

BUTTERFLY VALVE, STERILE POWDER DELIVERY APPARATUS CONSISTING OF A PLURALITY OF BUTTERFLY VALVES, AND METHOD FOR USE THEREOF

Technical field

This invention involves powder conveying field, specifically a butterfly valve, a sterile powder conveying device composed of multiple butterfly valves and its method of use for powder loading and unloading in pharmacy, biology, food and other industries.

Background technology

At present, it needs to convey materials from a sterile space to another and maintain the sterile state in the process in non-sterile production environment of products in pharmacy, biology, food and other industries. Technical difficulty is huge in the event of sterile transfer of a great number ($>10\text{kg}$) of sterile powder materials in a non-sterile environment.

Powder residue will be left on the inner surface of butterfly valve, including valve clack and seal ring, after powder conveying. The powder residue will disable sealing of butterfly valve to contaminate the sterile materials due to exposure to non-sterile environment. Meanwhile, the powder will leak into the environment, particularly some sensitive materials, to have negative influence on the environment and operating personnel. In addition, the cleaning media will leak into the materials during online cleaning to contaminate the sterility of materials to be transferred and receiving containers.

The technology widely used in the world is split butterfly valve technology, but it has some defects: a) powder residue will be left on the inner surface of butterfly valve after powder conveying to damage air-tightness of butterfly valve and sterility of products; b) the powder residue causes wear of sealing gasket of butterfly valve to leak fine particles, which entails frequency replacement of sealing gasket; c) online cleaning and sterilization between two split valve clacks is impossible due to unreliable sealing; d) VHP disinfection technology fails to strictly guarantee sterility; e) leakage is possible during VHP disinfection, bringing risk to health of production personnel. The sterility guarantee of this technology is insufficient as air-tightness can not be guaranteed.

Content of invention

The technical problem solved by this invention is to overcome defects of above existing technology, and provide a butterfly valve for purging powder residue to guarantee effective air-

tightness of the butterfly valve.

To this end, the following technical scheme is adopted in this invention: the butterfly valve consists of valve body and valve clack in the valve body. Its characteristic is that the valve body is installed with at least one sprinkler connected to an inlet valve outside the valve body for purging the inner surface of butterfly valve; in the middle of the valve clack is a horizontal drainage tray, one end of which is closed and the other is water outlet, and the valve clack is equipped with at least one drain hole connected to the drainage tray; the sprinkler is above the drainage tray.

Furthermore, the upper surface of valve clack is a concave cambered surface, which tends to store water, and the drain hole is at the bottom.

This invention can inject sterile gas at appropriate pressure after powder conveying to purge the inner surface of butterfly valve to remove the powder residue and guarantee complete sealing between butterfly valve clack and sealing gasket. The butterfly valve can be manual or automatic, and sanitary stainless steel butterfly valve is used.

Another purpose of this invention is to provide a sterile powder conveying device composed of multiple above butterfly valves, which is capable of online cleaning, sterilization and drying for the butterfly valve and purging powder residue in the butterfly valve to guarantee sterility of materials during conveying.

The technical scheme used for another purpose of this invention is as follows: the sterile powder conveying device composed of multiple above butterfly valves is equipped with a butterfly valve group with multiple butterfly valves. Its characteristic is that the water outlet of drainage tray of the butterfly valve at the bottom of butterfly valve group is connected to a drain valve outside the butterfly valve; it also includes upstream sterile equipment and downstream sterile receiving container, between which is the butterfly valve group, the lower end of the butterfly valve at the bottom of butterfly valve group is connected to feeding hole of downstream sterile receiving container, and discharge hole of upstream sterile equipment is connected to an upstream butterfly valve that is connected to the butterfly valve on the top of the butterfly valve group.

Corresponding media can be injected for online cleaning, sterilization and drying of non-sterile areas of butterfly valve group as the butterfly valve can be completely sealed to realize repeated butt-joint without affecting the sterility of materials conveyed and downstream sterile receiving container.

Moreover, the downstream sterile receiving container is installed with a respirator, and a

respirator valve is set between them for control of the respirator.

