CHEMICAL INDUSTRY SCR DENOX TREATMENT CASE STUDY

1. Waste Gas Parameters

The waste gas comes from the ammonia oxidation unit, with a flow rate of approximately 16,920 m^3/h at ambient temperature and atmospheric pressure. Its main components are NMHC, methanol, hydrogen cyanide, CO, etc. The oxygen content in the waste gas exceeds 6%, and the particulate matter content is below 5 mg/m^3. The specific composition is as follows:

Pollutant	Waste Gas Generation Rate (m^3/h)	Inlet Concentration (mg/m^3)
VOCs	17,000	373.4705882
Methanol		285.1764706
Hydrogen cyanide		84.11764706
CO		196
Sulfuric acid		3.411764706
Formaldehyde		15.70588235
Monomethylamine		21.47058824
NOx		90–130
Total	**17,000**	**1,069–1,109**

Among these components, monomethylamine and hydrogen cyanide contain nitrogen and will generate nitrogen oxides after high-temperature oxidation. Together with the nitrogen oxides already present in the waste gas, they would promote the formation of acid rain if discharged into the atmosphere without treatment. Although the waste gas contains sulfuric acid, its concentration is extremely low, and no treatment is needed.

2. Process Route

To control NOx emissions, this project employs SCR to carry out DeNOx treatment on the oxidized flue gas.

First, the waste gas enters the RTO through the main fan. In the combustion chamber of the RTO, high-temperature oxidation ensures the thorough decomposition of the VOCs. After high-temperature oxidation, the flue gas leaves the RTO through another set of regenerative chambers, leaving the heat inside the RTO and thereby improving thermal efficiency. Next, the treated flue gas must still pass through SCR DeNOx to remove the nitrogen oxides, as shown in Fig. 2-1.

SCR requires the flue gas temperature to be within 180–420 °C, whereas the flue gas discharged from the RTO is usually below 100 °C. To meet the temperature requirement, the low-temperature flue gas can be heated by a heat exchanger and then mixed with the high-temperature flue gas drawn from the combustion chamber. The heat exchanger can directly recover the waste heat of the flue gas after DeNOx, as shown in Fig. 2-2, so no additional heat source is required.

