WHAT IS CLAIMED IS:

1. A vial comprising;

a bottom interior surface at least a portion of which has an incline angle to a horizontal plane greater than 0 degrees and a cylindrical interior wall substantially perpendicular to the horizontal plane and meeting the bottom interior surface, wherein the bottom surface and cylindrical wall form a container for containing a liquid;

an outlet channel for fluid flow out of the vial through the cylindrical wall;

an inlet channel for fluid flow into the vial through the cylindrical wall, the inlet channel defining a direction vector of fluid flow, wherein the direction vector is oriented at a first predefined angle with respect to the horizontal plane and oriented at a second predefined angle with respect to a line tangent to the cylindrical interior wall such that fluid flowing in through the inlet channel causes an upwardly moving fluid vortex to be created in the vial.

2. The vial according to claim 1, wherein the inlet channel is disposed at a vertical position closer to the bottom interior surface than the outlet channel.

3. The vial according to claim 1 or 2, wherein the cylindrical wall includes a ramp portion that extends inwardly from the cylindrical wall and further defines an interior surface that pushes rotational flow in the vial toward a center of the vial and wherein the ramp portion extends vertically from a position proximate to the bottom interior surface to a first predefined vertical position with respect to the outlet channel.

4. The vial according to claims 1 – 3 wherein the ramp portion is configured to produce a higher mixing shear in a solution in a first portion of the vial in a region proximate to the inlet and outlet as compared to lower mixing shear in a solution in a second portion of the vial in regions further from the inlet and outlet.

5. The vial according to any one of the above claims wherein the inlet channel comprises an inner diameter equal to or smaller than an inner diameter of the outlet channel (e.g., 1% to 80%, from about 10% to about 75%, from about 25% to about 50% smaller).

6. The vial according to any of the above claims, wherein

the bottom interior surface is approximately flat and the first predefined angle is in a range from about 10 degrees to 60 degrees (e.g., in a range from 20–25 degrees) with respect to the horizontal plane.

7. The vial according to claim 6, wherein the second predefined angle of the direction vector of fluid flow through the inlet is equal to or greater than 0° (e.g., between 0 and 20°, between 0 and 10°) with respect to the line tangent to cylindrical wall.

8. The vial according to any one of claims 1–4, wherein

the vial has a convex interior bottom surface, and

wherein a radius of curvature of the cylindrical wall is greater than a radius of curvature of the convex bottom surface.

9. A delivery device comprising:

a first syringe in fluid connection to the inlet of the vial according to claims 1 - 8, wherein the vial is in fluid connection to a three-way fluid connector through the outlet channel to the vial;

a second syringe in fluid connection to the three-way fluid connector;

and a patient interface in fluid connection to the three-way fluid connector; wherein,

the device is configured for delivery of:

(a) a first solution from the first syringe, through the vial, through the three-way fluid connector, and through the patient interface to a patient, and

(b) a second solution from the second syringe, through the three-way connector, and through the patient interface to a patient, and

wherein the inlet channel is disposed for delivering the first solution to the vial at the first predefined angle such that settled particles in a particle-containing solution in the vial are dispersed in the solution and exit the vial through the outlet channel.

10. The delivery device according to claim 9, further comprising a selecting-valve integrated with the three-way fluid connector for selective delivery of the first solution from the first syringe through the selecting valve to the patient or for selective delivery of the second solution from the second syringe through the selecting valve to the patient.

11. The delivery device according to claim 10, wherein the selecting-valve integrated with the three-way fluid connector is configured as a three-way stopcock.

12. The delivery device according to claim 9, further comprising a first one-way valve disposed between the first syringe and the inlet channel, and a second one-way valve disposed between the second syringe the three-way connector, wherein

the first one-way valve allows fluid flow from the first syringe to the vial, and the second one-way valve allows fluid flow from the second syringe to the three-way fluid-connector.

13. The delivery device according to claim 12, further comprising a third one-way valve disposed between the vial outlet and the three-way fluid connector, wherein the third one-way valve allows fluid and particle flow from the vial to the patient interface when a fluid pressure on an inlet of the third one-way valve is at least about 0.2 psi above a pressure on an outlet of the third one-way valve.