In addition, the adjacent butterfly valves are connected by flange, welding or quick clamp, which is selected in light of practical situation.

Furthermore, the sprinkler is a 360° spray ball or nozzle, which can realize 360° spray. The sprinkler can be fixed or rotary, which is selected on the basis of practical situation. The position of sprinkler on the butterfly valve can be changed as needed.

The third purpose of this invention is to provide method of use of the above sterile powder conveying device. The butterfly valve group is connected with butterfly valve 1, butterfly valve 2 and butterfly valve 3 in series from top to bottom. The steps are as follows:

a. The discharge hole of upstream sterile equipment is connected to upstream butterfly valve, which is connected to butterfly valve 1 with flanges or clamps, and then they undergo online cleaning, sterilization and drying together;

b. The feeding hole of downstream sterile receiving container is connected to butterfly valve 3 and butterfly valve 2 connected in series, and then they undergo online cleaning, sterilization and drying together;

c. Move downstream sterile receiving container to below upstream sterile equipment, lift downstream sterile receiving container with lifting equipment and accurately connect it to butterfly valve 1, and connect butterfly valve 1 and butterfly valve 2 with clamps in an airtight way to complete connection of sterile conveying device;

d. Open butterfly valve 2, drain valve and inlet valves, inject cleaning fluid into the non-sterile area between butterfly valve 1 and butterfly valve 3 through sprinklers of butterfly valve 2 and butterfly valve 3 for online cleaning, then inject clean steam for online sterilization, finally inject sterile gas for online drying, and close all valves after operation is finished;

e. Open all butterfly valves after online cleaning, sterilization and drying in step d is completed, and open respirator valve of downstream sterile receiving container to convey sterile powder from upstream sterile equipment to downstream sterile receiving container; select appropriate size of butterfly valve in light of flowability of powder;

f. Close upstream butterfly valve, open inlet valves, inject sterile gas through sprinklers of butterfly valve 1, butterfly valve 2 and butterfly valve 3 to purge inner surface of butterfly valve to remove the powder residue after powder conveying; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

g. Close butterfly valve 1, butterfly valve 2 and butterfly valve 3 after purging, inject sterile

gas from respirator of downstream sterile receiving container for blowback of filter element of respirator, and pressurize downstream sterile receiving container to keep positive pressure in it; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

h. Close respirator valve, and open the clamps to remove downstream sterile receiving container to finish the whole sterile powder conveying.

Moreover, the method and duration of purging in step f is determined through verification on the basis of flowability of the product, and intermittent pulsating purging or sectional purging is used.

Furthermore, the sterile gas is compressed air or inert gas, which is selected according to product properties.

The beneficial effect of this invention: 1) complete butterfly valve is used for good air-tightness; 2) powder residue on the inner surface of butterfly valve can be purged after use to guarantee air-tightness; 3) online cleaning, sterilization and drying can be conducted for non-sterile areas between butterfly valves to reliably guarantee sterility; 4) repeated sterile conveying can be achieved by conducting online cleaning, sterilization and drying once to realize high efficiency.

Description of figure

Figure 1 is structure diagram of butterfly valve of this invention.

Figure 2 is top view of Figure 1.

Figure 3 is A-A section view of Figure 1.

Figure 4 is structure diagram of butterfly valve clack of this invention.

Figure 5 is top view of Figure 4.

Figure 6 is structure diagram of sterile powder conveying device of this invention.

In the figure, 1-valve body, 2-valve clack, 3-sprinkler, 4-inlet valve, 100-butterfly valve group, 101-butterfly valve 1, 102- butterfly valve 2, 103- butterfly valve 3, 104-sprinkler of butterfly valve 1, 105- sprinkler of butterfly valve 2, 106- sprinkler of butterfly valve 3, 107, 108 and 109- inlet valve, 110-drain valve, 111- drainage tray, 112- drain hole, 200- upstream sterile equipment, 201- upstream butterfly valve, 300- downstream sterile receiving container, 301- respirator valve, 302- respirator.

Specific implementation method

This invention is further described below in line with specific implementation method.

