

Study on environmental protection equipment treatment process and pollutants treatment measures: taking a flue gas emission treatment project as an example

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Abstract. This paper makes an in-depth analysis on the failure of equipment used in environmental protection projects based on the actual situation of the development and construction of environmental protection projects, puts forward corresponding maintenance and optimization measures according to the use of equipment and existing problems, and focuses on the control measures for pollutants produced in the application of environmental protection equipment for reference.

Keywords. Environmental protection equipment, pollutants, water pollution, air pollution, adsorption plant, pollution control.

1. Basic situation and accident analysis of a flue gas emission treatment project

The project studied in this paper is an electric boiler ultra-low flue gas emission project, in which four 35 t boilers are constructed with new ultra-low flue gas emission devices. The technical path of flue gas emission is as follows: NO_x is removed by the “SNCR+SCR” denitrification process, dust is removed using a bag dust collector, SO₂ is removed by the limestone-gypsum desulfurization process with two boilers and one tower, and a wet electrostatic precipitator (WESP) is allocated at the inlet of the desulfurization tower, so as to effectively remove fine smoke and gypsum rain droplets in the flue gas, and minimize the emission concentration of flue gas pollutants, ensuring that the stability of the treated flue gas can reach the specified standard [1].

The main content of the construction of the flue gas emission treatment project is as follow. First, active measures are taken to monitor the changes in the flue gas temperature, flow and pressure, and then the results are converted into the analog quantity and transmitted to the flue gas control system. Second, before desulfurization of the flue gas, the sampling unit needs to be placed in front of the absorption tower, and the equipment involved includes the pressure transmitter and flow transmitter [2]. After desulfurization of the flue gas, the sampling unit can be placed in the position of the absorption tower. Third, after the flue gas is purified by desulfurization tower, a two-layered dewaterer is installed, including the condenser, filter and filtration treatment device, to ensure that the flue gas is dry.

A major dust explosion accident occurred in one of the company’s workshops, causing 180 deaths and 520 injuries. An in-depth analysis of the accident suggested that bag dust collectors used to collect aluminium dust were used to collect the air in the workshop, while the aluminium dust generates heat by friction in a certain space under the influence of airflow, and thus generates static electricity. Bag dust collectors are only used for dust removal and not for static electricity removal. In the case of a large amount of dust, they may easily block the ventilation pipe, affecting the ventilation in the workshop. A dust explosion occurs when a large amount of dust is deposited in the pipe.

After a series of inspections on the company’s workshops, ESPs in all workshops were of good effect, and gas fractionation units were installed in each workshop according to the problems during the operation and development of the company. Combination of these units could effectively deal with pollutants. To ensure the performance of the equipment, operators are required to regularly maintain the equipment.

2. Design of management system of environmental protection equipment in the flue gas emission treatment project

2.1. Technical protocol

Computer and information technologies are indispensable to the maintenance of environmental protection equipment. The monitoring and management system for equipment operation is built and designed with the support of advanced technologies, and the operation of the equipment is monitored with the support of the system, thus designing unique equipment management and maintenance modules [3].

2.2. Modules of the maintenance and management system of environmental protection equipment

(1) Equipment management module. This module has such functions as adding, deleting, updating, importing and exporting equipment and searching equipment information. Information of the replacement of new and old equipment can be adjusted and updated in time with the support of the module system, thus finally improving the management level of equipment.

(2) Equipment maintenance and management module. This module includes equipment allocation, maintenance, early warning and scrapping, among which the equipment allocation function can realize the effective management of unnecessary equipment and reduce its use, and the equipment early warning function can warn the equipment failure in time [4].

(3) Equipment query and statistics module. Functions of the equipment include information query, management of the use of equipment, and statistics of the maintenance and management of equipment.

(4) Basic information management module. This module involves the management of equipment categories and faults, and the management personnel can comprehensively record the maintenance information of each equipment.

