Research on Fine Chemical Process and Equipment Detection and Computer Monitoring Technology

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Abstract. The quality of fine chemical material production is a very important content in chemical production process. It is necessary to do a good job of process control related factors, strengthen the research on relevant characteristics, and further point out the production index of fine chemical industry. In order to ensure the effectiveness of chemical production. In recent years, the rapid development of information technology, including big data, cloud computing, industrial interconnection, mobile interconnection, robot, artificial intelligence and deep learning, has created new opportunities for the upgrading of fine chemical process detection and control technology. Therefore, in-depth analysis and study of the characteristics of fine chemical production process and the current situation and development trend of process parameter detection and control technology, and in-depth study of new fine chemical process measurement and control technology will be necessary to improve the comprehensive automation level of fine chemical process and promote the development of fine chemical production technology which will also produce important economic benefits and technical value.

Keywords: Fine Chemical Process, Equipment Monitoring, Computer, Monitoring Technology

1. Overview of refined production process control
In recent years, the proportion of fine chemical production process in chemical industry has gradually increased. The detection and control of fine chemical production process and equipment process parameters mainly include thermal parameters, mechanical parameters, chemical parameters and so on. Because there are many kinds of parameters to be detected and controlled, the strong corrosion of process medium, the complex characteristics of process dynamic mutation, pure lag, large inertia lag, nonlinear, non-stationary and other unfavorable factors, such as field corrosive gas, vibration, electromagnetic interference, noise and so on, bring many difficulties to the detection and control of process parameters in fine chemical production process. In addition, the fine chemical production process is generally small in scale, batch production is more, the process characteristics are complex, and the level of comprehensive automation and intelligent production is low, which affects the technical level and economic benefit of fine chemical production process. But at this stage, the scale of
fine chemical industry is not big. At present, the production process and very complex process characteristics of batch production plants also affect the realization of controllable technology, and also adversely affect the rapid development of chemical industry. Combined with the characteristics of the production process of complex chemical plants, in order to further develop the comprehensive control technology, it is very important to improve the overall automation level of the production of fine chemical products. According to the needs of chemical production, we can also select various technologies to control the time process of fine chemical industry and micro fine chemical industry from the aspects of comprehensive control of product function, production control of automatic processing, process control related to information technology and so on. The experience process of fine industry can be controlled by combining technology with practice, and the important characteristics of production process and time control can be summarized simply, that is, the whole chemical industry is more complex, the production scale is small, the variety is many, the replacement period is short. The production process is detailed, the chemical industry will be more diversified, so all kinds of operation processes are very complex, and because there is not enough labor, the fineness and overall production level of the chemical plant are low, the categories are diversified, and the replacement period is short. The manufacturing process of fine chemical industry is very diversified, the operation process is complex, the labor intensity is high, and most of the refining manufacturing processes in the chemical industry are discontinuous in its production process. This is a very difficult task in very complex processes and operations, requiring a large number of core technologies and controlling them, increasing the difficulty of production [1]. Figure 1 shows the configuration of fine chemical production workshop.

2. Research on fine chemical production process and equipment testing technology
Along with the development of computer technology, sensor technology, digital image processing, nondestructive testing technology, process analysis technology PAT, big data and other information technologies, many new technical methods and means are provided for the process parameter detection of fine chemical production process and its production equipment.

Fine chemical industry can be controlled from the aspects of computerization, Chinese traditional fineness level, process control mode, production cost of chemical products in factories, and the overall production cost of products can be saved. The low efficiency of the process obviously limits the production level of the automatic equipment in the process of fine non-ferrous metals control technology. In the era of globalization and information content technology, the reduction of computer standards has promoted computerization in various industries. The maturity of automatic technology also provides a good personnel ratio, which can control the fine details and chemical processes. Complex fine chemicals can control various technologies and gradually move towards a computer-aided trend. These two processes control the core technology of automatic small batch development. The most traditional feed methods used in the production of complex and
non-intermittent chemicals are recycled for mass production. This production is inefficient in terms of process efficiency due to repeated operations, and the automatic manufacturing machinery of chemical manufacturing can be controlled by using standard manual batch because of the loss of low switching frequency. Not only can the disadvantages of the mode be reduced, but also the stable application of computer technology can be controlled more accurately [2]. As shown in Figure 2, this figure briefly introduces some research directions of fine chemical industry.

