

1 **“DESANDING APPARATUS AND SYSTEM”**
2

3 FIELD

4 Embodiments disclosed herein relate to a system and apparatus for
5 the removal of particulates, such as sand, from fluid streams produced from a
6 well, while minimizing abrasion of the involved equipment.

7
8 BACKGROUND OF THE INVENTION

9 Production from wells, in the oil and gas industry, often contain
10 particulates such as sand. These particulates could be part of the formation from
11 which the hydrocarbon is being produced, introduced particulates from hydraulic
12 fracturing or fluid, loss material from drilling mud or fracturing fluids, or from a
13 phase change of produced hydrocarbons caused by changing conditions at the
14 wellbore (asphalt or wax formation). As the particulates are produced, problems
15 occur due to abrasion, and plugging of production equipment. In a typical
16 startup, after stimulating a well by fracturing, the stimulated well may produce
17 sand until the well has stabilized, often up to several months after production
18 commences. Other wells may require extended use of a desander.

19 Erosion of the production equipment is severe enough to cause
20 catastrophic failure. High fluid stream velocities are typical and are even
21 purposefully designed for elutriating particles up the well and to the surface. An
22 erosive failure of this nature can become a serious safety and environmental
23 issue for the well operator. A failure, such as a breach of high pressure piping or
24 equipment, releases uncontrolled high velocity flow of fluid which is hazardous to
25 service personnel. Release to the environment is damaging to the environment

1 resulting in expensive cleanup and loss of production. Repair costs are also
2 high.

3 In all cases, retention of particulates contaminates surface
4 equipment and the produced fluids, and impairs the normal operation of the oil
5 and gas gathering systems and process facilities.

6 In one prior art system, a pressurized tank ("P-Tank") is placed on
7 the wellsite and the well is allowed to produce fluid and particulates. The fluid
8 stream is produced from a wellhead and into a P-Tank until sand production
9 ceases. The large size of the P-Tank usually restricts the maximum operating
10 pressure of the vessel to something in the order of 1,000 – 2,100 kPa. In the
11 case of a gas well, this requires some pressure control to be placed on the well to
12 protect the P-Tank. Further, for a gas well, a pressure reduction usually is
13 associated with an increase in gas velocity which in turn makes sand-laden
14 wellhead effluent much more abrasive. Another problem associated with this
15 type of desanding technique is that it is only a temporary solution. If the well
16 continues to make sand, the solution becomes prohibitively expensive. In most
17 situations with this kind of temporary solution, the gas vapors are not conserved
18 and sold as a commercial product.

19 An alternate, known prior art system includes employing filters to
20 remove particulates. A common design is to have a number of fiber-mesh filter
21 bags placed inside a pressure vessel. The density of the filter bag fiber-mesh is
22 matched to the anticipated size of the particulates. However, filter bags are
23 generally not effective in the removal of particulates in a multiphase conditions.
24 Usually, multiphase flow in the oil and gas operations is unstable. Large slugs of
25 fluid followed by a gas mist is common. In these cases, the fiber bags become a

1 cause for a pressure drop and often fail due to the liquid flow therethrough. Due
2 to the high chance of failure, filter bags may not be trusted to remove particulates
3 in critical applications or where the flow parameters of a well are unknown. An
4 additional problem with filter bags in most jurisdictions, is the cost associated with
5 disposal. The fiber-mesh filter bags are considered to be contaminated with
6 hydrocarbons and must be disposed of in accordance to local environmental
7 regulation.

8 In Canadian Patent 2,433,741, issued February 3, 2004 and in
9 Canadian Patent 2,407,554, issued June 20, 2006, both to Applicant, a desander
10 is disclosed having an elongate, horizontal vessel having an inlet at one end and
11 an outlet at another, the outlet separated from the inlet by a downcomer flow
12 barrier, such as a weir, adjacent the vessel's outlet or exit. The weir forms, and
13 maintains, an upper freeboard portion having a cross-sectional area which is
14 greater than that of the field piping from whence the fluid stream emanates for
15 encouraging water and particulates to fall out of the freeboard portion. Water and
16 particulates accumulate along a belly portion. The accumulation of particulates is
17 along a substantial length of the elongate vessel increasing the difficulty of
18 periodic manual removal of such accumulating using scraper rods and the like.

