

This Sheet Has Been Replaced



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10Background of the Invention1. Field of the Invention

This invention relates to a pipeline and has particular
5 reference to a pipeline for transporting a congealable
solution of cellulose in an aqueous organic solvent.

The term "congealable solution" as used herein means a
solution which, as a consequence of changes in temperature,
pressure, flow, or degradation can result in the formation
10 of a substantially solid, substantially unmovable product.

The invention has particular application to congealable
solutions of cellulose susceptible to exothermic reactions,
such as congealable pastes or slurries. The invention has
further particular application to a pipeline for the
15 transport of mixtures of cellulose, a tertiary amine n-oxide
and a non-solvent for cellulose, such as water.

2. Description of the Related Art

It is well known to incorporate into pressure vessels
a safety pressure relief device. A common form of safety
20 pressure relief device is a bursting disc. A bursting disc
essentially comprises a membrane which is relieved, either
by bursting open or being blown out of its holder, or both,
under the action of a pressure greater than the normal
operating pressure for the pressure vessel but below the
25 pressure at which the vessel itself will rupture.

Bursting discs are conventionally mounted in small pipe
spurs located off of a pressure vessel or are formed as part
of the wall(s) of the pressure vessel.

It has now been discovered that there may be particular
30 problems with a pipeline used for transporting a congealable
solution of cellulose where an excess pressure may arise in



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the transport pipeline itself. The present invention is concerned with the provision of an over-pressure relief device for a pipeline for transporting a congealable solution where there is a possibility that an excess
5 pressure may arise within the congealable solution. The excess pressure may arise within the pipeline itself or may be the result of a rise in pressure external to the pipeline.

Summary of the Invention

10 According to one aspect of the present invention there is provided a pipeline for the transport of a congealable solution of cellulose in an aqueous organic solvent, the pipeline being provided with at least one over-pressure relief device comprising a disc displaceable under the
15 action of pressure to form a vent for the pipeline, characterised in that the disc is positioned in the pipeline so that a part at least of the surface of the disc is washed by the solution passing through the pipeline.

The disc is preferably a bursting disc and may be
20 mounted in a holder inserted into a branch off the pipeline, so that the surface of the disc is in part substantially flush with the inside of the wall of the pipeline. The branch may have a flange, and the holder may have a cooperating flange, the two flanges being secured together,
25 preferably by being bolted together. The bursting disc may be of stainless steel and may be welded (e.g. electron beam welded) to the bottom of the holder.

The branch may further extend into a contained receptacle area downstream of the flange into which
30 congealed solution may be expelled in the event of bursting of the bursting disc. Desirably the branch is maintained at a temperature of above 80°C.

The invention has particular utility where the



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congealable solution is susceptible to exothermic reactions, and particularly in the case of a mixture of cellulose and a tertiary amine n-oxide, optionally with water. The tertiary amine n-oxide may be an n-morpholine n-oxide.

5 By "washed" as used herein is meant that at least a part of the surface of the disc is kept substantially free of congealed material in the event that conditions conducive of congealing of the solution arise in the pipeline. Essentially the bursting disc is so mounted in the pipeline
10 that there is no significant "dead space" between the disc and the flow of congealable solution within the pipeline, so that congealed material is not able to build up and form a plug which would impede (or at worst prevent) operation of the disc in the event of an over-pressure appearing within
15 the pipeline. If congealing does arise, degradation of the congealed product may occur, and if this degraded material is carried into the main solution stream it can either block up downstream filters or will reduce the quality of a final product made from the solution, and may prevent the relief
20 of pressure through the bursting disc due to the presence of the degraded product.

The invention also extends to a method of transporting a congealable solution of cellulose in an aqueous tertiary amine oxide as featured in claim 9.

25 Brief Description of the Drawing

By way of example, an embodiment of the present invention will now be described with reference to the accompanying drawing, of which:

Figure 1 is a schematic view of a pipeline including a
30 branch and flange,

Figure 2 is a partial cross-section of Figure 1 incorporating a bursting disc and not being in accordance



with the invention,

Figure 3 is a cross-section similar to Figure 2, but in accordance with the invention, and

Figure 4 is an enlarged view of the portion within the circle IV of Figure 3.

Description of the Preferred Embodiment

Figure 1 illustrates a pipe 1 through which is transported a congealable solution. In particular the pipe 1 may be used to transport a solution of cellulose in a tertiary amine oxide such as n-methyl morpholine n-oxide. The solution may further include a small quantity of water. The solution may be manufactured by the process described in US-A-4,246,221.

The solution passing through the pipe 1 will congeal in the event that the solution cools sufficiently (it is normally pumped through the pipe at a temperature in the range 100 to 120°C). The solution, being an organic solution, may also decompose to form a hard compound which can adhere to the inside wall surface of the pipe.

In order that there may be a protection against sudden increases in pressure in the pipe, for example, by way of an exothermic reaction within the solution, there is provided one or more over-pressure relief devices in the pipeline.

Over-pressure relief devices are, of course, well known. For example the pipe 1 may be provided with a branch 2 having an integral flange 3 as shown in Figure 1 and an over-pressure relief device could be attached to the flange 3.

Figure 2 shows a conventional over-pressure relief device arrangement in which a bursting disc, in the form of



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a flat plate 4, is clamped between the flange 3 and the flange 5 on a dump tube 6 by means of bolts 7. It has been discovered, however, that such an arrangement is unreliable for use with congealing or congealable materials particularly those materials subject to very rapid increases in pressure as a result of an exothermic reaction within the materials. It has been found that the arrangement illustrated in Figure 2, although perfectly satisfactory for gases or liquids, may not react satisfactorily when used with congealable solutions. It has been found that with the arrangement illustrated in Figure 2 there can be a failure of the bursting disc to open in the event of an over-pressure within the pipe 1. The solution to this problem is provided by the arrangement illustrated in Figures 3 and 4.

