Status and Needs Research for On-line Monitoring of VOCs Emissions from Stationary Sources

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Abstract. Based on atmospheric volatile organic compounds (VOCs) pollution control requirements during the twelfth-five year plan and the current status of monitoring and management at home and abroad, instrumental architecture and technical characteristics of continuous emission monitoring systems (CEMS) for VOCs emission from stationary sources are investigated and researched. Technological development needs of VOCs emission on-line monitoring techniques for stationary sources in china are proposed from the system sampling pretreatment technology and analytical measurement techniques.

1. Introduction
Air pollution especially the gigantic scale dust haze caused by PM2.5 (fine particulate matter, smaller than 2.5 microns) has become one of most prominent environmental problem domestically. Volatile organic compounds, VOCs not only is the hazard of human’s health directly, as the major precursor of PM2.5 and the key component of photochemical smog, but also plays a significant role in the formation of complex air pollution [1, 2]. According to some statistics [3–5], the main emissions of VOCs are from stationary sources in urban areas which account for about 55% of the all resources from human activities. The production of VOCs from stationary sources relies on certain industries including petrochemicals, electronics, spraying, tannery and printing etc. and it has the characteristics of variety types’ pollutants in high intensity and high concentration which lasting long time and great effects regionally [6, 7]. Therefore, the target of reducing concentrations of PM2.5, O3 in order to decrease haze, photochemical pollution and urban air quality conditions could be achieved by taking control the of VOCs emission from stationary sources [8] in a efficiently and effectively way. VOCs has been classed as one of the emphases of air pollution control in “twelfth five-year plan on air pollution prevention and control in key regions” by Ministry of Environmental Protection.

The precondition and foundation of control emissions of VOCs from stationary sources are monitoring and evaluating accurately VOCs’ quantity and concentration. Currently, the widely used method of monitoring VOCs emission, in China, is sampling manual at original source and testing and analyzing back in lab [9]. In the Occident, aiming on monitoring VOCs from stationary source, a series of continuous emission monitoring systems has been applied gradually [10, 11] thus the accuracy and reliability have been improved by big percentages for the efficiency [12–14]. At this stage in China, the monitoring systems are in development so that most of them for VOCs are imported. Due to the lack of cost-effectiveness, after-sales service and standard criteria in this industry, apparently the limitation of application of continuous emission monitoring systems has been shown in Chinese market.
2. The Current Status of VOCs Emission Monitoring from Stationary Source in China and Abroad

Table 1. Current standards and regulations of VOCs gas emissions in China

| Type                  | Name                                                                 | VOCs monitored objects                                                                 |
|-----------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| National Standards    | Integrated Emission Standard of Air Pollution (GB 16297-1996)        | Benzene, Toluene, Xylene, Formaldehyde, Acetaldehyde, Acrolein, Chloral-benzene, Vinyl chloride, Phosgene, Non-methane total hydrocarbon |
|                       | Emission Standard of Pollutants for Synthetic Leather and Artificial Leather Industry (GB 21902-2008) | Benzene, Toluene, Xylene, Non-methane total hydrocarbon                                  |
|                       | Emission Standard of Air Pollutants for Bulk Gasoline Terminals (GB 20952-2007) | Hydrocarbon (Non-methane total hydrocarbon)                                             |
|                       | Emission Standard of Air Pollutants for Gasoline Filling Stations (GB 20952-2007) | Hydrocarbon (Non-methane total hydrocarbon)                                             |
|                       | Emission Standard of Pollutants for Rubber Products Industry (GB 27632-2011) | Benzene, Toluene, Xylene, Non-methane total hydrocarbon                                  |
|                       | Emission Standard of Pollutants for Petroleum Refining Industry (Exposure Draft) | Benzene, Toluene, Xylene, Trichloroethylene, Non-methane total hydrocarbon, Isopropanol, acetone, Dichloromethane |
|                       | Emission Standard of Pollutants for Electronic Industry (Series of Standards) (Exposure Draft) | Ethylene dichloride, 1,3- Butadiene, 1,2-Dichloroethane, Benzene, Vinyl chloride, Acrolein, Formaldehyde, Methyl chloride, Toluene, Xylene, Non-methane total hydrocarbon |
|                       | Emission Standard of Pollutants for Industrial Surface Coating (Exposure Draft) | Ethylene dichloride, 1,3- Butadiene, 1,2-Dichloroethane, Benzene, Vinyl chloride, Acrolein, Formaldehyde, Methyl chloride, Toluene, Xylene, Non-methane total hydrocarbon |