19 While Applicant has substantially maintained their elongated
20 horizontal design virtually unchanged over the past 8 years or so, there has been
21 a desire to improve the ease with which the vessel can be cleaned and further
22 improvement in separation efficiency. Further, due to the nature of the gases
23 handled, including pressure and toxicity, all vessels and pressure piping must be
24 manufactured and approved by appropriate boiler and pressure vessel safety
25 authorities.

SUMMARY OF THE INVENTION

Desanding apparatus is provided which is placed adjacent to a well's wellhead for intercepting a fluid stream flow before prior to entry to equipment including piping, separators, valves, chokes and downstream equipment. The fluid stream can contain a variety of phases including liquid, gas and solids. In one embodiment, a pressure vessel is inserted in the flowstream by insertion into high velocity field piping extending from the wellhead. The vessel contains an upper freeboard portion having a cross-sectional area which is greater than that of the field piping from whence the fluid stream emanates. As a result, fluid stream velocity drops and particulates cannot be maintained in suspension. The freeboard portion is maintained through control of the angle of the desander, obviating the need for a downcomer of Applicant's own prior art horizontal desanders.

14 In a broad aspect, a desanding system receives a gas stream
15 containing entrained liquid and particulates. The system comprises a vessel,
16 elongated along a longitudinal axis and inclined from a horizontal at a non-zero
17 inclination angle. The vessel has a fluid inlet, adjacent an upper end for
18 discharging the gas stream into the vessel at an inlet velocity, and a fluid outlet,
19 spaced along the longitudinal axis from, and lower than, the fluid inlet.

The vessel further has a gas/liquid interface at the fluid outlet, a belly storage portion formed below the interface, and a freeboard portion formed adjacent an upper portion of the vessel above the interface. The freeboard portion has a freeboard cross-sectional area which diminishes from the fluid inlet to the fluid outlet, wherein a freeboard velocity, adjacent the fluid inlet is less than the inlet velocity, the freeboard velocity being such that the entrained liquids and

1 particulates fall out of the gas stream for collecting in the belly storage portion. A
2 desanded gas stream flows out of the freeboard portion and out the fluid outlet,
3 being free of a substantial portion of the particulates.

4 More preferably, a vessel of an embodiment disclosed herein is
5 incorporated in a desanding system to replace existing prior connective piping for
6 a wellhead, the vessel being supported using structure to align the vessel with
7 the wellhead piping and downstream equipment. The desander's fluid inlet and
8 fluid outlet, associated with the inclined world of the desander, are adapted to
9 connect to the orthogonal world of the connective piping.

10 In another broad aspect, a method for desanding a fluid stream,
11 emanating from a wellhead and containing gas and entrained liquid and
12 particulates, comprises providing an elongated vessel having a longitudinal axis
13 which is inclined from the horizontal. The vessel has a fluid inlet adjacent an first
14 end of the vessel and a fluid outlet spaced along the longitudinal axis from the
15 fluid inlet; inclining the vessel at angle from a horizontal at a non-zero inclination
16 angle so that the fluid outlet is lower that the fluid inlet for forming a freeboard
17 portion above the fluid outlet. The fluid stream is discharging from the fluid inlet,
18 into the vessel and substantially parallel to the longitudinal axis for establishing a
19 liquid interface in a belly portion of the vessel, the belly portion and being formed
20 below the fluid outlet. Liquid and particulates are being directed along a
21 trajectory in the freeboard portion of the vessel to intercept a substantial portion
22 of the particulates at the liquid interface for storage in the belly portion. A
23 desanded gas stream is recovered at the fluid outlet which is substantially free of
24 particulates.

1 The inlet can be parallel or non-parallel with the longitudinal axis for
2 enabling a trajectory to intercept the gas/liquid interface. The fluid stream can be
3 introduced through a replaceable nozzle. The fluid inlet can be curved to align
4 the inlet from the inclined desander and orthogonal piping from a wellhead.

