

Method and mould assembly for rotation moulding a pipe part with a spigot end, as well as pipe part obtained therewith.

The invention relates to a method of rotation moulding a pipe part having a main body and a spigot end.

Rotation moulding of pipe parts is known. Rotation moulding allows for considerable freedom of design. It moreover may be a cost effective moulding method where the number of pipe parts to be made is relatively low and/or their size is relatively large.

A disadvantage of rotation moulding is that some outer dimensions of the pipe part may be hard to control. During cool off, the pipe part will inevitably shrink, causing its outer surface to back away from the mould. As a result, said outer surface may become deformed. This may in particular cause problems where said outer surface is part of one or more dedicated sections that in use are to effect a close fit with an external part, such as a socket or a seal.

Embodiments of the invention seek to provide a method of rotation moulding a pipe part with a spigot end, wherein the disadvantage of known rotation moulding methods is overcome or at least reduced.

To that end, a support structure is provided in the pipe part during rotation moulding. This support structure is arranged to keep an outer contour of the or each dedicated section of a spigot end into contact with the mould, at least during cool off, so that said outer contour conforms to the inner contour of the mould. Since the mould's inner contour can be accurately manufactured, the outer contour of the dedicated section will be accurately controlled as well.

According to the first aspect of the invention, there is provided a method of making a pipe part comprising a main body and a spigot end, said spigot end having at least one dedicated section with an outer contour that in use is to effect a close fit with an external part, wherein the pipe part is rotation moulded in a mould , and wherein at least during cool-off a support structure is provided in the pipe part, which support structure keeps the dedicated section into contact with the mould, so as to have the outer contour of the dedicated section conform to the inner contour of the mould, wherein the support structure extends along an inner side of the dedicated section, the dedicated section comprises a circumferential groove, and the support structure is locally bonded to the dedicated section in the area of said groove.

According to an embodiment of the invention, the support structure may be a separate component that is removed or separated from the pipe part when this pipe part is released from the mould. Alternatively, the support structure may become part of the pipe part during moulding. This provides the advantage that after removal of the mould, the support structure may continue

to support the dedicated section so as to prevent or limit undesired deformation thereof during use.

According to another embodiment of the invention, the support structure can be rotation moulded against a core. As a result the support structure can be moulded simultaneously with the pipe part and form an integral part thereof. The core will prevent inward shrinkage of the support structure. The support structure, in turn, can act on the dedicated section(s) of the spigot end so as to maintain an outer contour thereof into contact with the mould.

The core thus permits the pipe part to be locally provided with an additional wall or a wall of increased wall thickness. It permits material to be added where needed and allows the remainder of the pipe part to be single walled. Thus, material may be saved.

A second aspect of the invention relates to a pipe part obtainable or obtained with a rotation moulding method according to the first aspect of the invention. Such pipe part comprises a spigot end with at least one dedicated section and a support structure that extends along an inner side of said dedicated section. Thanks to the support structure, the outer contour of said dedicated section can be accurately controlled during moulding, as explained above, thereby allowing said dedicated section to effect a close fit with an external component. Where said external component is a seal, said seal may no longer have to be unduly complex or oversized as it will have little dimensional inaccuracies to overcome.

The support structure can be designed to merely bear against the dedicated section. According to an advantageous embodiment, the support structure is at least locally bonded to said dedicated section. This may contribute to the overall stiffness of the spigot end. It may furthermore enhance the reproducibility of the dedicated section, because at the bonded regions, the total wall thickness will be about twice the wall thickness of the single walled pipe portions. In general, such larger wall thickness will result in less shrinkage, when measured in absolute values. As a result, the deviation

margin on said shrinkage will be smaller as well, resulting in better reproducibility.

According to a further embodiment of the invention, the support structure may be formed as a circumferential wall or rib that is closed in itself. Such ring shaped structure may add to the overall stiffness and form stability of the spigot end. Preferably, the circumferential wall or rib is connected to the dedicated section along its entire circumference, for optimal stiffness.

According to yet a further embodiment of the invention, the dedicated section(s) and/or the support structure may be adjoined by a double walled pipe portion. Such double walled pipe portion may add to the overall stiffness and form stability of the pipe part. It may for instance be formed between extended portions of the support structure and the dedicated section.