As for the butterfly valve shown in figures 1-5, valve body 1 is installed with a fixed 360° sprinkler 3 for purging inner surface of butterfly valve, connected to inlet valve 4 outside the valve

body. In the middle of the valve clack 2 is a horizontal oblong drainage tray 111, one end of which is closed and the other is water outlet. The upper surface of valve clack is a concave cambered surface, which tends to store water, and at the bottom are 4 drain holes 112 connected to drainage tray 111; the sprinkler 3 is above the drainage tray 111.

The sterile powder conveying device shown in Figure 6 is composed of butterfly valve group 100, upstream sterile equipment 200 and downstream sterile receiving container 300. Butterfly valve group 100 is between upstream sterile equipment 200 and downstream sterile receiving container 300. The lower end of the butterfly valve at the bottom of butterfly valve group is connected to feeding hole of downstream sterile receiving container 300, and discharge hole of upstream sterile equipment 200 is connected to upstream butterfly valve 201 that is connected to the butterfly valve on the top of the butterfly valve group. The butterfly valve group 100 is connected with butterfly valve 1 101, butterfly valve 2 102 and butterfly valve 3 103 in series from top to bottom. The water outlet of drainage tray of the butterfly valve 3 at the bottom of butterfly valve group is connected to a drain valve 110 outside the butterfly valve, and outfall of the drain valve is connected to drain valve and trap group. The downstream sterile receiving container 300 is installed with a respirator 302, and a respirator valve 301 is set between them for control of the respirator.

The method of use of above sterile powder conveying device is as follows:

- a. The discharge hole of upstream sterile equipment 200 is connected to upstream butterfly valve 201, which is connected to butterfly valve 1 101 with flanges or clamps, and then they undergo online cleaning, sterilization and drying together;
- b. The feeding hole of downstream sterile receiving container 300 is connected to butterfly valve 3 103 and butterfly valve 2 102 connected in series, and then they undergo online cleaning, sterilization and drying together;
- c. Move downstream sterile receiving container 300 to below upstream sterile equipment 200, lift downstream sterile receiving container 300 with lifting equipment and accurately connect it to butterfly valve 1 101, and connect butterfly valve 1 101 and butterfly valve 2 102 with clamps in an airtight way to complete connection of sterile conveying device;
- d. Open butterfly valve 2 102, drain valve 110 and inlet valves 108 and 109, inject cleaning fluid into the non-sterile area between butterfly valve 1 101 and butterfly valve 3 103 through sprinklers 105 and 106 of butterfly valve 2 and butterfly valve 3 for online cleaning, then inject clean steam for online sterilization, finally inject sterile gas for online drying, and close all

valves after operation is finished;

e. Open all butterfly valves after online cleaning, sterilization and drying in step d is completed, and open respirator valve 301 of downstream sterile receiving container to convey sterile powder from upstream sterile equipment to downstream sterile receiving container; select appropriate size of butterfly valve in light of flowability of powder;

f. Close upstream butterfly valve 201, open inlet valves 107, 108 and 109, inject sterile gas through sprinklers 104, 105 and 106 of butterfly valve 1, butterfly valve 2 and butterfly valve 3 to purge inner surface of butterfly valve to remove the powder residue after powder conveying; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

g. Close butterfly valve 1, butterfly valve 2 and butterfly valve 3 after purging, inject sterile gas from respirator 302 of downstream sterile receiving container 300 for blowback of filter element of respirator, and pressurize downstream sterile receiving container 300 to keep positive pressure in it; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

h. Close respirator valve 301, and open the clamps to remove downstream sterile receiving container 300 to finish the whole sterile powder conveying.

Only good implementation of this invention is described above, but it can not be interpreted as restriction for claims. This invention is not limited to the above implementation, and its specific structure can change. Any changes within the protection scope of independent claims are within protection scope of this invention.