5

6 BRIEF DESCRIPTION OF THE DRAWINGS

7 Figure 1 is a cross-sectional side view of Applicant's prior art
8 elongated horizontal desander illustrating downcomer flow barrier, fluid streams,
9 falling trajectory of particulates, and accumulations of separated liquid,
10 particulates and particulate-free fluid discharge;

11 Figure 2 is a cross-sectional view of an embodiment of a tilted or
12 inclined desander;

13 Figures 3A and 3B are perspective representations of the volumes
14 of the belly portion and freeboard portions of the inclined desander of Fig. 2;

15 Figure 4 is a cross-sectional view of another embodiment of an
16 inclined desander having a greater inclination angle than that of Fig. 2;

17 Figure 5 is a cross sectional view of a curved fluid inlet, square to
18 the desander, and having a long radius angular transition elbow between
19 orthogonal piping and the inclined desander;

20 Figure 6 is a representation of an inclined desander illustrating
21 parameters for an example 12 inch diameter desander handling 50 m³/d of fluid
22 flow; and

23 Figure 7 is a representation of an inclined desander illustrating
24 parameters for an example, 36 inch diameter, desander having a horizontal fluid
25 inlet.

1 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

2 A desander is typically inserted between or as a replacement for
3 existing piping such as connecting piping between a wellhead and downstream
4 equipment such as multiphase separators.

5 As shown in Fig. 1, a prior art horizontal desander comprises a
6 cylindrical pressure vessel 11 having a substantially horizontal axis A, a first fluid
7 inlet end 12 adapted for connection to the fluid stream F. The fluid stream F
8 typically comprises a variety of phases including gas G, some liquid L and
9 entrained particulates such as sand S. The fluid stream F containing sand S
10 enters through the inlet end 12 and is received by a freeboard portion 13. In the
11 illustrated prior art vessel, the freeboard area is set by a downcomer flow barrier
12 14. Accordingly, the velocity of the fluid stream F slows to a point below the
13 entrainment or elutriation velocity of at least a portion of the particulates S in the
14 fluid stream. Given sufficient horizontal distance without interference, the
15 particulates S eventually fall from the freeboard portion 13. Particulates S and
16 liquids L accumulate over time in the belly portion 15 and are periodically cleaned
17 out at sufficient intervals to ensure that the maximum accumulated depth does
18 not encroach on the freeboard portion 13. The desanded fluid stream, typically
19 liquid L and gas G, emanates from fluid outlet 16.

20 As shown in Figs. 2 through 7, embodiments of an inclined
21 desander 20 are free of the prior art flow barrier and, through tilting or inclination
22 of the vessel, maximize freeboard upon entry of the flow stream, and reduce
23 liquid flow rates for maximizing settling conditions therein and retention of
24 captured particulates S. Variability of the inclination angle α enables a measure

1 of variability between the respective freeboard and liquid-storing belly portion for
2 adjusting performance.

3 As shown in Fig. 2, the desander 20 comprises a vessel 22 having
4 an axis A oriented at an angle α to the horizontal H. The desander 20 has a fluid
5 inlet 24 at an upper end 25 for receiving a fluid stream F typically comprising a
6 variety of phases including gas G, some liquid L and entrained particulates such
7 as sand S. In this embodiment, the fluid inlet 24 is oriented parallel to a
8 longitudinal axis A of the vessel 22. A fluid outlet 26 is located along a top 28 of
9 the vessel 22, and spaced from the fluid inlet 24. In an operating state, a
10 gas/liquid interface 32 forms extending horizontally from about the fluid outlet 26.
11 A belly portion 40 is formed below the interface 32 for containing liquid L and
12 particulates S. A freeboard portion 44 is formed above the interface 32. The fluid
13 inlet 24 discharges into the freeboard 44. Particulate trajectory can be
14 manipulated by positioning and orienting a discharge end 29 of the fluid inlet 24.
15 In one embodiment, the discharge 29 of the inlet 24 can be aligned parallel to the
16 vessel axis A. The inlet 24 or discharge 29 can be oriented in other orientations
17 including above the inclined axis A, or below the axis A.

