Title: DEGASSER CONTROL MEANS

Abstract: Degasser with control means, comprising: a pipe formed separation chamber with an upstream end where fluid that is passed in by use of a spin element in the upstream end is set into rotation and separated into; a heavier fraction that essentially is accumulated along the inner pipe wall of the separation chamber and is taken out through an outlet in a downstream end of the separation chamber; an a lighter fraction essentially accumulated along the longitudinal axis of the separation chamber, from where an outlet pipe is arranged for delivery of the lighter fraction to; a control separator arranged to separate out any entrained heavier fraction from the lighter fraction, which entrained heavier fraction is taken out through a pipe from a bottom zone filled with heavier fraction in the control separator, preferably for delivery thereof to the heavier fraction from the separation chamber, while the lighter fraction is taken out from the control separator through a separate outlet pipe. The degasser is distinguished by an orifice/nozzle with differential pressure transmitter for transmitting the differential pressure over the orifice/nozzle arranged in the outlet pipe for the lighter phase from the separation chamber to the control separator, said differential pressure being used as basis for controlling a valve arranged in said outlet pipe.
Degasser control means

Field of the invention

The present invention relates to separation of fluids of different density in a flowing multiphase mixture, such as separation of liquid and gas. More particularly the invention relates to a control system for a degasser arranged in a pipeline for multiphase fluid that preferably contains a substantial amount of liquid in form of hydrocarbons and/or water, from which gas is to be removed.

Field of the invention and prior art

The present invention is particularly useful to achieve preferable operation of degassers and similar separation devices. A degasser is a type of cyclonic separator that functions according to the cyclone principle that is using the centripetal forces in a rotating fluid flow. More particularly lighter components will be deflected easier than heavier components, such that in a rotating fluid flow the lighter components will accumulate centrally while the heavier components accumulate along the periphery. A degasser that is particularly relevant in connection with the present invention is described in the international patent publication PCT/NO00/00224.

The degasser according to the above-mentioned publication is a device for separation of a fluid flowing through a pipeline, to a lighter fraction and a heavier fraction, in which device the fluid flow is set into rotation so that it is separated into a central zone essentially containing the lighter fraction and an outer annular zone essentially containing the heavier fraction, from which zones fluid fractions are taken out via respective outlet arrangements. More specifically, the degasser according to the above-mentioned publication is distinguished in that it is comprising an essentially tubular casing arranged to constitute a section of the pipeline proper, a spin element for rotation of the fluid flow being located at the upstream end of the casing, and the outlet means for the central zone comprising a discharge element arranged downstream of the spin element and having entry openings for discharge of the light fraction and possibly entrained heavier fraction from the central zone,

a control separator connected to the discharge element and arranged to separate entrained heavier fraction from the light fraction, the separator being provided with an outlet for separated heavier fraction, and an outlet for the light fraction, and

a control system comprising a level transmitter for indication of the level of separated heavier fraction in the separator, and a level control unit connected to the level transmitter and to a drain valve in the outlet of the separator for light fraction, and in cooperation with the valve seeing that the separated heavier fraction in the separator being
kept at a constant level corresponding to the maximally allowed, entrained quantity of the heavier fraction in the light fraction.

Unless else is specified the lighter fraction will generally consist of gas and the heavier fraction will generally consist of liquid, even though in principle all fluids of different density can be separated by the degasser, for example separation of glycol from oil.

The above described degasser is aimed operated such that as much gas as possible is passed to the control separator, but not so much that disproportional amounts of liquid are entrained with the gas. For a further description of the degasser reference is made to the above-mentioned publication.

Unfortunately it has appeared that by operation of the above-mentioned degasser an unfavourable tendency exists for flooding of the control separator, which is considered due to inappropriate function of the control system. Therefore a control system has been invented to be used with the degasser to avoid the tendency of flooding. Said improved control system is distinguished in that it is comprising:

- a differential pressure transmitter for indication of differential pressure between the zones for the lighter fraction in the separation chamber and the control separator, said differential pressure being used as basis for regulating a valve in the outlet pipe for the lighter fraction from the control separator, and

- a level transmitter for indication of the level of the heavier fraction in the control separator, said level being used as basis for regulating a valve in the outlet pipe for the heavier fraction from the control separator.

