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General Specifications of Gasoline Vapor Recovery Unit

油气回收装置通用技术条件

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Table of Contents

General Specifications of Gasoline Vapor Recovery Unit

1 Scope

This Standard specifies the classification and naming, general rules, conditions of use, design, requirements, test methods, inspection rules, marking, packaging, transportation, storage, accompanying documents, etc. of gasoline vapor recovery unit.

This Standard is applicable to the design, manufacture and inspection of gasoline vapor recovery units discharged from oil storage depots, gas stations, oil terminals and other places. The gasoline vapor recovery units of other oil products can be used by reference.

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 document.

GB/T 150.1 Pressure Vessels – Part 1: General Requirements

GB/T 150.2 Pressure Vessels – Part 2: Materials

GB/T 150.3 Pressure Vessels – Part 3: Design

GB/T 150.4 Pressure Vessels – Part 4: Manufacture, Inspection and Acceptance

GB 3836.1 Explosive Atmospheres - Part 1: Equipment - General Requirements

GB 3836.2 Explosive Atmospheres - Part 2: Equipment Protection by Flameproof Enclosures “d”

GB 3836.4 Explosive Atmospheres – Part 4: Equipment Protection by Intrinsic Safety “i”

GB 3836.9 Explosive Atmospheres – Part 9: Equipment Protection by Type of Protection “m”

3 Terms and Definitions

For the purposes of this Document, the following terms and definitions apply.

3.1 Gasoline vapor

Volatile organic compounds (calculated by non-methane total hydrocarbons) produced during gasoline storage, loading and unloading, and refuelling.

3.2 Vapor recovery efficiency

The ratio of the mass of gasoline vapor recovered by the vapor recovery unit to the mass of gasoline vapor that enters the vapor recovery unit in a unit time.

3.3 Vapor emission concentration

Under standard conditions (temperature 273K, pressure 101.3kPa), the mass of non-methane total hydrocarbons contained in the unit volume of the discharged dry gas.

3.4 Vapor recovery unit; VRU

The general name of a complete set of equipment that uses adsorption, absorption, condensation, membrane and other methods to separate the mixture of gasoline vapor and air and recover gasoline vapor.

NOTE: This complete set of equipment is mainly composed of static equipment (absorption tower, adsorption tank, membrane separator, heat exchanger, refrigeration equipment, etc.), dynamic equipment (motor, pump), pipeline system (pipeline and accessories, pipeline flame arrester, etc.), parameter monitoring and control system, etc.

3.5 Vapor recovery by adsorption method

A method that adopts adsorbent to separate the mixture of gasoline vapor and air, and recover the gasoline vapor.

3.6 Vapor recovery by absorption method

A method that adopts absorbent to separate the mixture of gasoline vapor and air, and recover the gasoline vapor.

3.7 Vapor recovery by condensation method

Use the direct or indirect condensation method to separate the mixture of gasoline vapor and air, and recover the gasoline vapor.

3.8 Vapor recovery by membrane method

5 General

5.1 The design of the vapor recovery unit shall follow the principles of safe operation, reliability, energy saving, and convenient maintenance.

5.2 The vapor recovery unit shall comply with the national and industry standards and technical specifications related to air pollutant emission, electricity, electrical, explosion-proof, fire safety, and noise, etc.

5.3 The vapor recovery unit shall be manufactured in accordance with the drawings and technical documents approved by the prescribed procedures, and shall comply with the provisions of this Standard.

5.4 All pressure tanks and pipelines should meet the relevant national special equipment production license requirements; motors, compressors (refrigerators), electrical and control equipment shall have explosion-proof performance, and the explosion-proof grade shall not be lower than dⅡBT4.

5.5 The emission performance of the vapor recovery unit shall comply with the provisions of GB 20950-2007 and GB 20952-2007, and the noise emission shall comply with the provisions of GB 12348.

6 Conditions of Use

6.1 Normal conditions of use

The vapor recovery unit shall be able to work normally under the following conditions:

a) The altitude does not exceed 2000m;

b) The ambient temperature does not exceed -25°C ~ +50°C;

c) Relative humidity is no more than 95% (at +20°C);

d) There are flammable gases in the T1~T4 groups of ⅡA and ⅡB, and the explosive gas mixture formed by gasoline vapor and air in Zone 2 hazardous locations (GB 3836.1);

e) A site without severe vibration and impact.

6.2 Special conditions of use

If there are special conditions of use such as the following, a special agreement shall be signed between the manufacturer and the user:

according to the place of use and actual needs; and the overall structure layout shall be reasonable and compact. It should be designed as a skid-mounted and complete set. The vapor recovery of the recovery unit shall adopt a closed collection system.

7.2.2 The structural design should consider the rapid changes in temperature and (or) air pressure during use, which may cause abnormal condensation in the recovery unit.

7.2.3 The design of the pressure tank shall comply with the provisions of GB/T 150.1 ~ GB/T 150.4, SH/T 3074, TSG R0004.

7.2.4 The selection of pipelines, valves, pipe fittings, etc. in the system shall comply with the provisions of SH/T 3059.