| Local Standards       | Integrated Emission Standard of Air Pollutants (Beijing) (DB11/501-2007) | Non methane hydrocarbons, Ethylene oxide, 1,3- Butadiene, 1,2-Dichloroethane, toluene, Xylene, Vinyl chloride, Methyl chloride |
|                       | Emission Standard of Air Pollutants for Petroleum Refining and Petrochemicals Manufacturing Industry (Beijing) (DB11/447-2007) | Total volatile organic compounds                                                     |
|                       | The Discharge Standard of Pollutants for Semiconductors Industry (Shanghai) (DB31/373-2010) | Benzene, Toluene, Xylene, Chlorobenzene, Non-methane total hydrocarbon |
|                       | The Discharge Standard of Pollutants for Bio-pharmaceutical Industry (Shanghai) (DB31/373-2010) | Benzene, Toluene, Xylene, Total volatile organic compounds |
|                       | Emission Standard of Volatile Organic Compounds for Surface Coating of Automobile Manufacturing Industry (Guangdong) (DB44/816-2010) | Benzene, Toluene, Xylene, Total volatile organic compounds |
|                       | Emission Standard of Volatile Organic Compounds for Printing Industry (Guangdong) (DB44/815-2010) | Benzene, Toluene, Xylene, Total volatile organic compounds |
| Industry Standards    | Cleaner Production Standard Automobile Manufacturing Painting (HJ/T293-2006) | Total volatile organic compounds                                                    |

For the monitoring and regulation of VOCs emission from stationary source, The United States Environmental Protection Agency (EPA) has put forward the control regulation of VOCs emission in
“Clean Air Act” as early as 1970 and in 1990 EPA[15] has established the detailed regulations and emission limits of VOCs emission for some industries such as industrial coatings. In 1996, The European Union implemented the “Integrated Pollution Prevention and Control” (1996/61/EC) [16] which has pointed out that certain industries including petroleum refining, bulk organic chemicals, fine organic chemicals, storage facility, coating and leather processing etc. should choose applicable control technique to achieve the standard according to the rate of flow and the concentration of VOCs. This paper has been revised into a rigorous edition in 2008. The revised edition “prevention and treatment of air pollution” [17] published by Japanese government in 2004 has added VOCs emission rules of monitoring and control for 9 kinds of emission facilities in 6 different industries.

It started not early in China that until 1997 the “discharge standard of air pollutants” (GB 16297-1996) [18] specified the emission limits for 9 kinds of VOCs including benzene and non-methane hydrocarbon etc. However, due to less maturity and poor integrity of VOCs emission standards, there is a lack of pertinence in the process of implement and the standard does not work well to its maximum power. Nowadays, with the growing attentions on air quality including management and monitoring of VOCs emission, the state and local governments gradually published a series of technical standards and regulations for VOCs emission monitoring what shown in table 1.

Developed countries such as the United States, Europe have developed a numbers of laws and regulations for VOCs continuous emission monitoring [19–22]. US federal regulations 40CFR 265/266/503 [23–25] requests that CEMS that testing total hydrocarbons must be installed in incinerator, burner of hazard waste and sludge incineration of Industrial furnace and sewer and requests continuous monitoring of VOCs emission for polymer industry, coating and printing industry organic synthesis industry as well. EU waste incineration directive (2000/76/EC) [26] requires that TOC (total organic carbon) emission form waste incineration plants is being monitored.

Now the common method to monitor VOCs emission from stationary sources in China is that sampling manual at emission source and testing and analyzing back in lab. Although more qualitative and quantitative accuracy and high sensitivity are proved in this method, compare with SO2, NOx monitoring methods those have already achieve continuous monitoring, the monitoring frequency and the timeliness are insufficient that could not reflect the concentrate change of the gas. Moreover, in the process of sampling, storage, transportation that there is a high possibility of samples loss and cross-contamination. The testing procedure is tedious and the testing sample quantity is limited so that the cost is quite high when using the traditional method. Therefore, some local governments have set up standards for VOCs such as non-methane total hydrocarbon, total volatile organic compounds and so on to being continuously automatically monitored. For example, in Beijing’s local standard DB11/501-2007[27], for non-methane total hydrocarbon and other air pollutants what can be continuously automatically monitored, if the initial emissions in exhaust funnel is greater than or equal to 10kg.h-1, the continuous monitoring systems are necessary; As well as In DB11/447-2007, for catalytic cracking unit and catalyst regeneration funnels and sulfur recovery unit of exhaust gas burning vent those have greater emission amount than 40000m3.h, the continuous monitoring systems should be equipped according to the characteristics of the pollutants.