Reference is made to the patent publication NO 20025841 for further details on the improved control system.

A demand still exists for improvements, both with respect to the degasser and the control system of the degasser.

Summary of the invention

The aim of the present invention is to meet the above mentioned demand, which is achieved by providing a degasser with control means, comprising

- a pipe-formed separation chamber with an upstream end where fluid flow that is passed in by use of a spin element in the upstream end is set into rotation and separated into a heavier fraction that in principle is accumulated along the inner pipe wall of the separation chamber and is taken out through an outlet in a downstream end of the separation chamber, and

- a lighter fraction that in substance is accumulated along the longitudinal axis of the separation chamber, from where an outlet pipe is arranged for delivery of the lighter fraction to
a control separator that is arranged to separate out optionally entrained heavier fraction from the lighter fraction, which entrained heavier fraction is taken out through an outlet pipe from a bottom area filled with heavier fraction in the control separator, preferably for delivery thereof to the heavier fraction from the separation chamber, while the lighter fraction is taken out from the control separator through a separate outlet pipe.

The degasser with control means is distinguished in that it is comprising:

an orifice/nozzle with differential pressure transmitter for transmitting the differential pressure over the orifice/nozzle arranged in the outlet pipe for the lighter phase from the separation chamber to the control separator, said differential pressure being used as basis for controlling

a valve arranged in said outlet pipe.

Preferably at least a part of the outlet pipe for the lighter fraction from the separation chamber to the control separator is arranged as a riser, separating said units, and preferably an orifice with a differential pressure transmitter for transmitting the differential pressure is arranged in the riser, said differential pressure being used for automatic regulation of a valve arranged in the riser. Said embodiment is particularly practical and economically beneficial to manufacture and operate.

In a preferred embodiment at least one orifice with differential pressure transmitter for transmitting differential pressure is arranged in the inlet to the outlet pipe for the lighter phase from the separation chamber to the control separator, said differential pressure being used for automatic regulation of a valve arranged in a part of the outlet pipe that is arranged as a riser. Said embodiment is particularly beneficial as the signals for control are provided as early as possible in the separation process.

The differential pressure can preferably be measured directly over the valve arranged in the outlet pipe for the lighter phase from the separation chamber to the control separator, said embodiment resulting in reduced equipment requirement.

The degasser according to the invention preferably comprises means for automatic gas takeoff, means for automatic liquid drainage and means for automatic protective functions, such that automatic operation is possible.

The degasser according to the invention is preferably an inline-degasser, such that the separation chamber constitutes a section of the pipeline per se. The control separator is preferably as small as possible (cf. the previously mentioned publications for further details) and significantly smaller than conventional separators. Thus very beneficial separation effect is achieved in relation to weight and volume of the equipment, and downstream located separation devices can be scaled down.

Drawings

The present invention is illustrated by way of figures, of which
Fig. 1 illustrates a basic embodiment of the degasser with control means according to the present invention,

Fig. 2 illustrates a fully equipped embodiment of the degasser with control means according to the present invention.

Detailed description

Reference is first made to Fig. 1 that illustrates the basic construction of a compact inline degasser with field instruments. A part of the outlet pipe for the lighter fraction from the separation chamber is illustrated arranged as a riser separating the separation chamber from the control separator. In the riser an orifice is arranged with a differential pressure transmitter for transmitting the differential pressure over the orifice, said differential pressure being used as basis for regulating a valve in the riser to regulate the flow rate of the lighter phase from the separation chamber to the control separator. As the density of gas is far less than the density of liquid, entrainment of liquid with a lighter phase from the separation chamber will result in a dramatic increase in differential pressure over the orifice, which dramatic increase in differential pressure results in the valve FV 100 in the riser being choked to avoid entrainment of liquid. On Fig. 1 this is illustrated with the symbol FC connected between the differential pressure transmitter DPT 100 and valve FV 100. With the expression that an orifice/nozzle with differential pressure transmitter for transmitting a differential pressure over the orifice/nozzle is arranged in the outlet pipe for the lighter phase from the separation chamber, it is meant that the measurement of differential pressure either is over an orifice, over intake holes or at least one nozzle in the inlet to the central outlet pipe for the lighter phase, or that the differential pressure is measured directly over the valve in the outlet pipe.

