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Safety requirements on hydrogen-oxygen generator

氢氧发生器安全技术要求

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Safety requirements on hydrogen-oxygen generator

1 Scope

This standard specifies the basic safety requirements for hydrogen-oxygen generators, the environmental safety requirements for places where hydrogen-oxygen generators are installed, gas supply systems, electrical devices, safety protection devices, test run, operation and maintenance, emergency treatment, etc.

This standard is applicable to hydrogen-oxygen generators and their hydrogen-oxygen mixed-gas gas supply pipelines, which have a working pressure ≤ 0.2 MPa and PV ≤ 8.0 MPa • L.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB 2894 Safety signs and guideline for the use

GB/T 4830 Industrial process measurement and control instruments - Pressure range and quality of air supply

GB 4962 Technical safety regulation for gaseous hydrogen use

GB 9448 Safety in welding and cutting

GB/T 19001 Quality management systems - Requirements

GB/T 24499 Technology glossary for gaseous hydrogen, hydrogen energy and hydrogen energy system

GB/T 29411-2012 Technical specification of hydrogen-oxygen generator with water electrolyte

GB/T 29729-2013 Essential requirements for the safety of hydrogen systems

GB 50058 Code for design of electrical installations in explosive atmospheres

GB 50177 Design code for hydrogen station

4 Basic requirements

4.1 Risk factors

4.1.1 The hydrogen concentration in the hydrogen-oxygen mixed gas is within its explosion limit, which is an explosive mixed gas. In a confined space, it is easy to be ignited or even explode, in case of open flame, high temperature, static electricity, etc.

4.1.2 Hydrogen-oxygen mixed gas may leak, through porous materials, mounting surfaces or sealing surfaces. The hydrogen-oxygen mixed gas will spread rapidly after leakage, resulting in the continuous expansion of flammable and explosive areas, meanwhile the diffusion process is invisible to the naked eye. The main factors, that affect the leakage and diffusion of hydrogen-oxygen mixed gas, include leakage port area, leakage pressure, leakage location, ambient temperature, ambient wind speed, obstacles.

4.1.3 Backfire may occur when the hydrogen-oxygen generator, that uses an open flame at the end, is used. Backfire may cause the hydrogen-oxygen mixed gas to burn and explode, in its pipeline AND in the hydrogen-oxygen generator.

4.2 Risk control

4.2.1 When using the hydrogen-oxygen generator, it shall be used immediately after production; it is forbidden to store and compress the hydrogen-oxygen mixed gas.

4.2.2 Under the premise of meeting the demand, control the usage of hydrogen-oxygen mixed gas.

4.2.3 The maximum working pressure of the hydrogen-oxygen generator should not be greater than 0.2 MPa. Under the conditions that meet the requirements of use, the working pressure of the equipment should be less than 0.1 MPa.

4.2.4 Where the hydrogen-oxygen generator is used, the accumulation of hydrogen-oxygen mixed gas in a confined space is not allowed.

4.2.5 The hydrogen-oxygen generator and its main pipeline shall be provided with safety devices, such as overpressure relief devices and flame arresters.

4.2.6 The place, where the hydrogen-oxygen generator is used, shall be equipped with fire extinguishing equipment, such as carbon dioxide fire extinguisher or dry powder fire extinguisher.

4.3 Safety level

4.3.1 Hydrogen-oxygen generators shall be classified into safety levels, according to working pressure and PV, as shown in Table 1.

installed, shall be fortified according to Zone 2, meanwhile it shall comply with the relevant provisions of GB 50058.

5.1.3 The water pressure of cooling water should be 0.2 MPa ~ 0.4 MPa.

5.1.4 The gas source pressure of the compressed air, for instruments or pneumatics, shall be determined according to relevant requirements; its quality shall comply with the provisions of GB/T 4830.