3. The Comparison of Structures and Techniques of On-line VOCs Monitoring Systems from Stationary Source.

3.1. The Structure Characteristics of On-line VOCs Emission from Stationary Source
Currently, the most usually used sampling methods of on-line VOCs monitoring systems are basically classified as entire extractive method, diluted extraction method and in-suit method.

3.1.1. Entire extractive method. The on-line VOCs monitoring system which use entire extraction method has 4 parts in the system: sample extraction, sample testing and analyzing, auxiliary testing and data collecting &transmission & analyzing. The structure of the system diagram is shown in figure 1.
(1) Sample extraction part generally including a sampling probe, heat traced pipelines, samples
preprocessing unit (filtering and dehumidifying) and sampling pump etc.
(2) Sample testing and analyzing part: Sample analyzer.
(3) Other auxiliary testing parts: whole system calibration unit, gas emission unit, back flushing unit and condensate discharging unit etc.
(4) Data collecting & transmission & analyzing part is for sampling and testing data and collecting, storage, recording, computing and uploading of index of system status.

**Figure 1.** System structure diagram of entire extractive VOCs-CEMS

### 3.1.2. Diluted extractive method.
Diluted extractive method contains 4 parts as same as entire extractive method that includes sample extraction, sample testing and analyzing, auxiliary testing and data collecting & transmission & analyzing. However, there are obvious differences of structures from entire extractive system. Figure 2 shows the structure of diluted extractive system.

(1) Sample extraction part generally including a sampling probe, sample transmission pipelines, samples preprocessing unit (filtering and dehumidifying) and sampling pump etc.
(2) Sample testing and analyzing part: Sample analyzer.
(3) Other auxiliary testing parts: whole system calibration unit, gas emission unit, dilution control unit and zero gas pretreatment unit.
(4) Data collecting & transmission & analyzing part is for sampling and testing data and collecting, storage, recording, computing and uploading of index of system status.

**Figure 2.** System structure diagram of diluted extractive VOCs-CEMS

### 3.1.3. In-suit VOCs-CEMS
In-suit VOCs-CEMS system mainly has 3 sections that are sample testing & analyzing, auxiliary testing and data collecting & transmission & analyzing as shown in figure 3.

(1) Sample testing & analyzing: sample measuring area, sample testing analyzer.
(2) Other auxiliary testing parts: flow gas calibration device (internal or external), calibration control unit, (light sources, specula) gas-curtain protection control unit.
(3) Data collecting & transmission & analyzing part is for sampling and testing data and collecting, storage, recording, computing and uploading of index of system status.

![System structure diagram of in-suit VOCs-CEMS](image)

**Figure 3.** System structure diagram of in-suit VOCs-CEMS

### 3.2. Comparison of Analytical Techniques for On-line Monitoring Systems from Stationary Source

The VOCs from stationary source pollution objects monitored by (VOCs) on-line monitoring systems usually include two categories, namely total VOCs emission and VOCs components. The analytical techniques commonly used include sensor technology, spectroscopy, chromatography, mass spectrometry and others. Analytical techniques and application characteristics for common on-line emissions monitoring instrument of VOCs from stationary sources are shown in table 2.

**Table 2.** Analytical techniques and application characteristics for common on-line emissions monitoring instrument of VOCs from stationary sources

