the cell culture solution precipitate, the supernatant from the cell culture solution is discharged, and the cell culture solution now concentrated by the reduction in liquid volume is transferred from the culture container to the cell recovery container.

[0006] However, in order to recover cells in this manner, before discharging the supernatant from the cell culture solution, the culture container first needs to be left to stand and the cells in the cell suspension left to precipitate, and so time is accordingly required until the cells are precipitated. Moreover, even when sufficient time is taken to precipitate out the cells in the cell culture solution, there is still a concern that cells might become mixed in with the supernatant by handling during discharge, and that cells might be discharged together with the supernatant.

[0007] WO No. 2014/007382 describes causing layers of melted resin to intrude into openings in a metal filter, and welding opposing resin layers together using laser welding so as to achieve sufficient weld strength. There is, however, an issue of the poor flexibility of a metal filter when employed for processing cells in a closed environment.

[0008] Japanese Patent Application JP2006-231875A describes a vehicle fluid filter employing polyester resin fibers (non-woven fabric) as a filter, with the filter sandwiched between case configuration members. JP2006-231875A describes the use of uncolored NYLON 66, NYLON 6, etc. without pigment or the like as the resin for one case configuration member, and the use of colored NYLON 66, NYLON 6, etc. colored with a pigment or the like as the resin for the other case configuration member.

SUMMARY OF INVENTION

Technical Problem

[0009] Embodiments of the present disclosure provide a filtration filter having a filter fixed with high weld strength between two polymer films, to provide a filter-equipped container having a filtration filter welded so as to section the interior thereof, and a method of removing foreign matter from a cell suspension by using a filter-equipped container.

Solution to Problem

[0010] Embodiments of the present disclosure provide materials and film thicknesses of polymer films and an opening area ratio of a filter to obtain a high weld strength between these polymer films and filter when producing a filtration filter having a filter fixed between two polymer films.

[0011] According to a first aspect of the present disclosure, there is provided a filtration filter including a first weld frame, a second weld frame, and a filter. The first weld frame is configured by a flexible polymer film that includes a polymer and that has a film thickness of

at least 120 μm, the first weld frame being formed into a frame shape including a first through hole penetrating an inside of the frame shape in a thickness direction. The second weld frame is configured by a flexible polymer film that includes a polymer and that has a film thickness of at least 120 μm, the second weld frame being formed into a frame shape including a second through hole penetrating an inside of the frame shape in the thickness direction. The filter is configured by a substance having a higher melting point than the substances of these polymer films and is provided with openings and has an opening area ratio due to the openings of from 10% to 80%. The filter is welded to both the first weld frame and the second weld frame in a state in which an outer peripheral portion of the filter is sandwiched between an entire periphery of the first weld frame and an entire periphery of the second weld frame. The first weld frame is configured by polymer including either a high density polyethylene (HDPE) having a melting point of from 120°C to 140°C, a linear low density polyethylene (LLDPE) having a melting point of from 105°C to 125°C, or a mixture including at least one of the high density polyethylene or the linear low density polyethylene.

[0012] Reference here to "opening area ratio" means a proportion of surface area of openings with respect to overall surface area.

[0013] According to a second aspect of the present disclosure, there is provided a filter-equipped container including the above filtration filter welded to an interior of a container made from a polymer, so as to section the interior of the container thereby.

[0013a] ~~According to a third aspect of the present disclosure, there is provided~~Disclosed herein is a filter-equipped container including a container configured by two opposing polymer sheets, peripheral edge portions of the respective polymer sheets being welded together; and a filter welded to an interior of the container so as to section the interior of the container and configured from a substance provided with openings and having an opening area ratio due to the openings of from 10% to 80%.

[0014] ~~According to a fourth of the present disclosure, there is provided~~Disclosed herein is a method of removing foreign matter from a cell suspension by injecting a cell suspension containing foreign matter or that might contain foreign matter into one section of the interior of the container in the above filter-equipped container, passing the cell suspension through the filtration filter, and recovering a filtrate containing cells from another section. The filter includes openings communicating through in a thickness direction. These openings have a diameter that enables cells to be passed through, but does not let foreign matter of a certain size or greater to pass through. Such foreign matter can accordingly be removed from a cell suspension by passing the cell suspension through the filtration filter.

