Application of On-line Corrosion Monitoring Technology

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Abstract:

Brief history and status quo line corrosion monitoring technology, focuses line corrosion monitoring techniques commonly used in four technologies: electrochemical monitoring, resistance probe monitoring, inductance probe pH probe monitoring and surveillance. Each line corrosion monitoring technology has its own advantages and disadvantages in different corrosive media and equipment must be selected according to the site can also be integrated use of various monitoring techniques, increase the sensitivity of line corrosion monitoring. By simply telling line corrosion monitoring technology in various devices, such as devices used in oil refining, in the application of the circulating cooling water system, the application field of surface production system in the application of atmospheric and vacuum distillation unit, in high content sulfur natural Gas Purification plant in FCCU applications and application platforms in the ocean, on-line corrosion monitoring technology are able to reach the expected results, and future line corrosion monitoring technology development done some prospects.

Key words: Corrosion; On-line Monitoring; Detection Method; Monitoring Technology.

Foreword

Corrosion monitoring technology in accordance with the corrosion factors are divided into: the development of two kinds of monitoring and corrosion monitoring results of the monitoring techniques, namely off-line corrosion monitoring technology and corrosion monitoring techniques. Line corrosion monitoring technology mainly stage electrochemical probes, probe resistance, inductance probe, hydrogen probes, electrochemical noise and other methods need to be monitored to monitor the corrosion process, but off-line corrosion monitoring technology mainly using ultrasonic measurement point thickness, coupons, corrosion inspection, corrosion product analysis methods need to be monitored for corrosion monitoring results [1]. Off-line corrosion monitoring technology has a long cycle, low

efficiency, large errors and other issues, while off-line corrosion monitoring technology to make up for lack of detection technology, enables precise monitoring of the corrosion process.

The on-line corrosion monitoring technology development overview

Corrosion detection technique is non-destructive testing technology from laboratory corrosion test methods and factory equipment evolved, is the urgent need of industrial production, especially the production environment petrochemical enterprises need to solve the problem [2].

According to the survey of developed countries, the annual losses due to corrosion caused by the roughly GDP (Gross Domestic Product) of 2% to 5%, at the same time, the world's annual production of steel, of which 10% is due to corrosion and consumption. Internationally from the 1980s, for corrosion monitoring technology for a clearer understanding of methods for monitoring corrosion constantly taking process aimed at slowing corrosion. The most representative is the American Cortest and Metal Samples Company, they are specialized in corrosion monitoring product development and marketing company, the main products are linear polarization corrosion measurement instrument, corrosion resistance probe meter, HP (Hydrogen Permeation) hydrogen permeation monitor, Microco corrosion monitor. Meanwhile, the United States, Britain and other petrochemical companies have begun to various corrosion monitoring techniques used in water treatment, oil refining, pipeline monitoring, research and development of corrosion inhibitors [3].

After 1998, the country for corrosion monitoring in the field, there have been many new technologies, representative of the CAS Institute of Metals and Sinopec Gaoqiao and other units jointly developed high temperature resistance probe technology, high temperature resistance probe technology online monitor 260 ℃ above high temperature corrosion; in 1998, electrochemical corrosion monitoring technology through the identification of Sinopec, has been widely used in petrochemical enterprises; in 2005, the CAS Institute of Metal Research inductive probe monitoring technology developed to fill the gap, so that the domestic corrosion monitoring technology reached the international advanced level; thereafter, line corrosion monitoring technology has been further developed into the corporate network and the Internet-based monitoring system, management and exchange of data more convenient. Development of these technologies so that our corrosion monitoring technology into the international advanced level, and some reached the international advanced level [3].

Commonly used on-line corrosion monitoring technology

At present, the common line corrosion monitoring technology is mainly the following four: electrochemical monitoring, resistance probe monitoring, surveillance and pH probe inductance probe monitoring.

Electrochemical Monitoring

Electrochemical Monitoring [4] is carried out by measuring the corrosion rate monitoring a technique in which the current indicators (Click for surface flows) is to determine the corrosion rate of the standard. This monitoring method has a short cycle, the advantages of fast, but limited environmental monitoring process, which must conduction in water.

