Discussion on the reformation plan of full-section sampling device and precision ammonia injection control technology for denitration system of a 300MW unit

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Abstract. Since the denitration efficiency adjustment method is extremely limited during the operation of the unit, the internal flow field of the denitration reactor is not clear, the denitration efficiency of different catalyst modules cannot be monitored, the ammonia spray is blind, and the ammonia injection amount is difficult to control. Especially under the condition of ultra-low load, in order to ensure that NOX meets the requirements of ultra-low emission, it is necessary to increase the amount of ammonia spray, resulting in large ammonia escape and high risk of air pre-blocking. For this problem, the full-section sampling device for denitration reactor and The optimization and optimization scheme of precision ammonia injection control technology is discussed.

1. Introduction
Under ultra-low load, the smoke flow field distribution is more uneven. Although the SCR system has a baffle to adjust the flow field uniformity, the effect is not obvious [1, 2]. The unevenness of the flow field means that the unevenness of the smoke concentration field is increased. In this bad situation, if the NOX concentration detection is simply used to control the amount of ammonia spray, it will inevitably lead to an increase in ammonia slip unevenness. At this time, if there is no accurate ammonia slip measurement technology to support, the formation of ammonium hydrogen sulfate will be intensified, which will have a long-term impact on the safe operation of the unit.

By installing an ammonia-spraying uniform full-section flue gas sampling device at the inlet and outlet of the denitration reactor, the full-section flow field of the denitration reactor inlet during operation can be monitored in real time, and the full-section NOx concentration field at the outlet of the denitration reactor can be evaluated in real time. The denitration efficiency of each catalyst module in the denitration SCR reactor, the deviation of the flue gas flow velocity field of the denitration reactor, the NOX concentration distribution of the denitration reactor section, the NOX concentration distribution, combined with the flow field deviation, optimizes the denitration and ammonia injection, thereby realizing The precise control of the ammonia-adjusting zone reduces the ammonia escape rate, reduces the amount of ammonia sprayed by the system, reduces catalyst blockage and air pre-blocking, and achieves energy-saving, emission-reducing and environmental protection, which is conducive to safe, stable, economical and environmentally friendly operation of the unit[3, 4].
2. Technical transformation purpose, transformation and test plan

Denitration reactor full-section sampling device and precision ammonia injection control technology transformation technology mainly have the following five points: 1) Denitration reactor inlet full-section flue gas field deviation monitoring and analysis and evaluation; 2) Denitration reactor outlet full-section flue gas NOx concentration distribution monitoring; 3) precise ammonia injection adjustment test of denitration reactor; 4) dynamic denitration efficiency monitoring of catalyst module; 5) reasonable control of ammonia injection amount, reducing corrosion and blockage of air preheater, and achieving energy saving effect.

The transformation and test scheme are as follows: 1) A uniform uniform full-section flue gas sampling device is arranged on the upper part of the first layer of the catalyst of the denitration reactor. According to the space condition of the unit reactor, the side wall arrangement is generally adopted; 2) The third layer catalyst of the denitration reactor is used. A uniform full-section flue gas sampling device is arranged in the lower part, and the side wall arrangement is generally adopted according to the space condition of the unit reactor; 3) selecting the typical load of the unit and the special working condition of the denitration operation, and performing the flue gas flow field at the inlet section of the denitration reactor Deviation distribution monitoring, analysis and evaluation report of flow field deviation of flue gas flow rate of denitration reactor; 4) Selecting typical load of unit and special working condition of denitration operation, carrying out NOx concentration field of full-section of denitration reactor outlet, especially for each zone catalyst module Denitration performance; 5) According to the full-section NOx concentration distribution at the outlet of the denitration reactor, combined with the inlet flue gas flow field and NOx monitoring status, the zone is adjusted to the inlet of the reactor, and the ammonia injection gate is adjusted to accurately adjust the whole reaction. Manual spray valve for each zone; 6) Dynamic denitration efficiency under different catalyst modules operating conditions Test.

3. Expected result

1) The entire reactor inlet section is gridded and evenly compensated, and the coverage of the full-section smoke flow field at the inlet of the reactor is 100%.

2) According to the arrangement of the catalyst module of the denitration reactor, the outlet section of the reactor is grid-likely distributed, and the coverage coverage of the full-section flue gas NOx concentration is 100%.