5.2 Installation site of hydrogen-oxygen generator

5.2.1 The setting location of the hydrogen-oxygen generator shall be determined, according to the gas supply scale and the use characteristics of the hydrogen-oxygen mixed gas. Hydrogen-oxygen generators, which have a safety level 1 and 2, should be arranged near the outer wall in the building (workshop).

5.2.2 There shall be no sundries, in the place where the hydrogen-oxygen generator is installed; the passage shall be kept unobstructed.

5.2.3 The partition wall of the special room for the hydrogen-oxygen generator shall be a solid wall of non-combustible body; it shall be provided with a fire door, which opens to the outside. The roof shall be flat; the roof shall be made of lightweight roof, which shall comply with the relevant provisions of GB 50177.

5.2.4 The place, where the hydrogen-oxygen generator is installed, shall be set up with natural ventilation and mechanical ventilation. During natural ventilation, the number of air changes shall not be less than 3 times per hour. The number of air changes for mechanical ventilation shall not be less than 12 per hour. The air outlet shall be located at a higher place on the roof or partition wall.

5.2.5 The upper part of the place, where the hydrogen-oxygen generator is installed, shall be equipped with a hydrogen concentration alarm, which shall be interlocked with the mechanical exhaust fan.

5.2.6 It is strictly forbidden to use an open flame for heating, in the place where the hydrogen-oxygen generator is installed.

5.2.7 The floor of the room, where the hydrogen-oxygen generator is installed, shall be flat, wear-resistant, anti-static. The doors and windows shall be made of materials, that do not spark when impacted.

5.3 Operating environment requirements

5.3.1 The ambient temperature is 5 °C ~ 40 °C.

5.3.2 The place of use shall be free of gas, steam, chemical deposits, dust and other explosive and corrosive media, that seriously affect the use of the hydrogen-oxygen

generator; there shall be no severe vibration and turbulence; it shall comply with the relevant provisions of GB 4962 and GB 9448.

6 Safety requirements for gas supply system

6.1 General requirements

6.1.1 The gas supply system includes hydrogen and oxygen generators, pipes, accessories.

6.1.2 The hydrogen-oxygen mixed gas shall not be discharged indoors; the discharge pipe shall be led out of the room AND shall be more than 2.0 m above the roof. A wet flame arrester shall be installed, on the hydrogen-oxygen mixed gas discharge pipe.

6.1.3 The gas supply system should be equipped with a extinguisher.

6.1.4 The main pipeline or gas branch pipeline of hydrogen-oxygen mixed gas shall be provided with nitrogen and other purging ports and shut-off valves.

6.1.5 The hydrogen-oxygen mixed gas system should be equipped with pressure gauges and overpressure relief devices.

6.2 Hydrogen-oxygen generator

6.2.1 The hydrogen-oxygen generator shall comply with the relevant requirements of GB/T 29411. It shall be manufactured in accordance with the drawings and technical documents, which are approved by the prescribed procedures.

6.2.2 The hydrogen-oxygen generator shall be equipped with a mechanical or electronic gas pressure control device, AND at least one level of mechanical gas pressure control device. When the gas pressure reaches the set value, the gas production shall be stopped.

6.2.3 The hydrogen-oxygen generator shall be equipped with at least one overpressure relief device. The release pressure of the overpressure relief device should be 1.25 times the working pressure.

6.2.4 The hydrogen-oxygen generator shall be equipped with two or more stages of flame arresters, one stage of which is a wet flame arrester, to effectively prevent backfire.

6.2.5 Flammable chemical accelerants, such as alcohol, gasoline, n-hexane, liquefied petroleum gas, etc., shall not be used, inside the hydrogen-oxygen generator.

6.3 Piping and accessories

6.3.1 The design and installation of the hydrogen-oxygen mixed gas pipeline shall comply with the relevant provisions of GB/T 29411-2012.

at the lowest point; the drainage device shall lead to the outside.

6.3.12 The flow direction of the hydrogen-oxygen mixed gas shall be marked on the pipeline.

7 Electrical installations

7.1 General requirements

7.1.1 The electrical facilities, at the place where the hydrogen-oxygen generator is installed, shall be fortified according to Zone 2; it shall comply with the relevant provisions of GB 50058.