18 The interface 32 is a generally obround, gas/liquid interface
19 between the belly and freeboard portions 40,44. The obround interface 32 has a
20 distal end 33 adjacent the fluid outlet 26 and a proximal end 34, the location
21 of which is intermediate the fluid outlet 26 and fluid inlet 24 and varies with liquid
22 level and inclination angle α . As a result of the desander 20 inclination, the
23 trajectory of the fluid stream F, from inlet 24, converges with the interface 32.
24 The trajectory for dropping sand S and liquid L into the belly portion 40 is
25 foreshortened, reducing drop out time. The vessel 22 is long enough to space

1 the fluid inlet 24 sufficiently from the interface 32 to minimize turbulence of the
2 liquid L in the belly portion 40, that spacing being dependent upon various design
3 factors including vessel inclination angle α , inlet fluid stream velocity and
4 characteristics.

5 At a steady state, the maximum level of the interface 32, is
6 controlled at the distal end 33, set by eventual liquid entrainment and discharge
7 at the fluid outlet 26. Gas G discharges at the fluid outlet 26. At steady state,
8 when the liquid level reaches the fluid outlet 26, any oil and other liquids are re-
9 entrained with the gas G exiting at fluid outlet 26. Particulates S continue to be
10 captured in the belly portion 40 until its volumetric capacity is reached.

11 Connective piping 46, between conventional wellhead and
12 downstream equipment, is typically in rectilinear or orthogonal arrangements.
13 Thus, the angle α of the desander 20 introduces coupling or connection
14 challenges. The connective piping 46 is generally horizontal or vertical and
15 incorporation of the inclined desander 20 requires an adjustment made at the
16 fluid inlet 24 and fluid outlet 26. In many scenarios, with a small inclination angle
17 α , the fluid outlet 26 can be fit to the top 28 of the vessel 22 at angle α , orienting
18 the outlet 26 vertically and thereby obviating the need for an angular transition.

19 Turning to Figs. 3A and 3B, the desander 20 is shown
20 diagrammatically split at the interface 32 for illustrating the incrementally
21 increasing volume of the belly portion 40 below and the incrementally decreasing
22 volume of freeboard portion 44, increasing and decreasing as referenced to the
23 feed stream F. The freeboard portion 44 demonstrates a cross-sectional area
24 which diminishes from the fluid inlet 24 to the fluid outlet 26. As shown in Figs. 2
25 and 4, a freeboard velocity at the fluid inlet 24 is such that the entrained liquids L

1 and particulates S fall out of the fluid stream F and collect in the storage belly
2 portion 40. The cross-sectional area of the freeboard portion 44, adjacent the
3 fluid inlet 24, is at its greatest for achieving the lowest average inlet velocity for
4 maximum drop out efficiency for particulates S and liquids L. As the freeboard
5 cross-sectional area adjacent the fluid inlet 24 is large and relatively unimpeded
6 by the belly portion 40, the velocity reduction upon discharge is significantly
7 greater than that of Applicant's prior art horizontal desander. Particulate removal
8 is accomplished while minimizing the portion of the vessel allocated to the
9 freeboard portion 44, maximizing the efficiency of that freeboard portion for
10 particulate drop out, and resulting in a greater allocation of the overall portion of
11 the vessel to the belly portion 40 for storage.

12 Velocity in the freeboard portion 44 increases after a substantial
13 portion of the particulates S have already deposited in the belly portion 40. The
14 cross-sectional area of the belly portion 40 increases towards the fluid outlet 26
15 and the velocity of liquids accumulating therein diminishes.

16 With reference again to Fig. 2 and to Fig. 4, in the belly portion,
17 particulates accumulate and flow downvessel at an angle of repose. The
18 accumulation of liquid L and particulates S establishes a downward flow in the
19 belly portion, and as the particulates accumulate and limit the free flow of the
20 liquid L in the belly portion 40, the liquid velocity begins to increase, drawing
21 more particulates S downvessel.

22 With reference to Fig. 4, the inclination angle α can be adjusted,
23 shown here as an increased angle over that of Fig. 2. At increasing angles α the
24 trajectory of the feed stream impinges the interface 32 at less acute angle,

1 impinges the interface 32 sooner and enables selection of shorter vessels 22 and
2 greater particulate removal efficiency.