3) Through the precise zoned ammonia injection adjustment test, the NOx concentration zone deviation rate of the full-section outlet of the reactor is less than 10%.

4) The clogging condition of the air preheater and the catalyst layer is significantly reduced, the resistance of the SCR reactor and the air preheater is obviously improved, the pressure difference of the air preheater is lowered, and the efficiency of the boiler is improved.

5) Under the same working condition load, the amount of denitration ammonia is significantly reduced, and the total amount of ammonia spray is not less than 10%.

6) Under the same working condition load, the ammonia escape rate is not less than 10%.

4. Economic Benefit Analysis

1) Save the cost of liquid ammonia. The NOx concentration unevenness (concentration relative standard deviation) of the denitrification unit section is generally greater than 50%. After the denitration spray ammonia full-section sampling device is installed, the denitration efficiency of the denitration catalyst layer can be monitored in real time, according to the concentration of NOx in each region of the flue gas section. The refined adjustment of ammonia injection can reduce the non-uniformity of NOx concentration in the denitration outlet section to less than 10%, and improve the effectiveness of ammonia denitification, thereby greatly reducing the ammonia loss. Calculated according to the utilization hours of 4300h, installed capacity of 300MW, liquid ammonia of 2,600 yuan / ton and increased ammonia injection efficiency of 10%, a single unit can save about 150 tons of liquid ammonia per year, equivalent to about 200,000 yuan.
2) Reduce the blockage of catalyst and air preheater and reduce the coal consumption of power supply. Due to the fine adjustment of ammonia injection, the efficiency of ammonia denitrification is improved, and the total ammonia injection amount is reduced under the condition that the denitrification efficiency is maintained, the inefficient ammonia injection is avoided, the ammonia escape concentration is lowered, and the catalyst layer blockage is effectively reduced. And the air pre-blocking phenomenon, greatly reducing the unit running resistance. According to the utilization hours of 4300h, the installed capacity of 300MW, the standard coal price of 700 yuan / ton, the reduction of coal consumption of 0.15g / kWh, the annual power generation of 3.1 billion kilowatt hours, the annual standard coal is about 465 tons, equivalent to about 180,000 yuan.

3) Prolong the service life of the catalyst, accurately replace the catalyst, and avoid the invalid replacement of the catalyst module. Accurate physical examination of the catalyst module under operating conditions, so as to quickly grasp the operating conditions of the entire catalyst layer, accurately replace the failed catalyst module with the level of maintenance, and reduce catalyst loss. The conservative estimate is based on the annual savings of 15 cubic meters of catalyst module, the catalyst module is 17,000 yuan / cubic, equivalent to about 260,000 yuan.

4) Reduce the frequency of cleaning of air preheaters and reduce safety risks. The ammonia escape caused by the uneven ammonia injection of the denitrification unit is the main reason for the blockage of the fly ash at the cold end of the air preheater. The application of the full-section sampling device can effectively reduce the frequency of cleaning and rinsing of the air preheater and reduce the high pressure manual cleaning belt of the air preheater. The security risks that come. The air compressor is cleaned once a year by a single unit, the cleaning cost is 100,000/time, and the annual cost is 100,000 yuan.

5) Improve the air leakage of the air preheater. The ammonia escape rate is greatly reduced, the risk of air pre-blocking is reduced, the flue gas resistance of the denitrification system is reduced, and the pressure difference of the preheating end of the air preheater is decreased, thereby reducing the air leakage rate of the air preheater and improving the primary wind and heat of the boiler. The secondary air temperature increases the boiler's thermal efficiency.

In summary, after adding the full-section sampling device for denitrification and ammonia injection, the uniformity distribution of ammonia spray in the cross section of the catalyst layer can be evaluated in real time, and the denitrification efficiency of the catalyst module can be monitored online to achieve precise control of ammonia injection, thereby saving liquid ammonia cost and reducing Catalyst and air preheater blockage and prolong the service life of the catalyst module can generate an economic benefit of about 800,000 yuan per year. In addition, it can reduce the corrosion of the air preheater and the entire flue system, extend the service life of the equipment, and reduce the maintenance period of the catalyst module maintenance project.

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