Implementation of an Automated Emissions Monitoring System at the Enterprise

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Abstract — **The automated emissions monitoring system is designed for continuous automatic measurement of mass (or volume) concentrations of pollutants, flow rate, temperature and humidity of gas-air mixtures discharged through stationary organized emission sources. The ASKPV functionality ensures the creation of a primary database, statistical processing and visualization of information, and calculation of emission power (g/s).**

Keywords — **monitoring, emissions, analysis, methods, risk assessment**

I. Implementation

Emissions that pollute the atmosphere represent a wide range of substances of different chemical composition, properties, and level of impact on the environment [1].

The highest degree of pollution comes from heavy metals and dangerous trace elements. These are compounds such as manganese, mercury, lead, arsenic, nickel, beryllium, boron, vanadium, lithium, zinc, fluorine, etc.

Protecting the environment from emissions involves a large number of measures, and successful results can only be achieved with an integrated, comprehensive control approach. Forecasts, programs and specific steps to protect the atmosphere from emissions should be built on the basis of constant objective monitoring, when the quantitative and qualitative assessment of the environmental situation is clear [2].

It is especially important to combat emissions of pollutants from industrial enterprises with large volumes of output, such industries as chemical, metallurgical, oil and gas, and cement.

Emission control provides a starting point and contributes to the formation of effective plans, as well as specific programs aimed at actively limiting adverse impacts on the living environment, using various tools and approaches.

Emission control is necessary, first of all, in order to, based on the obtained objective information - data on the impact of various substances on the atmosphere, to assess the sources of emissions, determine their compliance with legal requirements, and identify the presence of negative changes in ground-level air pollution. Ultimately, this will allow maintaining the required quality of atmospheric air and subsequently improving it [3].

II. Main part

An automated system for monitoring organized emission sources allows you to automatically transfer the results of

- Comparison of concentrations (mg/m^3) with MAC (maximum permissible concentrations) of these substances;
- Monitoring emissions (g/s) and comparing them with MPE (maximum permissible emissions);
- Data visualization [7];
- Transferring data to the local computer network of the station;
- Archiving data with cumulative totals;
- Preparation of commercial report for emissions charges.

III. Emission control methods

All measurements of emissions at sources are divided into 2 groups: qualitative - the chemical composition of emissions and quantitative - the concentration of pollutants.

To determine mass emissions, several different methods are used: instrumental (using automatic gas analyzers for continuous measurement of the concentration of pollutants), instrumental and laboratory (sampling from sources of pollution and their laboratory analysis), indicator (selective indicators for express analysis and preliminary assessment level of pollutants), calculated (determining the level of emissions) [8].

In addition to the above methods, in some cases they resort to emission control based on the results of an analysis of actual air pollution. In this case, actual concentrations are compared with reference values. Typically, this method is used to monitor the functioning of a large number of small objects, including unorganized sources located on the territory of the enterprise.

The most accurate are instrumental and laboratory methods. However, they require the use of special instruments, highly qualified specialists and a long period of time.

When carrying out control at emission sources, depending on the type of pollutants, measurements can be used: meteorological and physical parameters of gas emissions - calculated by direct measurements; the amount of dust is determined using gravimetry; concentration of sulfur and nitrogen oxides - measured by electrochemical methods; volatile aromatic hydrocarbons, styrene, phenols, methanol - calculated by gas chromatography; the level of acetic and sulfuric acid, ammonia, hydrogen chloride , hydrogen fluoride , hydrogen sulfide, formaldehyde, lead is calculated by spectrophotometry [9].