14. The delivery device according to any one of claims 9–13, further including a vial holder configured as a container having a top opening and a removable top cover, and wherein the container is configured to receive the vial therein through the top opening, and the removeable top cover is configured for compressing an elastomeric seal against an opening at the top of the vial when the top cover is attached to the container, thereby providing a fluid seal at the top opening of the vial, and

the inlet channel is provided with fluid connection to the first syringe using a first tube, the outlet channel is provided with fluid connection to the three-way valve using a second tube, and the vial holder includes an opening for allowing connection of the first tube to the inlet channel, and an opening for allowing connection of the second tube to the outlet channel.

15. The delivery device according to claim 14 further comprising a light disposed to illuminate the interior of the vial and wherein the vial and vial container are at least 80% transparent to the light.

16. The delivery device according to claim 14 or 15, wherein the container and vial are at least partially opaque to ionizing radiation (e.g., such that at least 50% of the radiation emanating from the interior of the vial is attenuated by the vial and container).

17. The delivery device according to any one of claims 14–16, further comprising a holder for the vial and vial holder, wherein the holder includes,

a moat channel surrounding the vial and configured for containing at least the volume of the interior of the vial,

a transparent lid for enclosing the vial and three-way fluid connector, and

a removable tray configured for attachment to the holder and configured for holding the three-way fluid connector and removably attaching to the vial holder.

18. The delivery device according to claim 17, wherein the fluid connection from the second syringe to the three-way fluid connector is provide by removable attachment to a third tube, the fluid connection from the three-way fluid connector to the patient interface is provide by removable attachment to a fourth tube, wherein at least a portion of the first, third and fourth tubes are placed in the holder when the device is in operation.

19. The delivery device according to any one of the above claims wherein the patient interface is a microcatheter.

20. A method for delivery of radiomicrospheres to a patient in need of radioembolization, the method comprising using the device of claim 9 to deliver radiomicrospheres from the vial to the patient.

21. The method of claim 20, further comprising delivering a contrast agent from the second syringe to the patient and visualizing the artery using the delivered contrast agent.

22. The method of claim 20 or 21, wherein the radiomicrospheres include Y^{90}.

CLAIMS

1. A vial comprising;

a bottom interior surface at least a portion of which has an incline angle to a horizontal plane greater than 0 degrees and a cylindrical interior wall substantially perpendicular to the horizontal plane and meeting the bottom interior surface, in which the bottom surface and cylindrical wall form a container for containing a liquid;

an outlet channel for fluid flow out of the vial through the cylindrical wall;

an inlet channel for fluid flow into the vial through the cylindrical wall, the inlet channel defining a direction vector of fluid flow, in which the direction vector is oriented at a first predefined angle with respect to the horizontal plane and oriented at a second predefined angle with respect to a line tangent to the cylindrical interior wall such that fluid flowing in through the inlet channel causes an upwardly moving fluid vortex to be created in the vial.

2. A vial according to Claim 1, in which the inlet channel is disposed at a vertical position closer to the bottom interior surface than the outlet channel.

3. A vial according to Claim 1 or 2, in which the cylindrical wall includes a ramp portion that extends inwardly from the cylindrical wall and further defines an interior surface that pushes rotational flow in the vial toward a center of the vial and in which the ramp portion extends vertically from a position proximate to the bottom interior surface to a first predefined vertical position with respect to the outlet channel.

4. A vial according to Claim 1, 2 or 3, in which the ramp portion is configured to produce a higher mixing shear in a solution in a first portion of the vial in a region proximate to the inlet and outlet as compared to lower mixing shear in a solution in a second portion of the vial in regions further from the inlet and outlet.

5. A vial according to any preceding claim, in which the inlet channel comprises an inner diameter equal to or smaller than an inner diameter of the outlet channel (e.g., 1% to 80%, from 10% to 75%, from 25% to 50% smaller).

6. A vial according to any preceding claim, in which

the bottom interior surface is approximately flat and the first predefined angle is in a range from 10 degrees to 60 degrees (e.g., in a range from 20–25 degrees) with respect to the horizontal plane.

7. A vial according to Claim 6, in which the second predefined angle of the direction vector of fluid flow through the inlet is equal to or greater than 0° (e.g., between 0 and 20°, between 0 and 10°) with respect to the line tangent to cylindrical wall.