Resistance Probe Monitoring

Resistance probe measurement is to measure the corrosion thinning wires through online. And to eliminate the effects of the use of temperature-compensated metal temperature coefficient. In this way monitoring technology applicable conditions and media are extensive, but due to the long measurement period, low sensitivity, resulting in not recording the instantaneous corrosion rate changes [5].

Inductance Probe Monitoring

Inductance probe monitoring is an effective way of indirect monitoring device corrosion, metal corrosion loss is measured as the foundation, through the exchange of signal change measured corrosion thinning caused by corrosion of the test piece to calculate the loss rate of corrosion. By placement in the pipeline measuring element for receiving the specimen after corrosion, due to the reduced cross-sectional area, causing the AC signal is changed, the AC signal is applied to the measurement test piece, by varying the AC signal to calculate the measure reduction element thin volume and the corrosion rate [6].

Inductance measured with a resolution of the monitoring probe 30nm. Since the measurement signal AC signals with anti-interference ability, high accuracy, it is currently more popular online monitoring methods.

PH probe monitoring

PH probe monitoring is the use of the sensitivity of the H +, and the electrode is the pH medium is measured.

Each line monitoring techniques have their advantages and limitations, detailed comparison see Table 1. So if you want an accurate on-site measurement and control need to use a variety of techniques to form a comprehensive on-line monitoring system.

In addition to Table 1, four kinds of on-line monitoring technology and methods, the paper also describes several other online monitoring technology, are: linear polarization probes and biological probes [7].

Principle of linear polarization probes is: Electrochemical Stren & Geary's law, that between the change in corrosion potential close to current and potential changes in a linear relationship, and the corrosion rate is inversely proportional to the slope. The advantage is a measure of speed, it can be directly measured instantaneous corrosion rate, time to reflect changes in equipment operating conditions, high sensitivity, data and intuitive. Weaknesses: Only for the electrolyte solution. Therefore linear polarization probing technology is mainly

used on water systems.

Table 1 Common online corrosion detection technology parameters

Monitoring method	Applicable medium	Operating conditions	Sensitivity	Probe price(RMB)	Reference position	Main manufacturers
Electrochemical monitoring	Aqueous electrolyte	Low pressure probe: use temperature is not more than 200 ℃, pressure is not greater than 2 MPa. High pressure probe: use temperature is not more than 100 ℃, pressure is not more than 20 MPa;	5%	2500	Circulating water pipeline, oil field sewage	Chinese academy of sciences institute of metal ; Honeywell company
Resistance probe monitoring	Any medium (oil/gas)	(1) the low temperature resistance, temperature is not more than 230 ℃, pressure is not greater than 2.5 MPa, can tear open outfit is its connection with pressure, pipeline diameter should not less than 150 mm, if the front belt hanging piece is 219 mm. The smaller pipe diameter shall not be monitoring corrosion trend. (2) : high temperature resistance probe temperature is not more than 400 ℃, pressure is not greater than 2.5 MPa, the connection method for flange connection and tear open outfit, with pressure pipeline diameter should not less than 150 mm, if the front with bolt diameter should not less than 219 mm, evaluation when select material used. (3) the low temperature high pressure resistance probe: using temperature is not more than 100 ℃, pressure is not more than 20 MPa, the connection method with flange connection without disassembling and flange connection can take to tear open outfit two kinds of pressure, process pipeline shall not be less than 150 mm in diameter, if the front with bolt diameter shall not be less than 219 mm, the material selection of more serious corrosion parts of the oil.	0.1~1μm	3500~6500	Atmospheric and vacuum heat pipe	Chinese academy of sciences institute of metal; Yi Anda company
Inductance probe monitoring	Any medium (oil/gas)	(1)low temperature tubular inductance probe: using temperature is not more than 230 ℃, pressure is not greater than 2.5 MPa, installation is under pressure to tear open outfit, process pipeline diameter should not less than 100 mm, if the front with the diameter of not less than 159 mm. The guidance note agent. (2) low temperature sheet inductance probe: using temperature is not more than 120 ℃, pressure is not more than 10 MPa, installation is under pressure to tear open outfit, process pipeline diameter not less than 50 mm. The guidance note agent used. (3) the high temperature tube inductance probe: using temperature is not more than 450 ℃, pressure is not greater than 2.5 MPa, disassembling connection methods have flanged connections and bring pressure two kinds, process pipeline diameter should not less than 100 mm, if the front with bolt diameter shall not be less than 159 mm. Guidance note agent	10~50nm	4500~8500	Crude distillation, catalytic cracking and hydrocrack-ing, circulating water yards	Metal research institute, Chinese academy of sciences, the RCS, Yi Anda company
PH probe monitoring	water	Temperature is not more than 70 ℃, pressure is not greater than 0.4 MPa	pH=0.2	4500	Crude distillation tower reflux tank sewage pipe	Chinese academy of sciences institute of metal ; Honeywell company