3 Inclination angles α can be adjusted, for a given length of vessel 22,
4 between fluid inlet 24 and fluid outlet 26, to accommodate gas G and liquid L
5 content in the feed fluid stream F. Inclination angles α would generally be in the
6 range of about 2 degrees to about 20 degrees. The shallowest operating angle α
7 is limited by the minimum requirement for a minimum freeboard 44 cross-
8 sectional area adjacent the inlet 24 once the interface 32 builds to about the fluid
9 outlet 26. The steepest operating angle α is limited by the requirement for a
10 minimum storage capacity in the belly portion 40. The minimum inclination angle
11 would be the condition where the inlet 24 is entirely in the gas phase of the
12 freeboard portion 44 and the gas phase at the discharge is of zero height. The
13 maximum inclination angle would be the condition where the inlet 24 is well
14 above the gas/liquid interface allowing substantial freeboard to handle slug flow.
15 Angles above 45 degrees limit the performance of desander considerably since
16 the residence time of the liquid phase in the belly portion 40 is reduced.

17 With reference to Figs. 4 and 5, the fluid inlet 24, exposed to
18 entrained particulates S in the fluid stream, is subject to greatest risk of erosion.
19 While the inlet 24 can be integrated with the vessel 22, one can also provide an
20 inlet 24 or discharge 29 that is replaceable for ease of maintenance. Options
21 include accepting eventual wear and shutdown of the desander 20 for
22 replacement of an integrated inlet 24; modifying the material or configuration of
23 the inlet 24 to prolong service life, or using replaceable discharge or nozzle for
24 minimizing turnaround time. As stated, one approach is to make the discharge
25 29 replaceable including incorporating features of a replaceable nozzle as set

1 forth in Applicant's Patent CA 2,535,215 issued May 8, 2008. A replaceable
2 nozzle 50 can be fit to a compatible coupling at the upper end 25 of the vessel
3 22. One form of replaceable nozzle 50 comprises the discharge 29, and a
4 threaded connection or nozzle flange 29i, for connection to a compatible
5 threaded connection or flange 24i at the inlet 24 of the vessel 22. The orientation
6 of the discharge is dependent on the coupling 24i,29i and arrangement of the
7 discharge relative thereto. The replaceable nozzle 50 includes a connecting
8 piping coupling, such as a connective flange 47i for connecting to the piping 47.

9 To maximize service life, the nozzle 50 can incorporate a curved
10 portion 51, such as a long radius elbow, transition between the orthogonal world
11 of the connecting piping and the inclined axis A of the vessel 22. That curved
12 portion 51 can be integrated with the inlet 24, nozzle 50 or located in advance
13 thereof, such as in a transition pup joint.

14 In operation, various sizes of desanders are employed in the prior
15 art for differing operational conditions. Prior art desanders 10, such as that
16 described in US 6,983,852 to Applicant, for different feed fluid streams F, might
17 include one typical standard vessel 11 having a nominal 0.3 m (12 inch) diameter
18 by 3.048 m (10 feet) long and another vessel 11 having 0.3 m (12 inch) diameter
19 by 6.096 m (20 feet) long, both of which are fitted with a downcomer weir to set
20 the freeboard portion.

21 Herein, in the inclined desander 20, the prior art downcomer flow
22 barrier, such as a weir, can be eliminated by providing similar 0.3 m (12 inch)
23 diameter vessels 22 and tilting the upper end 30 of the new desander 20 at about
24 twice the prior art weir height so as to form the interface 32 at the fluid outlet 26.
25 To mimic the minimum operating performance of the 3.048 m (10 feet) and

1 6.096 m (20 feet) prior art desanders, a 20 foot long inclined vessel 22 would only
2 need to be inclined about $\frac{1}{2}$ the angle α of the 10 foot long inclined vessel 22.
3 Performance can be adjusted by varying the angle.