In a preferred embodiment, the free end of the spigot end may be double walled. Such double walled design may provide for a form stable spigot end that can be readily inserted in a socket end.

According to another embodiment of the invention, the main body of the pipe part can be single walled. Such single wall may be smooth or profiled, e.g. corrugated. The profiling may enhance certain mechanical properties of the pipe part, such as its radial stiffness and/or its resilience in axial direction, while at the same time keep the wall thickness, and hence the weight per meter, a minimum. The corrugations may in particular be advantageous where the pipe part is going to be used underground, e.g. as sewer pipe or as shaft of an inspection chamber assembly. The corrugations may fill up with soil and thus help to anchor and stabilize the pipe part in the ground.

According to yet another embodiment of the invention the pipe part may further comprise a socket end with a dedicated section that has an inner contour that, in use, is to effect a close fit with an external part, such as a spigot end or a seal. This dedicated section may along its outer side be provided with a reinforcement structure that reinforces said dedicated section and as such limits deformation of its inner contour.

The reinforcement structure may be similar to the support structure in the spigot end, so as to provide similar advantages. According to an advantageous embodiment, the reinforcement structure may be bonded to the dedicated section at staggered regions that together span the entire circumference of said dedicated section but without forming a closed ring. This is described in further detail in NL 1036127 of applicant, the contents of which are incorporated herein by reference. Such staggered arrangement may reinforce the dedicated section, while at the same time ensure that all parts of the mould remain accessible for filling during rotation moulding, in particular those parts of the mould that in fill direction are located behind said staggered regions.

Alternatively, the bonded regions may be arranged to form one closed ring. This may cause parts of the rotation mould to be prematurely blocked for further filling, which may result in said parts being only partly filled. This in turn may result in the pipe part having parts of reduced wall thickness. This does not have to be a problem, depending on the location of said thin walled part(s) and/or the function thereof. Generally, a bonded region of closed ring configuration may be more appropriate for a spigot end than for a socket end.

A third aspect of the invention relates to a mould assembly for rotation moulding a pipe part according to the second aspect of the invention. The assembly comprises a mould against which the dedicated section is formed and a core against which the support structure is formed. In assembled condition, a gap is formed between the core and the mould, which is dimensioned such that during moulding the support structure is at least locally bonded to the dedicated section, thereby forming a so called kiss-off.

In a preferred embodiment, the mould may be of modular design, comprising at least a primary module for forming a spigot end according to embodiments of the invention and several secondary modules for forming the main body. These secondary modules may each have the same axial length or a different axial

length. Any number of said modules can be combined to form a mould of a desired axial length. Thanks to such modular design, pipe parts of various desired lengths may be produced with a minimum of different mould parts. The mould assembly may comprise a further module for forming a socket end,
5 or a second primary module for forming a second spigot end.

Further advantageous embodiments of a method, a pipe part and a mould assembly according to the invention are set forth in the dependent claims.

To explain the invention, exemplary embodiments thereof will
10 hereinafter be described with reference to the accompanying drawings, wherein:

FIG. 1 shows in perspective, partly cut-away view a pipe part with a spigot end according to the invention;

FIG. 2 shows a close up of the encircled part in Figure 1;

15 FIG. 3 schematically shows part of a mould assembly according to the invention, for making the pipe part of Figures 1 and 2;

FIG. 4 shows a close up of the encircled part in Figure 3;

FIG. 5 shows a shaft with a pipe part according to the invention; and

FIG. 6 shows in exploded view an inspection chamber assembly, of
20 which the respective components may be provided with a pipe part according to the invention.

Figures 1 and 2 show a pipe part 1 according to the invention with a main body 2 and a spigot end 3.

The main body 2 comprises a circumferential wall 4 which in the
25 illustrated embodiment is corrugated to enhance certain mechanical properties of the pipe part 1, such as its radial stiffness. Other profiles are of course possible. The wall 4 may alternatively or additionally be reinforced with ribs. The circumferential wall 4 could also be smooth.

The spigot end 3 comprises a dedicated section 5 with an outer
30 contour 6 that in use is to effect a close fit with an external component, such as

a socket or a seal. In the present embodiment, the dedicated section 5 comprises a circumferential groove 7 for accommodating a seal (not shown). The groove 7 is substantially W-shaped, in cross sectional view. Of course, other shapes are possible, so as to correspond to the shape of the external
5 component with which a close fit is to be effected.