Soft Measurement Based on Mathematical Model Estimation

Intelligent Control Technology

Time Control of Fine Chemicals

Machine vision detection technology based on image acquisition processing and recognition

Research on Detecting Technology of Fine Chemical Equipment

**Figure 2.** Some research directions of testing technology for fine chemical equipment.

2.1. Soft sensing techniques based on mathematical model estimation

There are still some important process parameters that can not or are difficult to measure directly on-line and in real time in the current fine chemical production process, including: high viscosity fluid flow measurement, high vacuum, high temperature, strong corrosive medium liquid level measurement and reverse suction liquid level measurement caused by sudden drop of vacuum degree, and powder chemical production process parameters such as powder process medium level, flow rate measurement, particle size distribution measurement, wet content. And they are very important for product quality, production safety and smooth operation of production process, so their detection problems must be studied and solved. The basic idea of soft sensing is to combine production process knowledge with automatic control theory, apply computer branch, select other variables that are easy to measure for important variables that can not be measured or difficult to measure for the time being. The parameters can not be measured directly based on model estimation. This kind of method can give the dominant variable information continuously, and the investment is low, the maintenance is simple and so on. The soft sensor system is mainly composed of auxiliary variable selection, data acquisition and processing, soft sensor model construction and online correction. Soft-sensing model is the core of soft-sensing system. The methods are empirical modeling, mechanism modeling and combined modeling. In addition, for the batch production process of biochemical products, many biological parameters include microbial fermentation heat, biomass respiration and metabolism parameters, biomass concentration, substrate concentration, metabolite concentration, and biological specific growth rate, substrate formation rate and substrate consumption rate. There are few instruments that can be measured online and in real time at home and abroad. Typical chemical parameters of fermentation process such as PH value, dissolved oxygen concentration and foam height are also
difficult to measure on-line. In order to solve the problem that these process parameters are difficult to measure on-line, the process parameters can be collected and stored by computer, and the process parameters can be estimated by using mathematical model, expert experience model and soft measurement based on neural network model operation and estimation, as well as state estimation [3].

2.2. Intelligent control technology
Chemical production mode and its control technology are also developing towards automatic small batch production. The realization of control technology is gradually moving towards intelligent application, realizing the development from single control to integrated control. After defining the characteristics of various chemical technologies, it is necessary to summarize the most advanced technologies in China. The development of technology practice experience is the general trend of the further development of core technology, and the refinement of fine chemical process can control the development of core technology. The complex chemical industry, according to the original specific strategy to control the production of chemical products, is attacked by both internal and external factors and living environment, which has the same impact. The overall technical level of traditional chemical operation equipment makes the quality level of each batch of other products not exactly the same, thus affecting everyone's reference data, resulting in the unified specification of the two standards cannot guarantee the same quality level. With the implementation of integrated intelligent control technology, the quality control of fine chemical products is always at the overall level, which fully ensures the reliability of products. Moreover, in recent years, the chemical industry is becoming more and more popular, and all kinds of chemical enterprises emerge in endlessly. In order to stand out among many enterprises, fine chemical industry has become the direction that must be chosen. As shown in Table 1, the chemical industry has gradually become very popular, and the number of enterprises is increasing year by year.

![Number of enterprises in chemical](image)

**Figure 3.** Changes in the number of chemical enterprises in recent years.

2.3. Time control of fine chemicals
The time control of fine chemical industry is an important index to realize information synthesis by control technology. In the early stage of the production of new fine chemical products, the production time of fine chemical industry does not match the actual data from manufacturing process to manufacturing end. In fact, the time control of operation mode depends not only on practical experience and theoretical basis, but also on the statistical results of comprehensive data. Increasing the collection of data and comprehensive information analysis of the two production processes, so as
to obtain the investment intensity comprehensively, scientifically judge all the parameters of manufacturing and production, and promote the realization of fine micro-chemical engineering and control manufacturing technology, And the overall development of science also has positive internal force to support the technical realization of new product quality.

2.4. **Machine vision detection technology based on image acquisition processing and recognition**

As a comprehensive nondestructive testing technology, machine vision MV (machine vision) includes sensor technology, light source lighting technology, optical imaging technology, digital image processing technology, mechanical engineering technology, control technology, computer hardware and software technology and man-machine interface technology, analog and digital video technology, etc. It is an effective way to realize precision detection, precise positioning and automatic production. At the same time, it has the characteristics of wide spectrum corresponding range, non-contact nondestructive measurement and long working time, so it has been widely used in many fields, such as packaging, medicine, industrial manufacturing, navigation and remote sensing image analysis. Although MV technology started at the end of the 20th century, because of its outstanding characteristics, it is widely used in various industrial fields, especially in recent years, the development is very rapid, and the application results at home and abroad emerge in endlessly. At present, the application of MV mainly focuses on detection, positioning, robot, motion control and measurement. Application demand for MV in motion control, production line, measurement, diagnosis and CNC equipment has grown rapidly in recent years. At present MV technology has developed mature, in mechanical assembly, product packaging and other industries have been widely used. By using MV technology, a series of machine vision systems, including infrared light source, camera sensor, programmable controller and image recognition software, can be designed and selected to realize the marking, azimuth detection, accurate positioning and loading control of containers in the process of container transportation, filling or filling, screw cover, labeling, spray code and so on. After the image is collected, the image can be analyzed and processed by binary, target location, feature matching, measurement, optical character recognition and so on. Based on the processing results, the programmable controller implements logic control and drives the actuator to act accordingly [4].