Biological probe mainly used to collect bacteria samples for crude oil system. Because the crude oil system, there are anaerobic bacteria sulfate-reducing bacteria (SRB), SRB is a depolarizing agent, accelerated corrosion of the pipe. Biological probe is to recognize SRB.

As well as to monitor the site for a specific device, media should consider various factors, using one or two effective online corrosion monitoring technology, you can select the specific reference to Table 2. Table 2 is probably a reference standard, the face of the site problem, it should be done to analyze specific issues.

Table 2 Corrosion monitoring technology choice

Systems	Approach	Numbers
Crude oil system	corrosion coupon, resistance probe and inductance probe, sampling, biological probe	3
Gas system	corrosion coupon, resistance probe and inductance probe	2
Production water system	corrosion coupon, sampling, linear polarization resistance probe, probe, inductance probe	2
Water injection system	corrosion coupon, linear polarization resistance probe, sampling, and biological probe, inductance probe	3
Closed drainage system	corrosion coupon, linear polarization probe, inductance probe	2

The application of on-line corrosion monitoring technology

Applications in the oil refining device

On-line corrosion monitoring role in refining production [8] is: To evaluate the effect of injection agent, guiding injection agent process; guidance crude oil mixing; automatic control NOTE agent; on-line monitoring and maintenance of fixed thickness measurement combined with guidance.

On-line corrosion monitoring technology through a combination of centralized. The key technology of this solution is that the monitoring point selection. Refining process equipment corrosion occurs mainly divided into two categories, namely high-temperature chemical corrosion and sulfide H2S, HCl temperature electrochemical corrosion. The former mainly for uniform corrosion; the latter mainly both general corrosion, pitting another, pitting and sulphide stress corrosion cracking. Therefore, the process should be based on means, corrosion distribution process corrosion, corrosion characteristics of phase transition zone materials for high-temperature equipment selected points. According to the principles of corrosion and design experience, high-sulfur refining apparatus above 260 ℃ began to focus on monitoring; high acid crude oil refining unit focused on monitoring more than 230 ℃.

On-line corrosion monitoring process, the probe often appear abnormal, there are two forms: one is the measurement value remains unchanged, the second is volatility measurement. In eliminating the wiring and outside interference issues, from the following aspects to solve: pH probe anomaly mostly because of the condensed water contains large amounts of hydrogen sulfide, because the structure of the probe tip is a glass semipermeable membrane, and the electrode is Ag / AgCl composition when there is pressure, so that the electrode prematurely damaged. Probe cleaning solution to the problem of pollution - electrode exit protection can be used.

Application of circulating cooling water system[9]

A new on-line (local) corrosion monitoring technology - coupled multi-electrode array sensor technology. It works by dividing the metal surface into small enough parts, each part independently of each other, and through an external circuit with a wire to these separate portions coupled

together to form a path, anode and cathode metal corrosion reaction so they will have simulated electronic corrosion generated will flow through an external circuit coupled to the cathode from the anode, the metal localized corrosion rate can be obtained by measuring the external current (cross-sectional area of each tiny part known) [10], and tow electrodes similar to each electrode common coupling between the junction and is connected through a resistor, the current flowing corrosion of the electrode to produce a small drop (μV) At the time through a resistor from the voltage drop across each resistor high sensitivity multichannel voltmeter was measured ratio of voltage and resistance is the current [11-12].

Coupled multi-electrode array sensor in the cooling water system chemical cleaning process for chemical cleaning effect, the results show its corrosion monitoring data and coupon consistent monitoring data, to cleaning quality standards, it is an important means of line corrosion monitoring.

