

BASF Catalyst O4-89

BASF Catalyst O4-89 has been developed for removing oxides of nitrogen from oxygen-containing off-gases. It is used, in particular, for destroying nitrous gases in off-gases from nitric acid plants. O4-89 is an extrudate of approximately 4.5 mm in diameter (S 4.5).

Mode of Operation

Oxides of nitrogen are converted on the BASF Catalyst O4-89 to nitrogen and water using ammonia:

- (1) $6 \text{ NO} + 4 \text{ NH}_3 \rightarrow 5 \text{ N}_2 + 6 \text{ H}_2\text{O}$
- (2) $6 \text{ NO}_2 + 8 \text{ NH}_3 \rightarrow 7 \text{ N}_2 + 12 \text{ H}_2\text{O}$
- (3) $\text{NO} + \text{NO}_2 + 2 \text{ NH}_3 \rightarrow 2 \text{ N}_2 + 3 \text{ H}_2\text{O}$
- (4) $4 \text{ NO} + \text{O}_2 + 4 \text{ NH}_3 \rightarrow 4 \text{ N}_2 + 6 \text{ H}_2\text{O}$

If the degree of oxidation is high, such as for example in off-gases of nitric acid plants, in which the NO_2 content of the nitrous gases detected is normally between 30 and 50 %, the conversion predominantly follows reaction (3), and also to a lesser extent reaction (4). If the degree of oxidation is low, the proportion of NO_2 being only, for example, 5 %, reaction (1) occurs preferentially. With degrees of oxidation of 50 % reaction (2) becomes dominating, thus reducing slightly the reaction rate. Within the temperature range of 150 – 400 °C, the conversion takes place selectively, i.e. the oxygen present in the off-gases oxidizes the ammonia which has been dosed in to a very limited extent, if at all. The heat formation during the conversion is equivalent to about 10 °C per 1000 ppm of NO_x .

Operational Conditions

Space Velocity

At pressures of less than 2 bar, operation using a space velocity of 2000-3000 h⁻¹ or 1/h is recommended. At elevated pressure, the space velocity can be increased significantly, depending on the requirements.

Temperature

The reduction of oxides of nitrogen is advantageously carried out within the temperature range between 170 and 380 °C. Below 170 °C, the NO_x conversion is usually too low. Above 380 °C, the selectivity of the catalyst slowly diminishes. An increase in the NO_x concentration is observed at the reactor outlet, since the oxygen in the gas stream oxidizes ammonia to oxides of nitrogen at elevated temperatures.

NH_3 Dosing

The amount of NH_3 which is required depends, according to each application, on the composition or degree of oxidation of the off-gas stream, on the operational conditions and on the desired NO_x conversion. In nitric acid plants, 1 mol of ammonia is added to the off-gas per mol of nitrous gases, in accordance with equation (3). In this way, there is only a very slight escape of NH_3 if any. No ammonia must be dosed during start up and/or at temperatures of less than 160 °C.

Material Safety Data Sheets (MSDS)

A safety data sheet covering the necessary information is available on request.

Physical Properties

Color	Brown-Yellow
Active Composition	V_2O_5 on metal oxide carrier
Loading Density, kg/L	Approx 1,100
Crush Strength, kg	Approx 4
Abrasion, %	< 10

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