. The front edge of the monolith blocks is reinforced to prevent erosion from operation in ash-laden gases. The blocks are then placed in metal elements and assembled into modules that are arranged in the reactor to efficiently contact the flue gas during system operation. To minimize the effects of large ash particles, in some installation, the catalyst blocks are covered by a screen with a smaller opening than the catalyst.