7.1.2 The place, where the hydrogen-oxygen generator is installed, shall be equipped with a power distribution cabinet, which shall be reliably grounded. Each hydrogen-oxygen generator should be powered independently; the power distribution cabinet shall be equipped with an emergency power-off switch, that is easy to operate.

7.1.3 There should be an intuitive power-off point, near the dedicated room for the hydrogen-oxygen generator, to facilitate maintenance by maintenance personnel.

7.1.4 The lighting fixtures at the places, where the hydrogen-oxygen generator is installed, shall be installed at a lower position; they shall not be installed directly above the hydrogen-oxygen mixed gas release source.

7.1.5 The protective steel pipes, for laying cables or conductors, shall be isolated and sealed, at the following positions:

a) Before the connector parts, where the cables or wires are led to the electrical equipment;

b) Between adjacent different environments.

7.2 DC power supply

7.2.1 Each electrolytic cell shall be equipped with a DC power supply separately; a high-frequency switching power supply should be used.

7.2.2 The DC power supply shall be provided with the function of voltage regulation and automatic current stabilization.

7.2.3 The rated DC voltage of the rectifier, for the electrolytic cell, shall be greater than the working voltage of the electrolytic cell; the voltage regulation range should be 0.6 ~ 1.05 times the rated voltage of the electrolytic cell; the rated DC current should be 1.1 times the rated current of the electrolytic cell.

7.3 Grounding requirements

7.3.1 The electrolytic cell shall be electrically grounded, according to the structural characteristics. For the electrolytic cell, which is connected to the positive and negative electrodes of the DC power supply at both ends, the resistance to ground shall be greater than 1.0 MΩ.

7.3.2 The hydrogen-oxygen mixed gas pipeline shall be grounded.

7.3.3 The hydrogen-oxygen generator shall be grounded; the grounding resistance shall be less than 4.0 Ω.

7.3.4 The flanges and valve connections of equipment and pipelines for hydrogen-oxygen mixed gas shall be bridged, by metal (copper) connecting wires.

8 Safety guards

8.1 General requirements

8.1.1 The place, where the hydrogen-oxygen generator is installed, shall be equipped with a hydrogen leak detection and alarm device, which shall be interlocked with the mechanical exhaust fan for control.

8.1.2 The hydrogen-oxygen generator shall have safety accessories, such as overpressure relief device and flame arrester.

8.1.3 The hydrogen-oxygen mixed gas supply system shall be provided with a purging device and an extinguisher.

8.1.4 The control system of the hydrogen-oxygen generator shall have the ability to monitor, display, control the pressure; it shall be able to automatically take corresponding safety measures, including shutting down the equipment.

8.1.5 The hydrogen-oxygen generator shall be equipped with an automatic control device, to meet the basic requirements for the use of self-produced hydrogen-oxygen mixed gas.

8.1.6 The hydrogen-oxygen generator and the hydrogen-oxygen mixed gas supply system shall be purged by nitrogen gas, before being overhauled, deactivated, restored to use.

8.1.7 The leak inspection of the hydrogen-oxygen generator, the hydrogen-oxygen mixed gas pipeline, the connection points of the accessories, etc., shall use soapy water or a portable combustible gas leak detector; it is forbidden to use an open flame for leak detection.

8.2 Overpressure relief device

8.2.1 The hydrogen-oxygen generator and the main pipeline of the hydrogen-oxygen

9.2 Operation

9.2.1 Operators shall undergo on-the-job training; take up their posts after passing the assessment.

9.2.2 Operators shall be free of color blindness, diseases that hinder the operation and other physiological defects; it shall avoid operations that affect operation or judgment after taking certain drugs.

9.2.3 The oxygen-hydrogen flame is not easy to detect; accidental burns shall be prevented.

9.2.4 It is strictly forbidden to smoke or use open flames, in the place where the hydrogen-oxygen generator is installed and in the fire-free area.