As described in the previously referred patent publications the degasser is operated as far as possible with optimum gas takeoff, which means that as much gas is taken out that an increase in the gas takeoff will result in a significant increase in the water amount that is entrained, but with very little effect with respect to further gas takeoff.

The original control structure for the degasser, described in the above mentioned international patent publication, was operated by adjustment of the separation effect by adjusting the flow rate of water drained out via valve FV 200, in addition to keeping the level in the control separator even by adjusting a valve FV 400 based on a level controller installed with the control separator. The volume of the control separator resulted in a significant inertia in the system with respect to control, in addition to a general non-linearity for differential pressure with respect to liquid entrainment in the area between 80 % and 100 % efficiency for the separation.
For a further description of the degasser with control means reference is made to Fig. 2 that illustrates a compact inline degasser with control means, in a fully equipped embodiment that represents the most preferred embodiment of the invention.

The retroactive flow controller FC 100 manipulates valve FV 100 to maintain a steady-state multiphase flow into the axial outlet pipe from the separation chamber, which is achieved based on measured differential pressure over the orifice. By a dramatic increase in differential pressure the set point for FC 100 must be adjusted, which can be undertaken automatically. Optimization of the gas takeoff must be considered in connection with the control of the liquid level in the control separator. To avoid emptying of the control separator the drained water must be replaced such that a liquid balance is maintained. Therefore level controller LC 100 A is arranged, connected to level transmitter LT 100 in the control separator and flow controller FC 100, as illustrated on Fig. 2. LC 100 A will automatically compensate for a decreasing level L 100 in the control separator by increasing the set point for FC 100, which will result in increased quantity of gas and entrained liquid to the control separator.

Liquid drainage from the control separator takes place via valve FV 200 and control thereof, which in principle takes place by flow transmitter FT 200 connected to flow controller FC 200 that again controls valve FV 200. Drainage of liquid from the control separator results in a decreased liquid level L 100 in the control separator, why the previously described level controller LC 100 A will undertake opening of valve FV 100 such that an increased flow rate of liquid arrives the control separator and the level in the control separator is re-established. The flow rate of liquid drained from the control separator will typically be in the range 5% to 10% of the total flow rate of liquid through the liquid outlet from the degasser. At steady-state flow rate of liquid through the degasser also the liquid drainage F 200 from the control separator can be kept at steady-state. If the total flow rate of liquid F 300 through the degasser varies, F 200 can be controlled in relation to F 300, such as indicated by connections between the flow transmitters FT 300 and FT 200 on Fig. 2.

The pressure in the control separator must be kept sufficiently high for the liquid to be passed from the control separator to the outlet pipe for the heavier phase from the degasser, and not the opposite way. This is achieved by controlling valve FV 400 such that it is sufficiently choked for the pressure in the scrubber to be at least as high as the pressure in the outlet pipe for the heavier phase from the degasser. More precisely this is achieved by connection from valve FV 400 to transmitters for flow in the outlet pipe for the lighter phase from the control separator, the pressure transmitter in the control separator (the connection is not illustrated on Fig. 2) and the connection via ZC 200 to the valve in the outlet pipe for the heavier phase from the control separator.

The degasser with control means is protected against liquid flooding and gas passage. The protective functions are arranged both to avoid closing downstream located
equipment, to protect connected control means and to provide possibility for automatic start and stop.

By using the retroactive level controller LC 100 B acting on valve FV 400 via flow controller FC 400, as illustrated on Fig. 2, flooding of the control separator and liquid in the outlet for the lighter phase (gas) from the control separator is avoided.