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A. Emission control and reduction measures

The main activities can be considered in several areas:

- replacement of energy sources with more harmless ones - gasification, nuclear energy and fuel disulfurization and other modern methods of energy production, transition to equipment with high efficiency;
- use of raw materials containing fewer pollutants, replacement of solid fuels with liquid and gaseous ones, optimization of the combustion process;
- pre-treatment of fuel and raw materials - disulfurization of fuel, separation of ash from coal, coke production, use of additives;
- changing production technology to a more environmentally friendly one ;
- limiting processes or temporarily stopping them under unfavorable conditions;
- application of temporary special measures for cleaning waste gases;
- excluding the placement of new sources of pollution in areas critical for the state of the atmosphere;
- control of the distribution and use of various types of fuel according to its quality in order to limit emissions of pollutants in certain areas that are unfavorable in terms of atmospheric cleanliness;
- increasing the distribution of pollutants over a larger area by using taller chimneys, taking into account safety issues, for example for air transport.

These measures must be taken into account both at the design stage and at the operation stage of the facility. To optimize atmospheric protection, it is necessary to study and monitor each of these ongoing activities. For all significant sources of pollution, decisions to minimize emissions must be made individually, taking into account scientific research and the level of technological progress in this field of knowledge. In this case, the most important role is assigned to emissions monitoring.

B. Measuring plant emissions

The measurement of pollutant emissions at an industrial enterprise is carried out on the basis of a schedule for monitoring stationary emission sources in order to comply with permissible emission standards calculated specifically for each enterprise [9].

1. Maximum single emission of pollutants during welding calculated by the formula:

$$G = (g \cdot b) / t \quad (1)$$

where g is the specific indicator of the emitted pollutant, g/kg; b - weight per day, kg; t - pure time continuous, sec.

2. The gross emission of pollutants during welding is calculated using the formula:

$$M = (g \cdot B)10^{-6} \quad (2)$$

where g is the specific indicator of the emitted pollutant, g/kg; B - mass consumed per year, kg /

IV. CONCLUSION

The system of continuous monitoring and regulation of harmful emissions into the atmosphere is designed to solve a whole range of problems, therefore the effect of its implementation must be assessed according to a number of indicators.

The economic effect consists of reducing fees for emissions of harmful substances into the atmosphere due to reliable instrumental monitoring and reducing emissions through control and regulation of the fuel combustion process; reducing fuel consumption as a result of increasing the efficiency of the main power equipment.

The technological effect is to ensure stricter compliance with boiler operation schedules by controlling the fuel combustion process. The implementation of expert and diagnostic systems, which are part of the SNMV, will make it possible to develop recommendations for optimizing the current operating modes of equipment and long-term recommendations for the repair, reconstruction and modernization of equipment. The ability to obtain operational information via the local computer network of the plant by the administration and services of the thermal power plant will lead to increased control over the actions of personnel and improvement of production discipline. The compilation of statistical reporting forms and the calculation of fees for emissions are automated.

In the end, we can highlight 5 main advantages that an enterprise receives from using the ASC system.

- Monitoring current concentrations of pollutants in exhaust gases and comparing them with permissible emission standards in real time. ASC allows you to continuously monitor the composition of exhaust gases and the concentration of pollutants in them, which, in turn, makes it possible to continuously monitor any changes and take timely measures to prevent deviations from established emission standards.
- Operational control over the efficiency of the combustion process or other technological process, process optimization. Operating personnel have a general picture of the fuel combustion process (technological process), the formation and removal of a gas-air mixture containing pollutants. ASC allows you to detect even the slightest deviation from the specified operating mode of equipment connected to an emission source and respond to them in a timely manner.
- Indirect benefits: reduction in costs for the generation of electrical and thermal energy, production of products and reducing gross emissions of pollutants by maintaining an efficient combustion process or other technological process, optimizing processes.
- Reducing the amount of environmental tax for emissions. Based on the data provided by ASK, the environmental tax for emissions of pollutants into the air is calculated. As a rule, the actual values of gross emissions of pollutants are 1.5–2 times lower than the calculated ones, which makes it possible to significantly reduce the amount of environmental tax for emissions for an enterprise.

Thus, the organization of monitoring systems for harmful emissions is one of the main tools for the practical implementation of the environmental characteristics of industrial facilities that meet modern stringent regulatory requirements.

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