4 As shown in Fig. 6, an example of an inclined desander 20 can
5 receive a fluid stream F of 50 m³/d, bearing particulates S having an average size
6 of 150 μ m. The fluid stream F can be discharged to vessel 22, having a 0.3 m (1
7 foot) diameter and 3.048 m (10 feet) long. A typical pressure of the fluid stream F
8 is about 7000 kPa (1015 psia). At an inclination angle α of 4.9 degrees, the
9 freeboard volume is 0.10 m³ and the belly portion is 0.486 m³. The resulting belly
10 portion capacity is about 502 kg of sand particulates.

11 As shown in Fig. 7, another embodiment of an inclined desander 20
12 illustrates some additional optional characteristics including a fluid inlet 24
13 oriented horizontally, the inlet being directly connectable to orthogonal connection
14 piping. The discharge 29 is oriented at an angle to the longitudinal axis A, in this
15 case in a generally horizontal plane, which is angled upwardly from axis A. The
16 initially horizontal trajectory of a substantial portion of the feed stream falls off
17 before engaging the vessel 22. In part, the inlet 24 can be square to the
18 connective pipe as, in this embodiment, the vessel 22 is of sufficient diameter,
19 such as 36 inches, to permit inlet placement in the freeboard 44 while the
20 trajectory is such that it minimizes or avoids vessel wall involvement. As shown,
21 a horizontal spacing between the inlet 24 and inside wall of the vessel 22 is about
22 1.5 feet.

23 Removal of accumulated particulates is conducted periodically with
24 the vessel 22 shut in, adjacent the inlet 24 and outlet 26, and depressurized.
25 Conveniently, access can be through a pressure-rated access closure and port at

1 the lower end 42, as the angle of repose and flow in the belly portion carries
2 particulates thereto. A suitable closure is shown in Fig. 1 of the prior art and in
3 Fig. 7 as adapted to the inclined desander 20. The vessel 22 is supported
4 sufficiently high of the ground or otherwise positioned for angular access thereto,
5 such as with scrapers and the like. A pressure vessel, hemispherical head-form
6 of closure 60 can be pivoted from the vessel 22 and counterweighted to close
7 flush to the inclined cylindrical end of the vessel 22. A gantry 62 assists in
8 manipulation of the head for access to the belly portion 40.

9 Further, the illustrated vessel 22 includes an eccentric end 64 at the
10 lower end 42, to reduce the diameter of the vessel 22 downstream of the fluid
11 outlet 26. Advantages of reducing the vessel diameter at the lower end 42
12 include adapting to a smaller, more easily manageable or standard form of clean
13 out. As shown the cleanout is a pressure-rated closure 60 supported upon gantry
14 62. In this embodiment, a 36 inch vessel, having 33 inch internal diameter, is
15 inclined at 4 degrees. The cylindrical portion of the vessel is about 20 feet long
16 with a 3 foot long eccentric portion, reducing the diameter from 3 to about 18
17 inches for fitting an 18 inch clean out.

18 Conventional pressure safety valves and other gas phase related
19 devices and instrumentation, not shown, are reliably located in the freeboard
20 portion 44 between the fluid outlet 26 and the upper end 25.

21

1 **THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE**
2 **PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:**
3

4 1. A desanding system for receiving a gas stream containing entrained
5 liquid and particulates comprising:

6 a vessel elongated along a longitudinal axis and having a fluid inlet adjacent
7 a first end of the vessel and a fluid outlet spaced along the longitudinal axis from the fluid
8 inlet towards a second end of the vessel, said vessel being inclined from a horizontal at a
9 non-zero inclination angle at all times during operation such that the fluid outlet is lower
10 than the fluid inlet, the fluid inlet discharging the gas stream into the vessel at an inlet
11 velocity, the gas stream travelling down the inclined vessel to the fluid outlet, the vessel
12 having:

13 a gas/liquid interface formed at the fluid outlet having a belly storage portion
14 formed therebelow and a freeboard portion formed adjacent an upper portion of the vessel
15 above the interface, the freeboard portion having a freeboard cross-sectional area which
16 diminishes along the inclined vessel from the fluid inlet to the fluid outlet; and

17 the freeboard portion at the fluid inlet causing the gas stream to have a
18 freeboard velocity adjacent the fluid inlet which is less than the velocity of the fluid in the
19 inlet, wherein

20 the freeboard velocity is such that the entrained liquids and particulates fall
21 out of the gas stream and collect in the belly storage portion, and

22 wherein a desanded gas/liquid stream flows out of the freeboard portion
23 and out the fluid outlet, being free of a substantial portion of the particulates, and
24 particulates accumulate in the belly portion for flowing downvessel towards said second
25 end.