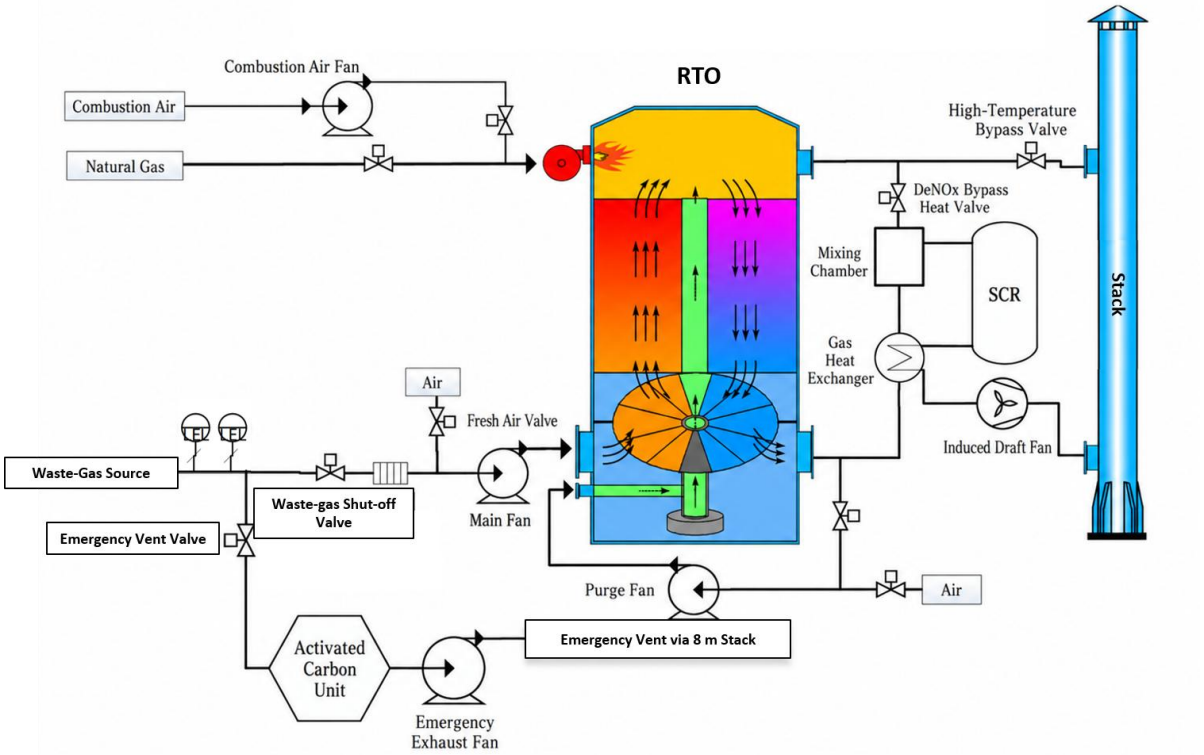

Fig. 2-1 The Overall Treatment Process

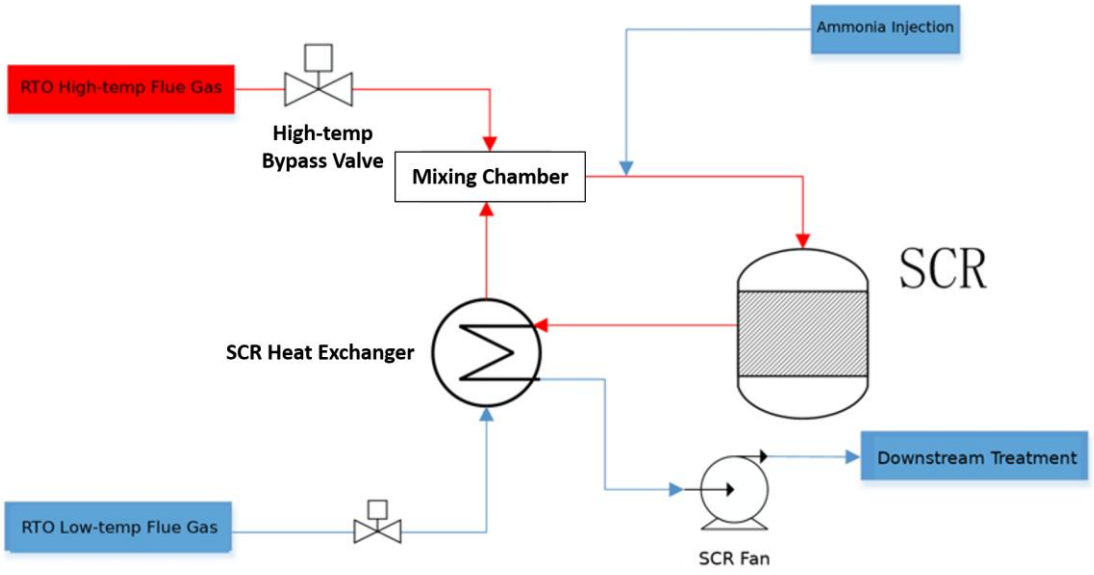

Fig. 2-2 The detail of the SCR equipment

3. Working Principle

3.1 RTO Principle

An RTO consists of several regenerative chambers and one combustion chamber. The waste gas first passes through the regenerative chambers, absorbing the heat stored in the ceramic media so that its temperature rises to several hundred degrees Celsius; it is then introduced into the combustion chamber, where the organic compounds (VOCs) are oxidized and decomposed into carbon dioxide and water at high temperature. After oxidation, the purified high-temperature gas leaves through another set of regenerative chambers, transferring its heat to the ceramic media there, which in turn preheat the incoming waste gas. Because heat is repeatedly recovered and reused within the RTO, the temperature difference between the inlet and outlet gas streams can be as low as about 40 °C, enabling the RTO to achieve very high thermal efficiency.

3.2 DeNOx Principle

Selective catalytic reduction (SCR) is currently the most widely applied flue gas denitrification technology in the world. It produces no by-products, causes no secondary pollution, features a simple equipment structure, and achieves a high removal efficiency (above 90%). The principle of SCR is that, with the aid of a catalyst, ammonia is injected into the flue gas to reduce the nitrogen oxides into nitrogen and water. Without a catalyst, the denitrification reaction would require a temperature as high as 850–1,100 °C. The catalyst is therefore the core of the SCR equipment; it is usually made of a specific material, such as a vanadium–titanium alloy.

4. Treatment Performance

NMHC ≤ 30 mg/m^3
NOx ≤ 100 mg/m^3