2.3. Design and implementation of the maintenance and management system of environmental protection equipment

(1) Design of the system. 1) Network topology structure. The system with direct access to the Internet deals with documents, and includes the core layer, security layer and application layer. 2) Design of the overall framework. The overall framework is determined according to the basic situation of the design of the system modules. 3) Design of the business logic layer. The business logic of different modules is designed according to local conditions. 4) Database building. Application requirements of system construction are analyzed, the logic structure of the ER model is built based on the conceptual model, and logic design is implemented using the database language or host language, to build a perfect database. 5) Database debugging. The database is debugged to ensure the safety and effectiveness of data information in the database and support the normal use of the database.

(2) Implementation of the system. 1) The development environment for the system is designed based on the Struts framework, in which the development statement is SQL Server, the development platform is MYECLIPSE, the JAVA code is used during system operation, and the management system is developed under the integration of the code [5]. 2) The IE Browser is installed in the system, and Windows is set as the operating system. 3) Subsequent test analysis is carried according to the environment construction analyzed above to test the system functions in an all-round way, followed by the improvement of these system functions according to the test results.

2.4. Solution to problems of environmental protection equipment

(1) Solution of the flow problem. 1) The pipeline and probe filter elements are cleaned to ensure that the pipeline is smooth and that the probe is not blocked. 2) The air pump gasket is contaminated. This problem will reduce the suction of the pump, and finally the dust cannot be removed in time. 3) Flow of the analyzer. Information of the use of the flowmeter is recorded comprehensively, and measures are taken in time in case of flowmeter failure. In the practical operation, the flowmeter is evaluated to determine whether the system is contaminated. 4) If the operation failure of the equipment is caused by the blockage of the condenser, relevant personnel are required to take appropriate measures to clean the condenser in time to ensure the normal function of the condenser, and improve the flue gas flow of the condenser and the measured value of the measuring instrument. 5) Solution of the problem of sampling line blockage. To avoid line blockage, more than 1 m needs to be reserved at both ends of the sampling pipe. By reasonably setting the distance in this way, the line blockage can be avoided and the possibility of functional failure of environmental protection equipment can be reduced.

(2) Solution of the system parameter error problem. 1) The gas chamber of the analyzer is observed for contamination, and measures should be taken in time to wash it if any. 2) The oxygen battery is closely observed to determine whether its voltage is 6 MV, and a new battery needs to be replaced promptly if the voltage is lower than the value. 3) The error between the measured value and the standard value. This error is controlled at about 2%; in case of a large error for the system equipment, relevant personnel need to adjust the equipment parameters by checking the range and zero, and install the dust concentration monitoring system in the negative pressure area, so as to solve a series of parameter errors.

(3) Solution of the problem of water in the pipeline. 1) The tracing band is checked for its normal operation, and the set value of the control instrument is controlled at 135-140°C. 2) In an environment with low electric tracing temperature and high moisture content of flue gas, the flue gas water in the pipeline will condense into water, which will aggravate the problem of water in the pipeline. Then, the temperature should be controlled above 100°C.

3. Treatment of pollutants in the flue gas emission treatment project

3.1. Water pollution treatment equipment

The water pollution treatment project involves several aspects, including the sludge treatment, water treatment, and daily management of the equipment. From the perspective of practical application, some physical equipment, such as precipitation equipment, filter unit, air floatation classifier and centrifugal plant, will be used in the above work. Chemical equipment, such as concrete treatment unit, oxidation-reduction unit and neutralization unit, is also required after screening by physical equipment. If the desired substances are still not obtained after treatment by chemical and physical treatment, some biological devices, such as anaerobic and aerobic devices, can also be used in the following work. By using these devices comprehensively, components in substances can be effectively separated to obtain the desired substances.

Based on the basic situation of municipal sewage, the sewage treatment section consists of the screen, grit chamber, precipitation tank, biological treatment equipment, sludge removal plant, primary and secondary precipitation units, sterilization unit and discharge unit. Precipitated sludge is treated with special sludge treatment equipment, from which some biogas and sludge are produced.

Unsatisfactory treatment efficiency may occur if the equipment is imperfect, the process is unreasonable and the efficiency is not high in the actual treatment of substances. Some pollutants may be attached to the pipes and cause more serious failure to the operation of the pipes. Efficient treatment of substances is a problem that needs to be focused on and solved during the use of each unit. In addition, these units may have poor treatment efficiency and purification quality in the long-term operation, and some of sludge in units may block filter holes and cause poor effect on the treatment of sewage in the short-term. At present, various equipment is used in the municipal sewage treatment project, and unreasonable operation of the system or hidden danger of equipment may cause unsatisfactory treatment effect on sewage.