Control conflict between LC 100 A and LC 100 B is avoided by setting the set point for LC100 B higher than the set point for LC 100 A. At said flooding protection either pressure controller PC 500 (not illustrated on Fig. 2) or alternatively control unit ZC 200 is overridden by LC 100 B.

By further flooding of the control separator valve XV100 will be closed, after which valve FV 400 also will be closed to protect connected equipment.

The degasser is also protected against passage of gas into the outlet for the heavier phase. If the liquid level L 100 in the control separator becomes sufficiently low the level controller LC 100 C will override the further control structure to choke valve FV 200 to avoid gas passage into the outlet pipe for the heavier phase from the degasser, as illustrated on Fig. 2 with connections between said units.

In principle the level controller LC 100 C can be combined with the level controller LC 100 B by being configurated as a level range controller, as LC 100 B also is to act on valve FV 400 if L 100 > L 100 HH and on FV 200 if L 100 < L 100 LL, as described above.

As mentioned the embodiment illustrated on Fig. 2 is considered the most preferred embodiment, since available microprocessor based control systems contain the functionality for monitoring and control of all the described variables. The cycle time for the control loops should preferably not be slower than 0.5 second. In particular this is true for the control loop with FC 100/LC 100, which represents the fastest control function.

All control means are preferably arranged with bumpless transfer between the different modes of operation, manual, automatic and cascade.

In addition to the control means described here, control means as described in the above mentioned patent publications can be implemented.
Claims

1. Degasser with control means, comprising
   a pipe formed separation chamber with an upstream end where fluid that is passed in by
   use of a spin element in the upstream end is set into rotation and separated into
   a heavier fraction that essentially is accumulated along the inner pipe wall of the
   separation chamber and is taken out through an outlet in a downstream end of the
   separation chamber, and
   a lighter fraction that essentially is accumulated along the longitudinal axis of the
   separation chamber, from where an outlet pipe is arranged for delivery of the lighter
   fraction to
   a control separator arranged to separate out any entrained heavier fraction from the
   lighter fraction, which entrained heavier fraction is taken out through an outlet pipe from
   a bottom zone filled with heavier fraction in the control separator, preferably for delivery
   thereof to the heavier fraction from the separation chamber, while the lighter fraction is
   taken out from the control separator through a separate outlet pipe,
   characterized in that
   an orifice/nozzle with differential pressure transmitter for transmitting differential
   pressure over the orifice/nozzle is arranged in the outlet pipe for the lighter fraction from
   the separation chamber to the control separator, said differential pressure being used as
   basis for controlling
   a valve arranged in said outlet pipe.

2. Degasser according to claim 1,
   characterized in that at least a part of the outlet pipe for the lighter fraction from the
   separation chamber to the control separator is arranged as a riser separating said units.

3. Degasser according to claim 2,
   characterized in that
   an orifice with differential pressure transmitter for transmitting the differential
   pressure is arranged in the riser, said differential pressure being used for automatically
   controlling
   a valve arranged in the riser.

4. Degasser according to claim 1,
   characterized in that at least one measurement nozzle with differential pressure
   transmitter for transmitting the differential pressure is arranged in the inlet to the outlet
pipe for the lighter phase from the separation chamber to the control separator, said differential pressure being used for automatically controlling a valve arranged in the part of the outlet pipe arranged as a riser.

5. Degasser according to claim 1, characterized in that the differential pressure is measured directly over the valve arranged in the outlet pipe for the lighter phase from the separation chamber to the control separator.

6. Degasser according to anyone of the preceding claims, characterized in that it comprises means for automatic gas takeoff, means for automatic liquid drainage and means for automatic protective functions.

7. Degasser according to anyone of the preceding claims, characterized in that it is an inline degasser, such that the separation chamber constitutes a section of the pipeline per se.

8. Degasser according to anyone of the preceding claims, characterized in that the control separator is as small as possible and far smaller than conventional separators.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01D 17/02, B01D 19/00, B04C 3/06, B04C 11/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B01D, B04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search: 17 June 2004

Date of mailing of the international search report: 21-06-2004

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