1 2. The desanding system of claim 1 wherein the fluid inlet has a
2 discharge end, the discharge end oriented for discharging the gas stream into the
3 freeboard portion.

1 3. The desanding system of claim 2 wherein the discharge end of the
2 fluid inlet directs the gas stream into the freeboard portion and parallel to the longitudinal
3 axis.

4

5 4. The desanding system of any one of claims 1 to 3 wherein the fluid
6 inlet further comprises a replaceable nozzle having a discharge end oriented for
7 discharging the gas stream into the freeboard portion.

8

9 5. The desanding system of claim 4 wherein the replaceable nozzle is
10 connected to the fluid inlet at a flange.

11

12 6. The desanding system of claim 1 wherein the gas stream emanates
13 from a wellhead and the fluid inlet further comprises:

14 a discharge end for directing the gas stream into the freeboard portion and
15 parallel to the longitudinal axis; and

16 a receiving end for receiving the gas stream and orthogonal to the wellhead.

17

18 7. The desanding system of claim 1 further comprising:

19 a conduit for conducting a fluid stream containing entrained particulates
20 from a wellhead, the conduit having a desander end; and

21 wherein the fluid inlet further comprises a discharge end for directing the
22 fluid stream into the freeboard portion and oriented parallel to the longitudinal axis, and a
23 receiving end for receiving the gas stream and oriented orthogonal to the desander end.

24

1 8. The desanding system of any one of claims 1 to 7, wherein the
2 inclination angle is variable for varying fluid stream conditions.

3

4 9. The desanding system of any one of claims 1 to 8 wherein said
5 gas/liquid interface is formed during operation, the gas/liquid interface extending
6 horizontally from about the fluid outlet.

7

8 10. The desanding system of any one of claims 1 to 9 wherein said the
9 cross-section area of the freeboard portion is at its greatest adjacent the fluid inlet.

10

11 11. The desanding system of any one of claims 1 to 10 wherein said
12 inclination angle is between about 2 degrees and about 20 degrees.

13

14 12. The desanding system of any one of claims 1 to 11 further
15 comprising: an access closure at said second end for removal of accumulated particulates.

16

17 13. The desanding system of any one of claims 1 to 12 wherein said
18 vessel has a smaller diameter downstream of the fluid outlet than the diameter of other
19 portion of the vessel.

20

21 14. The desanding system of claim 13 wherein second end of the vessel
22 is an eccentric end.

23

24 15. A method for desanding a fluid stream emanating from a wellhead,
25 the fluid stream containing gas, entrained liquid and particulates, the method comprising:

26 providing an elongated vessel having a longitudinal axis, a fluid inlet
27 adjacent a first end of the vessel and a fluid outlet spaced along the longitudinal

1 axis from the fluid inlet;
2 inclining the vessel at angle from horizontal at a non-zero inclination angle
3 so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid
4 outlet;
5 discharging the fluid stream from the fluid inlet, into the inclined vessel and
6 substantially parallel to the longitudinal axis for
7 establishing a liquid interface in a belly portion of the vessel, the
8 belly portion being formed below the fluid outlet, and
9 directing the liquid and particulates along a trajectory in the
10 freeboard portion of the vessel to intercept a substantial portion of the particulates
11 at the liquid interface for storage in the belly portion; and
12 recovering a desanded gas stream at the fluid outlet which is substantially
13 free of particulates.

14

15 16. The method of claim 15 further comprising:
16 varying the liquid interface.

1 17. The method of claim 16 further comprising:
2 varying the inclination angle for varying the liquid interface.

3

4 18. The method of claim 15 further comprising:
5 accumulating particulates in said belly portion; and
6 periodically removing accumulated particulates.

7