In view of the application of sewage treatment devices, a monitoring device may be installed on the sewage treatment equipment and a detection system be designed, so that the operation of the sewage treatment equipment is supervised and controlled based on the computer-aided system, thus providing important reference for the stable operation of the treatment equipment.

3.2. Air pollution treatment equipment

Air pollution treatment equipment includes dust-removing equipment, defogging equipment, gaseous pollutants purification equipment, and particulate and gaseous pollutants treatment equipment. From the perspective of actual application, the common problem in air pollution treatment is mainly the low efficiency of purification equipment. A single air pollution treatment equipment is only available for toxic and harmful gas, dust, fog or whatever, but is not effective to all pollutants in the air in the case of complex components of air pollution.

To better deal with the complex components in the air, it is necessary to study the components of the object to be treated before designing air pollutants treatment equipment, and choose the suitable treatment equipment and process according to these components. Meanwhile, sensors may also be installed on the air pollutants treatment equipment to monitor the purification effect of the equipment on the dust, toxic fog and toxic and harmful gas. If pollutants in the air are poorly purified, additional purification plants may be installed based on the purification results.

During air pollutants treatment, it is also necessary to choose a multistage purification system suitable for air pollution treatment in the polluted place according to the actual situation of the air pollution site to monitor and timely record the equipment operation parameters, thus supporting the stable and efficient operation of the equipment. In a polluted site with low air pollution levels, inertial dust collectors can be used for dust removal, and in this process the dust removal and separation effects of the device should be closely monitored; gases with high humidity and temperature may be removed by wet dust collectors and cyclone dust collectors, and airflow parameters and dust and particulate separation parameters are closely monitored under these dust collectors.

3.3. Solid waste treatment equipment

Solid waste is generally treated by harmless incineration, which is easily interfered by external factors and affects the treatment efficiency, and, if not treated properly, produces a series of pollutants and dust. For this problem, to improve the treatment effect of solid waste, the rotary kiln and waste conversion & recovery unit should be installed in the incineration facility of the solid waste treatment system. Air cleaning units and smoke removal units are installed in the smoke pipe, with sensors mounted in these units to monitor the operation of the equipment. The computer, by collecting and sorting a great deal of data information, can automatically analyze the problems in equipment and parts, providing maintenance and treatment information for equipment maintenance personnel.

4. Treatment effect

To better improve the optimization effect of the environmental protection equipment treatment process and the effect of pollutants treatment, relevant personnel are required to further advance the following work in the future. First, dust-removing equipment is checked before powering on and off. Second, equipment such as the gaps, air-tight doors, flanged joints, air pipes, dust collectors and measuring holes of the dust-removing system is regularly checked to prevent blockage and air leakage problems. Third, delicate parts and components of the dust-removing system are replaced in time, and bearing devices are lubricated. Fourth, measures are taken promptly to remove the dust in dust-removing equipment to ensure the clearing up. Fifth, operation of the dust-removal system and equipment is overhauled. Sixth, the application of dust-removing equipment is recorded, corrective measures are put forward according to the actual situation of equipment maintenance, and the use of the equipment is comprehensively recorded.

5. Conclusion

With the acceleration of industrialization, an increasing number of wastes are produced from the industries, which not only restricts the development of industries, but also induces a series of environmental pollution problems. To solve these problems, relevant personnel need to take active measures and use advanced technologies and equipment to deal with pollution based on actual social development, thereby providing more support for the stable development of enterprises, and improving the treatment effect of pollutants from the project. In this paper, based on the analysis on the flue gas treatment failure in a flue gas emission treatment project, proposals for the transformation of flue gas treatment equipment are put forward from process optimization and equipment transformation, and in-depth study is conducted on problems in the flue gas treatment. After a series of equipment transformation and upgrading, no failure occurs and the air pollution

is well treated in the whole workshop. This fully demonstrates that the use of suitable equipment in the construction site and good operation maintenance and management of the equipment can effectively improve the effect of environmental pollution control.

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