In the application field of surface production system [13]

The coupon method and the resistance method for corrosion monitoring field production system, and built according to the principle of corrosion monitoring points, respectively, in covering wellheads, separators, gas gathering pipelines, pressurized dewatering device and gathering trunk line of the whole system are corrosion monitoring [14]. Monitoring period the previous monitoring carried out once every 30 days; resistance probe line monitoring device is required once every three months of data collection, while from time to time according to the actual needs of production monitoring of specific areas.

Coupon method and the resistance method, although the method is based on point with the surface, but it can reflect timely and effective pipeline corrosion situation in the short term, it can analyze the reasons vary according to the results of corrosion, corrosion propose targeted recommendations; corrosion in the pipeline to carry out at the same time, the available means of monitoring the effective anti-corrosion test results for better targeted screening with internal pipeline corrosion protection provide an important basis.

Application of in atmospheric and vacuum distillation unit

Use of line corrosion detection system 10 sets low inductance probe, six sets of three sets of temperature probe and inductance probe pH value. Monitoring site in the preliminary distillation systems, atmospheric systems and pressure relief system. Through the atmospheric and vacuum distillation curve line corrosion monitoring system and real-time monitoring of oil quality analysis showed that the two are consistent. Line corrosion monitoring system can effectively monitor the corrosion of equipment corrosion from plant equipment, according to abnormal changes in corrosion curve, timely

adjustment and crude oil blending ratio of atmospheric and vacuum distillation plant process parameters adjustment, can effectively slow down the corrosion of plant equipment, to prevention[15].

In the application of high sulfur gas purification plant

The purification process for purification plant characteristics, DG-9500 probe each joint desulphurization, dehydration, sulfur recovery, tail gas treatment, acid water stripping units were arranged a 14-line corrosion monitoring points, through a one-year corrosion monitoring, obtained the degree of corrosion of each process node, combined with the results of corrosion coupon to find out the presence of high-sulfur natural gas purification plant corrosion weaknesses. Corrosion law analysis showed that the resultant line corrosion monitoring and corrosion coupon corrosion rates are basically the same, indicating that the use of online monitoring tools can be effectively used to monitor high-sulfur purification plant corrosion condition. Research results for the high-sulfur purification plant provides an important basis for corrosion control[16].

Application in catalytic cracking unit

The use of domestic DG-5300-a inductance probe line corrosion monitoring system developed by the United States RCS MK-9300 portable inductance probe line corrosion monitoring system comparison experiments. Determining corrosion monitoring location: low and stable part of the absorption column overhead air coolers and water coolers of import and export, as well as high-temperature parts of the device side line and the bottom line fractionation tower and heat exchange area as the install location corrosion monitoring probe. Experimental results show that the results of the two systems on-line monitoring of corrosion of metallic materials are basically the same, in order to prevent corrosion of equipment and provide technical support[17].

Application of ocean platform

Comprehensive Selection line corrosion monitoring technology, monitoring points should be focused on local positions corrosion, such as the platform riser, chemical injection point downstream; wellhead flowlines (chemical injection point downstream); - stage separator and the test separator import; separator for each level of the water outlet line; the every stage separation gas export pipeline; the water cooler gas export pipeline; flotation Di sorter produced water pipeline Yamaguchi; sorter flotation gas scrubber outlet line; injection system in addition to gas downstream; water system water injection injection pump downstream near sinks; closed drainage systems and so on[18].

Adopt effective corrosion monitoring technology can be used to determine the validity not only the extent of corrosion damage, to determine the

appropriate anti-corrosion measures and provide appropriate solutions tool, you can monitor corrosion measures provide production technology or management data, constitute automatic control system a part of.

The development direction of on-line corrosion monitoring technology

Corrosion Problems all the more serious, so line corrosion monitoring technology more and more people's attention, mainly in the following directions:

1. to enhance the sensitivity of the corrosion monitoring equipment, extend the service life of the probe, reduce monitoring costs;

2. According to the principles of safety and economy. A new method developed probes installed, reducing the impact of the probe installed on the original production equipment reliability

3. development of new corrosion monitoring equipment, improve the accuracy of line corrosion monitoring techniques;

4. the integrated use of line corrosion monitoring technology, a wide range of monitoring corrosion process, corrosion mechanism of intelligent judgment.

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