Claims

1. Butterfly valve consists of valve body (1) and valve clack (2) in the valve body. Its characteristic is that the valve body (1) is installed with at least one sprinkler (3) connected to an inlet valve (4) outside the valve body for purging the inner surface of butterfly valve; in the middle of the valve clack (2) is a horizontal drainage tray (111), one end of which is closed and the other is water outlet, and the valve clack (2) is equipped with at least one drain hole (112) connected to the drainage tray (111); the sprinkler (3) is above the drainage tray (111).
2. The characteristic of the butterfly valve described in claim 1 is that the upper surface of valve clack is a concave cambered surface, and the drain hole is at the bottom.
3. The sterile powder conveying device composed of multiple butterfly valves described in claim 1 or 2 is equipped with a butterfly valve group (100) with multiple butterfly valves. Its characteristic is that the water outlet of drainage tray of the butterfly valve at the bottom of butterfly valve group is connected to a drain valve (110) outside the butterfly valve; it also includes upstream sterile equipment (200) and downstream sterile receiving container (300), between which is the butterfly valve group (100), the lower end of the butterfly valve at the bottom of butterfly valve group is connected to feeding hole of downstream sterile receiving container (300), and discharge hole of upstream sterile equipment (200) is connected to an upstream butterfly valve (201) that is connected to the butterfly valve on the top of the butterfly valve group.
4. The characteristic of the sterile powder conveying device described in claim 3 is that the downstream sterile receiving container (300) is installed with a respirator (302), and a respirator valve (301) is set between them for control of the respirator.
5. The characteristic of the sterile powder conveying device described in claim 4 is that the adjacent butterfly valves are connected by flange, welding or quick clamp.
6. The characteristic of the sterile powder conveying device described in claim 4 is that the sprinkler is a 360° spray ball or nozzle.
7. The characteristic of the method of use of sterile powder conveying device described in claims 3-6 is that the butterfly valve group (100) is connected with butterfly valve 1 (101), butterfly valve 2 (102) and butterfly valve 3 (103) in series from top to bottom. The steps are as follows:
 - a. The discharge hole of upstream sterile equipment (200) is connected to upstream butterfly valve (201), which is connected to butterfly valve 1 (101) with flanges or clamps, and then they undergo online cleaning, sterilization and drying together;

b. The feeding hole of downstream sterile receiving container (300) is connected to butterfly valve 3 (103) and butterfly valve 2 (102) connected in series, and then they undergo online cleaning, sterilization and drying together;

c. Move downstream sterile receiving container (300) to below upstream sterile equipment (200), lift downstream sterile receiving container (300) with lifting equipment and accurately connect it to butterfly valve 1 (101), and connect butterfly valve 1 (101) and butterfly valve 2 (102) with clamps in an airtight way to complete connection of sterile conveying device;

d. Open butterfly valve 2 (102), drain valve (110) and inlet valves (108 and 109), inject cleaning fluid into the non-sterile area between butterfly valve 1 (101) and butterfly valve 3 (103) through sprinklers (105 and 106) of butterfly valve 2 and butterfly valve 3 for online cleaning, then inject clean steam for online sterilization, finally inject sterile gas for online drying, and close all valves after operation is finished;

e. Open all butterfly valves after online cleaning, sterilization and drying in step d is completed, and open respirator valve (301) of downstream sterile receiving container to convey sterile powder from upstream sterile equipment to downstream sterile receiving container; select appropriate size of butterfly valve in light of flowability of powder;

f. Close upstream butterfly valve (201), open inlet valves (107, 108 and 109), inject sterile gas through sprinklers (104, 105 and 106) of butterfly valve 1, butterfly valve 2 and butterfly valve 3 to purge inner surface of butterfly valve to remove the powder residue after powder conveying; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

g. Close butterfly valve 1, butterfly valve 2 and butterfly valve 3 after purging, inject sterile gas from respirator (302) of downstream sterile receiving container (300) for blowback of filter element of respirator, and pressurize downstream sterile receiving container (300) to keep positive pressure in it; the sterile gas should pass through sterile filtration system before entering the butterfly valve;

h. Close respirator valve (301), and open the clamps to remove downstream sterile receiving container (300) to finish the whole sterile powder conveying.

8. According to the method of use described in claim 7, the characteristic is that the method and duration of purging in step f is determined through verification on the basis of flowability of the product, and intermittent pulsating purging or sectional purging is used.

9. According to the method of use described in claim 7, the characteristic is that the sterile gas is

compressed air or inert gas, which is selected according to product properties.