2.5. **Process analysis and detection techniques based on spectroscopic and stoichiometric methods**

Sampling, testing, off-line analysis in traditional analytical methods, which have the limitations of complex operation, long time, more consumption of medicament and unsafe, make the research and application of online and real-time process analysis technology (PAT) develop rapidly. There are three ways of on-line analysis: side line analysis, in-line analysis and non-contact analysis. It can not only be used in raw material analysis, according to the situation of raw materials to adjust and control the production process similar to feedback action, but also can analyze products, intermediates, etc., to adjust and control the production process feedback. Along with the development of sensors, on-line detection instruments, databases and chemometrics, PAT came into being and evolved. The definition of PAT has evolved from the original process analytical chemistry method PAC (process analytical chemistry), that is, "physical or chemical analysis of process flow characteristics by on-line instruments or means "to the concept of" quality comes from design ". Some scholars define the PAT based on statistical method as "raw materials and process flow variables collected continuously over time, on-line analysis and control of process running state by comprehensive statistical method, with the goal of controlling final product quality, fault diagnosis and energy saving and consumption reduction" [5].

3. **Research on fine chemical production process and equipment monitoring technology**

At present, there are many problems in the monitoring of fine chemical production process and equipment operating condition, which mainly rely on the experience of operators. Process operating condition monitoring is judged by manual observation of temperature, pressure, flow rate, liquid level and other parameters. The operator's experience is different, which leads to different working
conditions. Sometimes, abnormal phenomena and accidents can not be detected as early as possible, and operational measures can not be taken to correct them in time, leading to failures and accidents. In addition, because the process medium is usually highly corrosive in fine chemical production, it often corrodes the process equipment and pipeline and causes leakage / burn accidents such as equipment and pipeline damage; some process media fouling and adhesion equipment wall causes more resistance to heat and mass transfer and affects the normal operation of process production; some powder process medium, crystalline process medium fluidity is not good, easy to cause pipeline blockage and other failures. At present, the maintenance of production equipment basically depends on the experience of operators, which leads to the lack of scientific and targeted maintenance. In the process of production, the fluctuation of product quality is inevitable, which is caused by the fluctuation of basic factors such as operators, machinery and equipment, materials, methods and environment. Volatility is divided into normal fluctuation and abnormal fluctuation. The purpose of process monitoring is to eliminate and avoid abnormal fluctuations, so that the process is in a normal state of fluctuation, that is, a controlled state.

The statistical process control technology based on statistical analysis, the abnormal working condition management technology based on artificial intelligence and expert system bring new opportunities to the monitoring of operating conditions of production process. The development of nondestructive testing, vibration analysis, helium leak detection and big data analysis makes the monitoring of operating conditions of small fine chemical equipment faster and more scientific. Through the popularization and application of computer and real-time database system, the data collection of small fine chemical production process can obtain a large number of production process operation data online and real-time, thus has abundant production data resources, effectively real-time statistical analysis of production process data, reflects and reveals the internal changes of production process, provides useful information for production process monitoring and improvement of product quality, implements online and real-time working condition monitoring and statistical quality control of production process, consummates small fine chemical production process monitoring and production quality control means, and improves the level of working condition monitoring and production quality control of small fine chemical production process [6].

Predictive maintenance is state-based maintenance. During the operation of the equipment, the main parts of the equipment are regularly monitored and diagnosed, the state of the equipment is determined, the future development trend of the equipment state is predicted, the predictive maintenance plan is made in advance according to the state development trend and possible failure mode of the equipment, and the time, content, mode and necessary technical and material support of the equipment should be repaired. Predictive maintenance, which integrates equipment condition monitoring, fault diagnosis, fault prediction, maintenance decision support and maintenance activities, is an emerging maintenance mode. The research and application of predictive maintenance technology is of great significance to ensure the stable and reliable operation of fine chemical production process. Therefore, according to the intermittent production characteristics of fine chemical process, the application of safety control engineering theory and method in fine chemical process can be studied in order to further improve the safety and reliability of small fine chemical process. The related technology can be extended to the early abnormal condition perception, early warning and disposal of chemical production accidents.

4. Conclusion
With the development of science and technology and various industries, the overall development of the chemical industry will be accelerated. Developed countries in Europe and the United States regard complex chemical industry and control technology as the key content of national economic development. It can be seen that complex chemical and control technologies have the most important significance. In the practical application of fine chemical process control technology, we must fully combine the relevant results obtained from scientific research, effectively support the normal development of industrialization, and on this basis, do a good job in the analysis of the advantages and
disadvantages of the present situation. In view of the high safety requirements of fine chemical production, the comprehensive statistical process monitoring of production conditions and production quality and the comprehensive safety protection control of production process are the important development directions of fine chemical process monitoring technology.

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