idreco

THE SCIENCE OF A PURE ENVIRONMENT

FLUE GAS NO_x REMOVAL

■ **The Denox Process**

Flue gases resulting from the combustion of fossil fuels require extensive treatment to insure optimum removal of SO_2 and NO_X if excessive pollution of the environment is to be avoided.

Today, there are a variety of proven processes avaliable for SO_2 removal. The most effective process to date for flue gas NO_X removal in power plants is known as selective catalytic reduction (SCR). It operates at temperatures of between 300° C and 400° C on the reaction principle that shown in Fig. 1 and may be summarized by the following equations:

$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$

$6NO_2 + 8NH_3 \longrightarrow 7N_2 + 12H_2O$

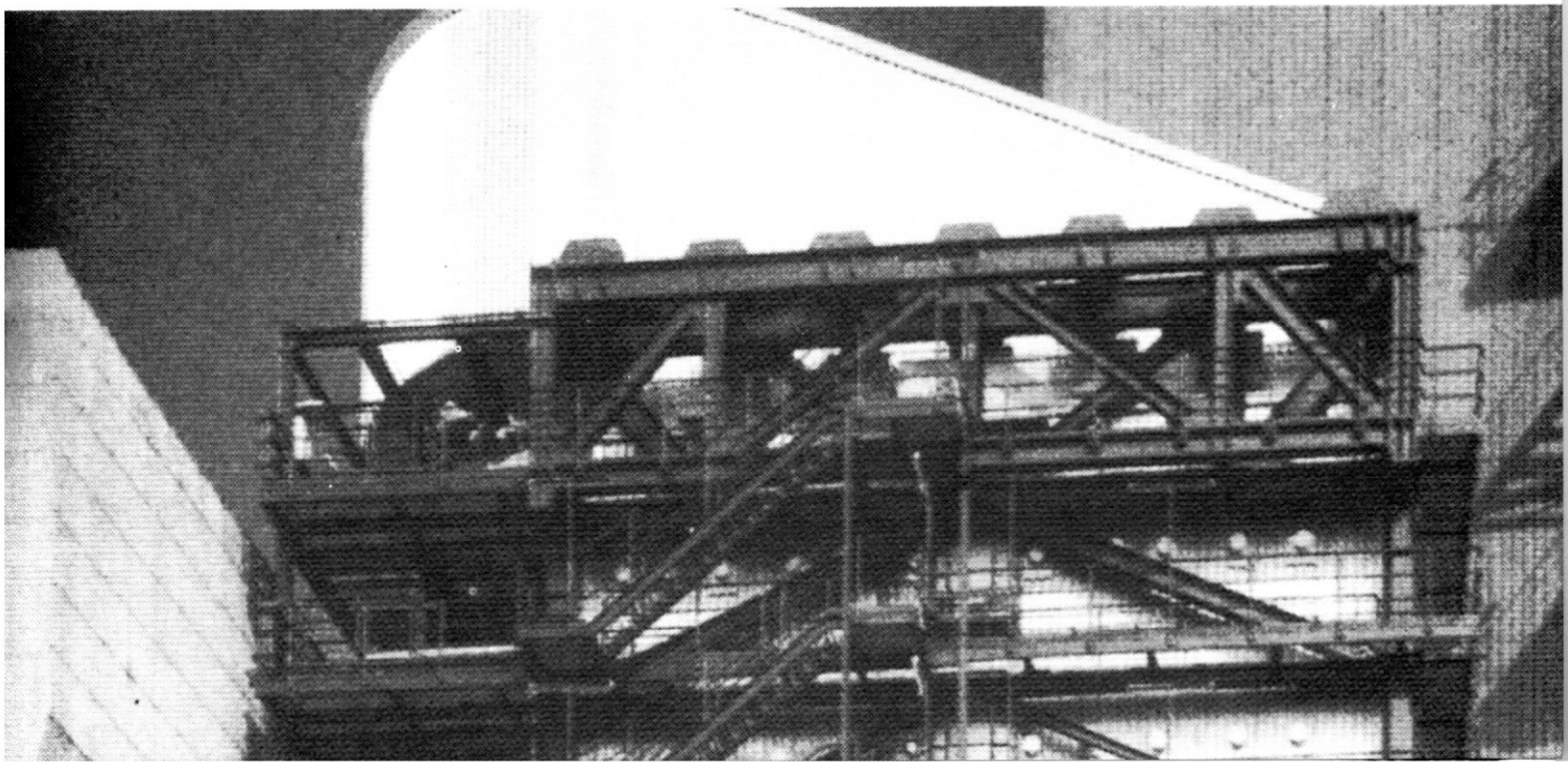
Before the flue gas enters the reactor, ammonia is added in the form of a NH_3/air mixture, which promotes the reduction of nitrogen oxides when the gas comes into contact with the catalyst.