15 In Figure 3 the pipe 1 is again provided with a branch 2 and a flange 3. The bursting disc is, however, provided on a "top hat"-shaped structure 17 bolted to the flange 3. The structure 17 illustrated in Figures 3 and 4 comprises a flanged portion 8 integral with a tubular member 9 welded to the bottom end 10 of which is a bursting disc 11 of stainless steel. Further details of the bottom of the tubular member 9 and the bursting disc 11 can be seen from Figure 4. It can be seen that the end 10 has a rebated portion 12 into which the bursting disc 11 is fitted prior to electron beam welding from the underside as shown in Figure 4 where the melted-together materials forming the weld are shown by the black triangle 12a. The disc may be flat, or convex or concave as required but must have part of its undersurface "washed" by the solution flowing in the pipe 1.

The bursting disc 11 if flat will, therefore, be effectively continuous with the inside of the wall 1a of the tube 1 only along a line. However, because the bursting disc 11 is along that line in contact with solution flowing through the pipe 1, the solution continuously washes some part of the surface of the bursting disc 11 and prevents



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deposits building up on it. With the arrangement illustrated in Figure 2 material can build up in the dead space 13 of the branch 2 and can either congeal or can decompose and form a solid adherent block within the dead 5 space. In the event of an over-pressure appearing within the pipe 1, this block can prevent bursting of the disc 4. By comparison with the arrangement illustrated in Figures 3 and 4, the surface of the disc 11 is always kept clear of deposit at least in part, and, therefore, at least some part 10 of the disc 11 is always exposed to the true pressure of the material within the pipe 1 and is thus ready to burst in the event of the appearance of the protected-against over-pressure within the pipe 1.

The flange 8 of the top hat structure 17 may be clamped 15 between the flange 3 and a further flange 14 attached to a dump tube 15. The dump tube 15 should be above 80°C (e.g. it may be heated to 100°C) and connected to a suitable receptacle (not shown), utilising expansion bellows if required, to contain product released in the event of an 20 over-pressure within the pipe 1 bursting open the disc 11. If required the space 16 within the structure 17 may be filled with nitrogen. A bursting disc detector may be mounted in the space 16.

Surprisingly, it has been discovered that provided the 25 temperature of a congealable solution of cellulose in an aqueous tertiary amine oxide - typically n-methyl morpholine n-oxide - is kept above 80°C, the pressure relief devices can be located at considerable distances apart along the length of a pipeline used to transport the solution

30 It is believed that this possibility for using widely spaced pressure relief devices arises because the result of an exothermic reaction within the pipeline is to give an impulse to the contents of the pipeline. As the cellulose solution forms a thixotropic dope, the impulse tends to 35 reduce the viscosity of the dope and permit gases from the



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site of the exothermic reaction or ("exotherm") to pass down the thusly-thinned material. The action of movement within the dope increases the reduction in viscosity thereby setting up a bore within the dope flowing in the pipeline.

5 Unexpectedly it has been discovered, therefore, that it is possible to mount the over-pressure relief devices as far apart as 27 metres and thus as far away from a potential exotherm as 13.5 metres and still obtain safe venting of the product. It may be possible to mount the devices even

10 further apart and thus even further away from a potential exotherm, such as for example 30 metres. Typically it would be preferred to provide an over-pressure relief device close to a potential source of an exotherm but because of the ability of the dope with which this invention is

15 particularly concerned to form cores within itself under exothermic conditions, it is possible to vent safely over much longer distances than might have been expected.

CLAIMS

1. A pipeline for the transport of a congealable solution of cellulose in an aqueous organic solvent wherein the pipeline is provided with at least one over-pressure relief device comprising a disc displaceable under the action of pressure to form a vent for the pipeline, characterised in that the disc is positioned in the pipeline so that a part at least of the surface of the disc is washed by the solution passing through the pipeline.
- 10 2. A pipeline as claimed in claim 1, characterised in that the disc is a bursting disc mounted in a holder inserted into a branch of the pipeline so that the surface of the disc is in part substantially flush with the inside of the wall of the pipeline.
- 15 3. A pipeline as claimed in claim 2, characterised in that the branch further extends into a contained receptacle area downstream of the holder into which solution may be expelled in the event of bursting of the bursting disc.
- 20 4. A pipeline as claimed in claim 3, characterised in that the extension of the branch is maintained at a temperature in excess of 80°C.
- 25 5. A pipeline as claimed in claim 1, characterised in that a plurality of said over-pressure relief devices are provided, these being separated by a distance in the range 0.5 to 30 metres.
6. A pipeline as claimed in claim 2, characterised in that the branch is provided with a flange, the holder has a co-operating flange and the two flanges are clamped together.
- 30 7. A pipeline as claimed in claim 2, characterised in that the disc is of stainless steel.



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8. A pipeline as claimed in claim 7, characterised in that the disc is electron beam welded into said holder.

9. A method of transporting a congealable solution of cellulose in an aqueous tertiary amine oxide, through a pipeline, characterised in that the solution is maintained at a temperature in excess of 80°C and said pipeline includes at least one over-pressure relief device, the device comprising a surface displaceable under the action of pressure to form a vent for the pipeline, the surface being mounted in the pipeline so that part at least of the surface is washed by the solution passing through the pipeline.

10. A method as claimed in claim 9, characterised in that said disc is formed as a bursting disc mounted in a holder inserted into a branch of said pipeline, the surface of said disc lying in part substantially flush with the inside of the wall of said pipeline.