7.2.5 The selection and design of automation instruments shall comply with the provisions of SH/T 3005.

8 Requirements

8.1 Performance requirements

8.1.1 The gasoline vapor recovery rate of the vapor recovery unit under the designed gasoline vapor concentration shall be no less than 95%.

8.1.2 The system resistance of the vapor recovery unit under the set processing capacity shall be no greater than 5000Pa.

8.1.3 The vapor recovery unit shall have system tightness:

a) The vapor recovery unit of the oil storage depot shall comply with the provisions of GB 20950-2007;

b) The vapor recovery unit of the gas station shall comply with the provisions of GB 20952-2007.

8.1.4 The concentration of gasoline vapor emission of the vapor recovery unit shall be no greater than 25g/m^3.

8.1.5 The noise emission of the vapor recovery unit shall be no greater than 70dB(A).

8.2 Requirements for main structural parts and components

8.2.1 Absorption tower

8.2.1.1 Packing absorption tower should be used.

8.2.1.2 The fillers shall be a structured fillers with low pressure drop, and the pressure

8.2.2.9 There shall be protection measures against power failure.

8.2.2.10 The adsorbent shall comply with the following provisions:

a) Activated carbon or other adsorbents with high adsorption performance should be used;

b) Under the operating temperature, the effective adsorption capacity of the adsorbent against butane shall be no less than 100g/kg; the desorption residual capacity shall be no more than 3g/kg. The effective adsorption capacity for gasoline vapor shall be no less than 150g/kg; and the desorption residual capacity shall be no more than 15g/kg;

c) When the adsorbent is active carbon, its specific surface area shall be no less than 1000m^2/g, and the apparent density shall be no less than 400kg/m^3;

d) The water content of the adsorbent shall be no higher than 5%;

e) The cycle life shall be no less than 30000h.

8.2.3 Membrane separator

8.2.3.1 The membrane module in the membrane separator shall provide sufficient mechanical support for the membrane and strictly separate the high-pressure raw material side from the low-pressure permeation side.

8.2.3.2 It shall be convenient to install and replace the membrane or membrane module. The packing density of polymer membrane modules should be higher than 6000m^2/m^3, and the packing density of inorganic membrane modules should be higher than 400m^2/m^3.

8.2.3.3 The membrane in the membrane separator shall be installed firmly; and the membrane module shall have a certain pressure-bearing capacity. The overall design pressure of the membrane separator shall be no less than 2 times the operating pressure on the high-pressure side, and also no less than 0.3MPa.

8.2.3.4 The membrane module separator shall be equipped with a safety valve or other high-pressure protection measures that match the design pressure.

8.2.3.5 The separation membrane shall comply with the following provisions:

a) The separation membrane material is organic polymer material or inorganic membrane, which shall have high separation permeability and anti-pollution performance. Membrane materials with a gasoline vapor-air separation factor greater than 100 should be used, or select the materials with the permeability for n-butane no less than 20 times than that for nitrogen;

8.3.3 The compressor used in the vapor recovery unit shall meet the requirements of GB/T 10079, GB/T 18429, and GB/T 19410. The compressor for gasoline vapor boosting should select a liquid ring compressor.

8.3.4 The vacuum pump can be a wet vacuum pump or a dry vacuum pump. When selecting a wet vacuum pump, it should select a liquid ring type with efficient gas-liquid separation supporting equipment. When selecting a dry vacuum pump, it should select a screw type, and it has the functions of on-line temperature monitoring and temperature control interlocking.

8.3.5 When the front end of the vapor recovery unit cannot effectively collect the gasoline vapor discharged from the tanker or refilling point, a gasoline vapor drainage device or fan shall be added.

8.3.6 When the system resistance of the vapor recovery unit is greater than 5000Pa under the set processing capacity, the vapor recovery unit shall be equipped with booster equipment. If the vapor recovery unit is far away from the oil tanker or refilling point (the pipeline pressure drop is greater than 2kPa), a gasoline vapor drainage device or fan shall be added.

8.3.7 When the operating load changes greatly, the machine and pump shall adopt a variable frequency speed regulating device.

8.3.8 When working normally for 8h at room temperature, and the maximum surface temperature of heating parts such as motors shall be no higher than 130°C.

8.3.9 The machine and pump shall be able to run continuously for 25000h without failure (except for vulnerable parts)

8.4 Requirements for main parts and accessories of the pipeline

8.4.1 Pipeline

8.4.1.1 The pipeline should adopt seamless steel pipe. Carbon steel and alloy steel seamless steel tubes shall comply with the provisions of GB/T 8163; stainless steel seamless steel tubes shall comply with the provisions of GB/T 14976.

8.4.1.2 The series of steel pipe dimensions shall implement the provisions of SH/T 3405.

8.4.2 Valve

8.4.2.1 Valves for gasoline vapor pipelines shall select general petrochemical valves or API valves, and shall comply with the provisions of relevant standards.

8.4.2.2 The pressure rating of the valve shall be no lower than 1.1 times the designed pressure of the pipeline.

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