[0015] ~~According to a fifth aspect of the present disclosure, there is provided~~Disclosed herein is a method of removing foreign matter from a cell suspension. This method includes

injecting a cell suspension into one section of the interior of the container in the above filter-equipped container, passing the cell suspension through the filtration filter, recovering a filtrate containing cells, and also injecting liquid for suspending cells into the same section, re-suspending cells remaining in the same section, passing the re-suspended cell suspension through the filtration filter, and recovering a filtrate containing cells.

Advantageous Effects

[0016] In embodiments of the filtration filter and filter-equipped container disclosed herein, portions of the filter not sandwiched between the first weld frame and the second weld frame, namely portions corresponding the first through hole and the second through hole, exhibit a function as a filter. Due to the filter being welded to the first weld frame and the second weld frame with a high weld strength, the weld portion does not easily separate, and there is little concern that fluid might leak from the weld portion.

[0017] Thus there is little concern of solution leakage from the weld portion in cases in which the filter-equipped container of technology disclosed herein is employed to execute the method to remove foreign matter from a cell suspension of technology disclosed herein.

BRIEF DESCRIPTION OF DRAWINGS

[0018] Fig. 1 is a plan view illustrating a filter-equipped container according to an exemplary embodiment.

Fig. 2 is an exploded perspective view illustrating a filter-equipped container according to the exemplary embodiment.

Fig. 3 is schematic perspective view illustrating a filter-equipped container according to the exemplary embodiment.

Fig. 4 is a cross-section sectioned along line A-A of Fig. 1.

DESCRIPTION OF EMBODIMENTS

[0019] As in the example illustrated in Fig. 2, an exemplary embodiment of technology disclosed herein is a filtration filter 16. The filtration filter 16 includes a first weld frame 10 and a second weld frame 12, and a planar shaped filter 14 sandwiched between the first weld frame 10 and the second weld frame 12 and fixed thereto by welding. The filter 14 is made from a substance having a higher melting point than the substance of the first weld frame 10 and the second weld frame 12 and includes a portion not sandwiched between the first weld frame 10 and the second weld frame 12.

[0020] Detailed explanation follows regarding each member configuring a filtration filter of technology disclosed herein, using the filtration filter 16 illustrated in Fig. 2 as an example.

CLAIMS

1. A filtration filter, comprising:

a first weld frame configured by a flexible film that includes a polymer and that has a film thickness of at least 120 μm, the first weld frame being formed into a frame shape including a first through hole penetrating an inside of the frame shape in a thickness direction;

a second weld frame opposing the first weld frame in the thickness direction and being configured by a flexible film that includes a polymer and that has a film thickness of at least 120 μm, the second weld frame being formed into a frame shape including a second through hole penetrating an inside of the frame shape in the thickness direction at a position corresponding to the first through hole; and

a filter configured by a substance having a higher melting point than the first weld frame and the second weld frame, the filter being provided with openings and having an opening area ratio due to the openings of from 10% to 80%, and being welded to both the first weld frame and the second weld frame in a state in which an outer peripheral portion of the filter is sandwiched between an entire periphery of the first weld frame and an entire periphery of the second weld frame,

the first weld frame being configured by a polymer that includes either a high density polyethylene having a melting point of from 120°C to 140°C, a linear low density polyethylene having a melting point of from 105°C to 125°C, or a mixture including at least one of the high density polyethylene or the linear low density polyethylene.

2. The filtration filter of claim 1, wherein the first weld frame is configured by a polymer that consists of either a high density polyethylene having a melting point of from 120°C to 140°C, a linear low density polyethylene having a melting point of from 105°C to 125°C, or a mixture including at least one of the high density polyethylene or the linear low density polyethylene.