8. A vial according to any of Claims 1 to 4, in which

the vial has a convex interior bottom surface, and

in which a radius of curvature of the cylindrical wall is greater than a radius of curvature of the convex bottom surface.

9. A delivery device comprising:

a vial according to any preceding claim,

a first syringe in fluid connection to the inlet of the vial, in which the vial is in fluid connection to a three-way fluid connector through the outlet channel to the vial;

a second syringe in fluid connection to the three-way fluid connector;

and a patient interface in fluid connection to the three-way fluid connector; in which,

the device is configured for delivery of:

(a) a first solution from the first syringe, through the vial, through the three-way fluid connector, and through the patient interface to a patient, and

(b) a second solution from the second syringe, through the three-way connector, and through the patient interface to a patient, and

in which the inlet channel is disposed for delivering the first solution to the vial at the first predefined angle such that settled particles in a particle-containing solution in the vial are dispersed in the solution and exit the vial through the outlet channel.

10. A delivery device according to Claim 9, further comprising a selecting-valve integrated with the three-way fluid connector for selective delivery of the first solution from the first syringe through the selecting valve to the patient or for selective delivery of the second solution from the second syringe through the selecting valve to the patient.

11. A delivery device according to Claim 10, in which the selecting-valve integrated with the three-way fluid connector is configured as a three-way stopcock.

12. A delivery device according to Claim 9, further comprising a first one-way valve disposed between the first syringe and the inlet channel, and a second one-way valve disposed between the second syringe the three-way connector, in which

the first one-way valve allows fluid flow from the first syringe to the vial, and the second one-way valve allows fluid flow from the second syringe to the three-way fluid-connector.

13. A delivery device according to Claim 12, further comprising a third one-way valve disposed between the vial outlet and the three-way fluid connector, in which the third one-way valve allows fluid and particle flow from the vial to the patient interface when a fluid pressure on an inlet of the third one-way valve is at least 0.2 psi above a pressure on an outlet of the third one-way valve.

14. A delivery device according to any of Claims 9 to 13, further including a vial holder configured as a container having a top opening and a removable top cover, and in which the container is configured to receive the vial therein through the top opening, and the removeable top cover is configured for compressing an elastomeric seal against an opening at the top of the vial when the top cover is attached to the container, thereby providing a fluid seal at the top opening of the vial, and

the inlet channel is provided with fluid connection to the first syringe using a first tube, the outlet channel is provided with fluid connection to the three-way valve using a second tube, and the vial holder includes an opening for allowing connection of the first tube to the inlet channel, and an opening for allowing connection of the second tube to the outlet channel.

15. A delivery device according to Claim 14, further comprising a light disposed to illuminate the interior of the vial and in which the vial and vial container are at least 80% transparent to the light.

16. A delivery device according to Claim 14 or 15, in which the container and vial are at least partially opaque to ionizing radiation (e.g., such that at least 50% of the radiation emanating from the interior of the vial is attenuated by the vial and container).

17. A delivery device according to Claim 14, 15 or 16, further comprising a holder for the vial and vial holder, in which the holder includes,

a moat channel surrounding the vial and configured for containing at least the volume of the interior of the vial,

a transparent lid for enclosing the vial and three-way fluid connector, and

a removable tray configured for attachment to the holder and configured for holding the three-way fluid connector and removably attaching to the vial holder.

18. A delivery device according to Claim 17, in which the fluid connection from the second syringe to the three-way fluid connector is provide by removable attachment to a third tube, the fluid connection from the three-way fluid connector to the patient interface is provide by removable attachment to a fourth tube, in which at least a portion of the first, third and fourth tubes are placed in the holder when the device is in operation.

19. A delivery device according to any preceding claim, in which the patient interface is a microcatheter.

20. A device according to Claim 9 for use in the delivery of radiomicrospheres to a patient in need of radioembolization, in which radiomicrospheres are to be delivered from the vial to the patient.

21. A device for use according to Claim 20, in which a contrast agent is to be delivered from the second syringe to the patient and in which an artery is to be visualized using the delivered contrast agent.

22. A device for use according to Claim 20 or 21, in which the radiomicrospheres include Y^{90}.