| Numbers | Techniques                          | Monitored Objects | Technical characteristics |
|---------|------------------------------------|-------------------|--------------------------|
| 1       | Hydrogen Flame Ionization Detection(FID) | THC, TVOC, NMTHC | High sensitivity to hydrocarbons; Wide range of linearity; Strong stability; Simple construction; Convenience of maintenance and service; Extensive use; The test would effect by Oxygen, water and other organic matters with nitrogen, oxygen, and halogen atoms. |
| 2       | Photoionization Detection(PID)       | THC, TVOC         | Compact size; No auxiliary gas needed; Strong portability; Mainly used in indoor environment monitoring, emergency monitoring, hazardous/leakage gas alarm and monitoring and analyzing of total VOCs in pollution source tracking. The kinds of VOCs that can be tested by PID method are relevant with the energy of ultraviolet lamp. Different response coefficients for different compounds and low response coefficients even no response for some short Linear Alkanes. |
| 3       | Catalytic Oxidation-Non-dispersive Infrared Absorption (NDIR) | THC               | Low stability and sensitivity; Easily affected by coexisting disrupters; Having problems like catalyst poisoning, incomplete |
|   | Method                                              | Components | Advantages                                                                 | Limitations                                                                 |
|---|-----------------------------------------------------|------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 4 | Gas Chromatography-FID/PID/Mass Spectrum            | THC, TVOC, NMTHC VOCs | High testing sensitivity; Good selectivity; A single component of VOCs and TVOC can be monitored and several components can be monitored at same time; Common used in occident and other developed Asian countries and have gained a well feedback in some economically developed cities in China. The flaws of this method are long testing period, slow response and high variations in components quantity, sensitivity, selectivity, accuracy and workload of equipment maintenance when configures with different detectors. |   |
| 5 | Fourier Transform Infrared Spectrometry (FTIR)     | VOCs       | High maturity of technique with great variety of testing VOCs components and analyzing components at same time; Short testing period; Quick response. However, the sensitivity is lower than chromatographic methods. |   |
| 6 | Differential Optical Absorption Spectroscopy (DOAS) | VOCs (benzene series) | High maturity of technique and can test VOCs components. Without preprocessing, the technique takes non-contact directly testing and response in a very short time; On-line monitoring in testing light paths area can be achieved. Lower sensitivity than chromatographic methods and Limitation of testing varieties mainly testing benzenes like benzene, toluene and so on. |   |
| 7 | Ion mobility spectrometry (IMS)                    | VOCs       | High sensitivity; No vacuum system needed compare to Mass spectrometry; Simple structure and low cost; available to low concentration and high corrosion gas. Poor specificity that only could test limit types VOCs components and easily affected by disrupters. At present, IMS has been applied in fields of emergency monitoring and food security monitoring as a portable monitor. |   |
| 8 | Tunable Diode Laser Absorption Spectroscopy         | CH₄        | High sensitivity; Good selectivity; less interference; Without preprocessing, the technique takes non-contact directly testing and response in a very short time; On-line monitoring in testing light paths area can be achieved. Usually only one component could be tested by on single light source. |   |
3.2.1. Total VOCs Emission On-line Monitoring. The total VOCs emission on-line monitoring from stationary source is more simple and rapid than the monitoring on emission components. In the case of VOCs emissions, especially where the source of VOCs is known, Emission Gross Online Monitoring plays a better role in supervision and control of pollution. Different countries or standards have different names or definitions for the evaluation of VOCs emission gross, usually including TOC, THC, NMTHC, TVOCs and other different forms. Different names and specific detection methods are related, so it needs to distinguish and choose in practice, according to environmental management requirements and online monitoring capabilities.

Total organic carbon (TOC) refers to the presence of organic carbon in the form of carbon concentration, is commonly used for evaluating the overall concentration of VOCs in Europe. Total hydrocarbons (THC), also known as total hydrocarbons, refer to the total amount of hydrocarbons in the gas. The total hydrocarbon is defined in the HJ 604-2011 standard [30], and the total amount of gaseous hydrocarbons and their derivatives measured by hydrogen flame ionization detector (FID) is in methane. Non-methane total hydrocarbons (NMTHC), also known as non-methane total hydrocarbons, refer to the total amount of hydrocarbons other than methane in the gas. Since methane accounts for 70% to 80% of atmospheric organic compounds and does not participate in photochemical reactions with a small impact on the environment. The emissions produced by biological metabolism in the natural environment is much larger than anthropogenic emissions. Therefore, the methane is not always included in the list of monitoring pollutants. The definition of total VOCs (TVOC) depends on specific methods or criteria. In one case, the total amount of VOCs is expressed in terms of the equivalent concentration of the specified VOCs, such as benzene, toluene or propane; the other is the sum of the individual VOCs concentrations in the specified range, which is essentially a VOCs component Monitoring.

3.2.2. VOCs Emission Components On-line Monitoring. VOCs components online monitoring from stationary source is mainly applicable to the cases that fixed source of pollutants VOCs are complex, or that the individual emission characteristics of pollutant discharge concentration is high and harmful, or that the species of some special industry emissions of VOCs is unknown and so on. The main monitoring and analysis technology is basically derived from the laboratory testing method, to achieve on-site measurement of pollution sources through the system optimization and field applicability improvements of the laboratory testing technology. The types of VOCs contaminants in the field can be substantially the same as those of the laboratory.