3. The filtration filter of claim 1 or claim 2, wherein the first weld frame, the filter, and the second weld frame are welded together in a state in which fluid to be filtrated is able to move through the first through hole, a portion of the filter not contacting either the first weld frame or the second weld frame, and the second through hole in this order.

4. The filtration filter of any one of claim 1 to claim 3, wherein the second weld frame is configured by a polymer that includes either a high density polyethylene having a melting point of from 120°C to 140°C, a linear low density polyethylene having a melting point of from 105°C to 125°C, or a mixture including at least one of the high density polyethylene or the linear low density polyethylene.

5. The filtration filter of any one of claim 1 to claim 3, wherein the second weld frame is configured by a polymer that consists of either a high density polyethylene having a melting point of from 120°C to 140°C, a linear low density polyethylene having a melting point of from 105°C to 125°C, or a mixture at least one of the high density polyethylene or the linear low density polyethylene.

6. The filtration filter of any one of claim 1 to claim 5, wherein the filter includes at least one material selected from the group consisting of a polyester, a polyamide, a polyolefin, a polyether ether ketone, a polyether sulfone, a carbon fiber, and a metal.

7. The filtration filter of any one of claim 1 to claim 6, wherein the filter is a woven product or a knitted product.

8. The filtration filter of any one of claim 1 to claim 7, wherein a diameter of the openings in the filter is from 5 μm to 200 μm.

9. The filtration filter of any one of claim 1 to claim 8, wherein the filter has a rectangular sheet shape.

10. The filtration filter of any one of claim 1 to claim 9, wherein a shape of the first weld frame and a shape of the second weld frame are substantially identical.

11. The filtration filter of any one of claim 1 to claim 10, wherein the filter is welded to the first weld frame and the second weld frame in a state that the filter has been sandwiched between the entire periphery of the first weld frame and the entire periphery of the second weld frame by being heated to a temperature equal to or higher than the melting point of the first weld frame or the second weld frame and equal to or lower than the melting point of the filter.

12. A filter-equipped container comprising:

the filtration filter of any one of claim 1 to claim 11 welded so as to section an interior of a container made from a polymer.

13. The filter-equipped container of claim 12, wherein:

the container is configured by two opposing flexible polymer sheets of a substantially identical rectangular shape, peripheral edge portions of the respective polymer sheets being welded together;

the first weld frame of the filtration filter provided at the interior of the container is welded by a first weld portion having a substantially U-shape that is open in one direction when one of the flexible polymer sheets of the container is viewed in a thickness direction;

the second weld frame of the filtration filter is welded by a second weld portion having a substantially U-shape that is open in another direction when the other flexible polymer sheet of the container is viewed in the thickness direction; and

an opening of the first weld portion and an opening of the second weld portion face opposite sides.

14. The filter-equipped container of claim 12 or claim 13, wherein at least one of an injection port or a discharge port is provided at the container.

15. The filter-equipped container of claim 14 wherein an injection port is provided at one section of the interior of the container sectioned by the filtration filter and a discharge port is provided at another section of the interior of the container sectioned by the filtration filter.

~~16. A filter-equipped container comprising:~~

~~a container configured by two opposing polymer sheets, peripheral edge portions of the respective polymer sheets being welded together; and~~

~~a filter welded to an interior of the container so as to section the interior of the container and configured from a substance provided with openings and having an opening area ratio due to the openings of from 10% to 80%.~~

~~17. A method of removing foreign matter from a cell suspension, the method comprising:~~

injecting a cell suspension into one section of the interior of the container in the filter-equipped container of any one of claim 12 to claim 16;

passing the cell suspension through the filtration filter; and

recovering a filtrate containing cells from another section.

18. A method of removing foreign matter from a cell suspension, the method comprising:

injecting a cell suspension into one section of the interior of the container in the filter-equipped container of any one of claim 12 to claim 16;

passing the cell suspension through the filtration filter;

recovering a filtrate containing cells from another section;

injecting liquid for suspending cells into the one section;

re-suspending cells remaining in the same section;

passing the re-suspended cell suspension through the filtration filter; and

recovering a filtrate containing cells from another section.