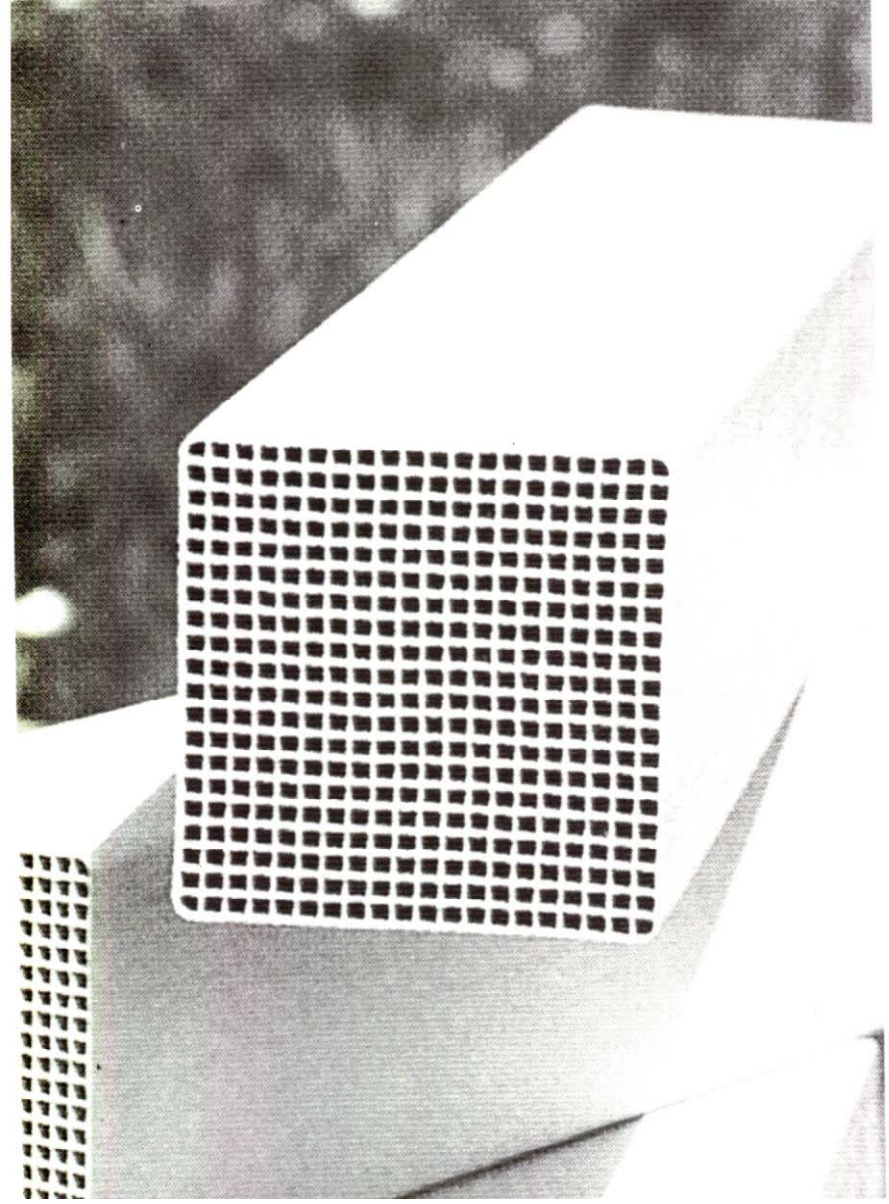
Figs. 2 and 3 show the preferred arrangements for the DENOX reactor. The location of the DENOX unit downstream of the boiler between the economizer (feed water preheater) and the combustion air preheater is known as the "high-dust" configuration. When the unit is located downstream of the electrostatic precipitator this result is the so-called "low-dust" variant. In this configuration the DENOX unit may be also installed downstream of the desulphurization system. This result is the so-called "Tail-end" configuration.

■ **The design**

Taking into account the customer specifications and the amount of space available in each case, the size of individual reactors is optimized with the aid of pilot plant tests. The criteria of particular importance include the thorough mixture of NH_3 and NO_X molecules in the reactor hood and a constant gas flow in the vertical part of the reactor.

The key design parameter in a reactor of this type is the so-called space velocity (SV). This is a measure of the residence time of the flue





gas mixture (at STP) within the catalyst volume.

Calculation of the space velocity takes into account the following factors :efficiency of the DENOX reaction, temperature, allowable ammonia slip, flue gas analysis, dust analysis etc.

The SV is used in calculating the amount of catalyst required per unit time for a given volume of flue gas. In coal-fired power plants, the SV is normally between 1000 and 3000 per hour whereas for oil - and gas - fired boilers it will be higher, resulting in a smaller quantity of catalyst being required for the NO_X reduction. Extra space is normally provided to allow catalyst to be added when the overall performance begins to decrease, thereby raising the effective service life of the catalyst. In this way, it is possible to extend the time between complete replacement of the catalyst. (see Fig. 4).