4. Technical Characteristics and Research Needs of VOCs On-line Monitoring from Stationary Source

4.1. Technical Characteristics of VOCs On-line Monitoring From Stationary Source

The application of VOCs On-line monitoring systems has been widely popularized in China. However, in the process of monitoring from stationary source there is a difference between samples; the environment conditions are quite severe during the sampling and analyzing and the equipment are operating intensely in an environment with a relatively high pollution and the concentration of VOCs from stationary source and the it requires the coverage of the system more wide; Thus, in order to reach the needs of reliability and stability for VOCs monitoring, sampling and analysis parts what can meet higher demand of the systems are necessary. Table 3 includes characteristics for on-line emissions monitoring of VOCs from stationary sources.
Table 3. Characteristics for on-line emissions monitoring of VOCs from stationary sources

| Numbers | Technical characterizes and needs                                                                 | Effects                                      |
|---------|-------------------------------------------------------------------------------------------------|---------------------------------------------|
| 1       | Sampling: System must be available working in the environment of the flue which has high temperature, high humidity, heavy dust and strong corrosiveness | Long-term stable operation                   |
| 2       | Sampling: VOCs components are easily absorbed and dissolve to water which leads to sampling loss and testing results distortion. | Accuracy and stability                       |
| 3       | Analyzing: Complex components; Interference components; Discrepancies of components’ concentration. | Accuracy and stability                       |
| 4       | Analyzing: Requirement of quick response;                                                      | Long-term stable operation; Accuracy and stability. |
| 5       | Sampling and analyzing: Complex working conditions; Large varied amplitude; Various management synergies. | Long-term stable operation; Accuracy and stability. |
| 6       | Analytical instruments: high concentration of VOCs; Wide testing scale.                         | Accuracy and stability                       |
| 7       | System equipment: various components of VOCs; Different needs for different industries.         | Applicability of monitoring system           |

4.2. Development of VOCs On-line Monitoring Technology

4.2.1. Systematic sampling and pretreatment technology. High temperature, high humidity, high dust, strong corrosive and other adverse environmental conditions are the serious challenges which must be conquered when using on-line monitoring system to monitor a variety of pollutants from fixed sources. Through the industrial production processes, VOCs waste gas emissions from fixed sources generally contains a variety of solid and liquid impurities, most of which are sticky; given the complex properties of monitoring media, to ensure that the collection and pretreatment of the sample is not distorted, as well as to ensure that the results of systematic monitoring analysis truly reflect the facts, are the focus and difficulties of the development for the on-line monitoring technology of fixed source VOCs emissions.

1) VOCs emissions from fixed source are usually accompanied by a large amount of gaseous moisture, however water not only causes the sample loss during collection and transmission processes, but also subsequently causes serious interference to the measurements. Commonly used water removal technology removes some of the VOCs at the same time when removing the water, resulting in distortion of sample gas distortion. Therefore, three kinds of VOCs-CEMS sampling technology are commonly as follows.

a) Gas dehydration technology. Ensuring that the moisture is separated from the sample in the gaseous state, so that sample moisture removal does not causes the loss of VOCs components at the same time, which could get the retention of the components to be analyzed to the maximum degree. The technology is applicable to the high humidity situation when waste gas emissions such as coating industry. The dehydration equipment is usually composed of acidic materials, and alkaline gas (NH₃) in the waste gas could easily cause damage to the equipment, in addition, the service life, dehydration capacity and heat resistance shall depend on the actual discharges from the pollution source.

b) Whole-course high temperature sampling technology. Whole course heating could significantly reduce the condensation own water vapor, which prevents the sample adsorption to the pipeline. Starting from the sampling probe, through the sample transmission line, to the injection flow path inside the equipment, and to the flow path switching valve, sampling pump and detector, the whole...
use of high temperature (120℃ ~ 180℃) heating to prevent sample condensation loss. This technology is suitable for petrochemical and related industries, to avoid adsorption loss of some components with high boiling point after the cooling process, which result in untruly reflection of VOCs emissions in the waste gas. The material of heat pipe, stability of long-term high-temperature heating, corrosion resistance of system components, system life and other related aspects should be restricted to high standard and requirements.

c)  Dilution sampling technology. Using the strictly pretreated dry zero gas to dilute the sample (the dilution ratio is typically 50-200) to significantly reduce the moisture content of the sample gas, and weaken the moisture interference and influence. The technology is applicable to situation when the concentration of VOCs emissions is high such as electronics industry and so on, to avoid exceeding the measurement range of the instrument. The technology has a strict requirement for the quality of diluted zero gas, and the control of dilution ratio needs to be very accurate, moreover, the VOCs content has been greatly reduced after dilution, hence the requirement for the detection sensitivity of the analytical instrument is high.