9.2.5 When the hydrogen-oxygen generator is running, it shall not be knocked, repaired, tightened under pressure; the tools that are prone to sparks shall not be used.

9.2.6 When the hydrogen-oxygen generator is running, it shall neither be over-pressured, nor shall it be operated under negative pressure.

9.2.7 When the hydrogen-oxygen generator is out of use, firstly perform the shutdown operation, according to the prescribed procedures; disconnect the power supply of the equipment; then empty the hydrogen-oxygen mixed gas in the equipment and the pipeline; use nitrogen, etc. to carry out effective purging and replacement of the hydrogen-oxygen mixed gas in the pipeline.

9.3 Maintenance

9.3.1 The electrolyte replacement cycle, in the electrolytic cell of the hydrogen-oxygen generator, shall not exceed one year.

9.3.2 Check the filter element before use; replace it in time, if it is damaged.

9.3.3 Check at least once a month whether the hydrogen-oxygen generator's electrolyzer and its ancillary equipment, flame arrester tank and other shells are deformed and leaked; whether the hydrogen-oxygen gas supply pipes, valves and connections are in good condition.

9.3.4 The pressure gauge, pressure sensor, temperature sensor, overpressure relief device, hydrogen leakage detection alarm device, flame detection alarm device, etc. shall be tested and calibrated, once every 6 months.

9.3.5 After the equipment is repaired and transformed, the system shall be tested for pressure resistance, purging, leakage, automatic control; it can be put into use, only after meeting the requirements.

9.3.6 When the hydrogen-oxygen mixed gas pipeline, valve and wet flame arrester are

frozen, the operator shall use hot water or steam to thaw it; the maintenance personnel shall wear a mask to operate. Do not use open flame to bake or use tools, such as a hammer, to strike.

9.3.7 The operation plan and safety protection measures, such as isolation, purging, replacement, ventilation, shall be formulated for the maintenance or inspection of the hydrogen-oxygen generator, which shall be approved by the equipment, safety, other departments. Without the written approval of the supervisor of the safety department, the operator shall not repair or disassemble the hydrogen-oxygen generator equipment, piping system, etc.

10 Emergency treatment

10.1 General requirements

10.1.1 The organization using the hydrogen-oxygen generator shall formulate an emergency treatment plan, for the leakage, fire, explosion of the hydrogen-oxygen generator and the hydrogen-oxygen mixed gas supply system.

10.1.2 The emergency treatment plan shall be formulated, according to the actual situation of the using organization, the use and parameters of the hydrogen-oxygen mixed gas, the requirements of the relevant local departments, etc., in combination with the provisions of this standard. It shall comply with the relevant provisions in GB/T 29729-2013.

10.2 Main requirements for emergency treatment

10.2.1 When the hydrogen-oxygen mixed gas leaks and the hydrogen leakage alarm device issues a level 1 alarm, the exhaust fan shall be automatically turned on. When the hydrogen-oxygen mixed gas leaks and the hydrogen leakage alarm device issues a level 2 alarm, the hydrogen-oxygen generator shall stop running, after the terminal's open flame operation is extinguished, meanwhile the possible ignition source in the area shall be excluded. Workers wear personal protective equipment to check for leaks.

10.2.2 If the hydrogen-oxygen mixed gas leaks and the hydrogen-oxygen generator fails to shut down, the power supply of the hydrogen-oxygen generator, etc. shall be cut off in time, after the terminal's open flame operation is extinguished.

10.2.3 When a fire occurs, due to the leakage of hydrogen-oxygen mixed gas, the power supply shall be cut off in time, after the terminal open flame operation is extinguished; the fire safety department shall be notified and reported to the relevant authorities, to quickly organize rescue.

10.2.4 When a fire occurs due to leakage of hydrogen-oxygen mixed gas, it should use carbon dioxide fire extinguishers, dry powder fire extinguishers, etc., to extinguish the fire.

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