2) Long-term high concentration of particulate matter in the waste gas from fixed source could easily cause blockage and abrasion of the probe and pipeline of on-line monitoring system, affecting VOCs-CEMS operation and measurement, generally in the sample collection process, using inertial separation technology, regular high frequency back-flush technology and filter heating technology can effectively solve the problems of long-term cumulative particulate matter from the waste gas and loss of VOCs with high boiling point due to filtration and adsorption.

3) The strong corrosive gases formed by SO2 and NOx in the waste gas from fixed pollution sources are more likely to cause damage to sample collection and transmission parts of the system, therefore, corrosion-resistant materials are chosen for the instrument parts for sample collection and transmission, and high temperature heating treatment is needed in order to reduce its affection to equipment.

4) The sampling and transmission processes of component adsorption and adhesion in the VOCs-CEMS would easily cause distortion measurement of VOCs. Three kinds of effective solutions contain: Selection of inert material and devices used in sampling probe, pipelines, filter and valves to contact with the samples from the very beginning of the sampling procedure; a big amount of sampling gas flow passing quickly in order to minimum the effect of condensation and adsorption procedures on sampling gas; calibration in the whole system from sampling probe to analyzer to avoid the loss of the testing results.

4.2.2. System analysis and measurement technology. On the basis of the current environmental air VOCs monitoring and analysis, the technology of on-line monitoring and analysis on fixed pollution VOCs sources has been more mature and reliable. In China, emission concentration of VOCs in fixed sources spans greatly, many monitoring components complex and the pollution monitoring facilities are used in conjunction with various pollution control facilities. To meet the requirement of the monitoring of different VOCs pollution sources, online GC-FID/PID/MSD analysis technique is applied popularly for its multi-group determination and extremely high sensitivity, so is FTIR analysis technique for its multi-group determination and rapid detection.

1) Development requirement of GC-FID/PID/MSD analysis technique

a)  Dynamic adsorption and thermal parsing techniques. The dynamic pollutant emissions of VOCs are complex and the concentration difference is large. The dynamic adsorption-fast thermal parsing analysis technique supports the two kinds of analysis modes, namely the adsorbent padding concentration sampling and the quantitative sampling. Sample analysis can be done from a volume fraction of 10-9 to 10-6 magnitude on a single instrument.

b) Two-dimensional chromatography counter-blowing technique. Through switching the connection of the two chromatographic columns in series / parallel, target VOCs compounds for test and other high-boiling impurities are separated effectively, which improves the analysis system selectivity and analysis efficiency, and avoids the equipment pollution of the impurities emission from the pollution sources, and also improves long-term Operational reliability of the equipment.
2) Development requirement of FTIR analysis technique.
   a) Interference system resolution adaptive technology. Different applicable scenarios and the testing objects need different resolution to achieve the best analysis and measurement results. By designing interference system resolution adaptive algorithm for different VOCs measurement object, accurate measurement results are obtained.
   b) High sensitivity online VOCs monitoring analysis technique. High spectral power-to-noise ratio (SNR) is achieved by high-precision, high-stability motion scanning technology and high sensitivity low noise infrared signal detection technology. This improves the accuracy and repeatability of the online instrument measurement spectrum further, and improves the detection sensitivity of FTIR in the online monitoring and analysis of fixed VOCs pollution sources, and also meets the needs of the analysis and monitoring on low concentration VOCs.

5. Conclusion
In accordance with China’s Twelfth Five-year Environmental Protection Plan and requirements for long-term development of environmental protection, on-line monitoring of fixed source pollution emission of VOCs, regular daily monitoring and total emission reduction have become the focus of work for China’s air pollution prevention and control. At present, fixed source VOCs emission on-line monitoring technology and equipment are mainly dependent on import; therefore, to form the industrialization of related domestic on-line monitoring equipment, it has become China’s current trend to develop domestic on-line equipment for fixed source VOCs emission monitoring with independent intellectual property rights. Simultaneously, on the basis of this, the environmental protection department should study, compile and publish the technical standards and relevant technical specifications of the fixed-source VOCs emission monitoring equipment as soon as possible, so as to meet the application requirements for environmental monitoring and management at all levels in the monitoring and supervision of VOCs emission from fixed source.

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