The spigot end 3 further comprises a support structure 8 that during moulding of the pipe part 1 helps to control the outer contour 6 of the dedicated section 5 by keeping it into contact with the inner contour of a mould. In the illustrated embodiment, the support structure 8 comprises a
10 circumferential wall 10 that bears against an inner side of the dedicated section 5. The circumferential wall 10 may at its axial inner end 11 be curved radially inward, as shown. Such curved design may add to the stiffness and form stability of the support structure 8. The circumferential wall 10 may at its opposite end be extended with a wall portion 12 that delimits a hollow,
15 double walled pipe portion 14, together with an extended wall portion 13 of the dedicated section 5. In the illustrated embodiment, the hollow pipe portion 14 extends up to a free end 15 of the spigot end 3 so as to form a hollow edge portion 16. Such double walled pipe portion 14, 16 may enhance the overall stiffness and form stability of the spigot end 3. The double walled edge portion
20 16 moreover may have a rounded end surface which may facilitate insertion of the spigot end 3 into a socket end or seal. Of course, in other embodiments the edge portion 16 of the spigot end 3 may be single walled and/or shaped differently.

In a preferred embodiment, the circumferential wall 10 of the
25 support structure 8 does not just bear against the dedicated section 5, but is bonded thereto as well. For maximum stiffness and support, the bonded region(s) 18 may extend along the entire circumference uninterruptedly, so as to form a closed ring. In the embodiment according to Figures 1 and 2, the support structure 8 is bonded to the dedicated section 5 along two bonded
30 regions 18, each spanning the entire circumference. Alternatively, bonding

may take place along discrete regions 18. This may be advantageous during rotation moulding of the pipe part 1, because the non-bonded portions between the bonded regions 18 will form openings that allow for complete filling of the mould. Such discrete bonded regions 18 may for instance be arranged in a staggered way, as described in NL 1036127 of applicant. Such configuration allows the entire circumference to be spanned by the bonded regions 18, which is beneficial for the overall stiffness of the configuration, but without compromising the filling behaviour of the mould.

Figures 3 and 4 schematically show a mould assembly 20 according to the invention, with a moulded pipe part 1 inside. The mould assembly 20 comprises a mould 22 and a core 24. The mould 22 is substantially cylindrical of shape with an inner contour that basically corresponds to the outer contour 6 of the pipe part 1 to be moulded. The mould 22 is at its shown end surrounded by a flange 23. The mould 22 further comprises at its inner side, near said open end, a circumferential rib 25 with a substantially W-shaped cross section for forming the dedicated section 5.

The core 24 is substantially hat shaped, with a top surface 26, a circumferential wall 28 that slopes downward from said top surface 26 and a flange 29 that surrounds the circumferential wall 28 near its bottom edge. The top surface 26 is covered with a top plate or a top layer 27 of a material with low heat conductivity and/or poor adherence properties, such as for instance Poly-Tetra-Fluor-Ethene (PTFE). Alternatively or additionally, the top surface 26 and/or top layer 27 may be provided with a cooling means, for instance a circulation system filled with a coolant so as to prevent said top surface 26, 27 from becoming hot when the remainder of the mould assembly 20 is heated.

In use, the core 24 is mounted in the open end of the mould 22 and fixated with its flange 29 to the flange 23 of the mould 22. In this mounted condition, a gap 30 is formed between the circumferential wall 28 of the core 24 and the circumferential rib 25 of the mould 22. The width T of this gap 30 may vary in axial and/or circumferential direction but is, at least at some

locations, equal to or smaller than twice the wall thickness t of the single walled portions of the pipe part 1.

Once assembled, the mould assembly 20 is filled with a plastic in powder form. Next the assembly 20 is heated and rotated so as to distribute the powder along its inner wall and cause it to melt. Thus, a layer of melted plastic will form along the inner side of the mould assembly 20 with a layer thickness t . In the gap 30, a layer of plastic material will form against the rib 25 so as to form the dedicated section 5. Another layer of plastic material will form against the core 24 so as to form the support structure 8. There where the width T of the gap 30 is sufficient small, i.e. less than twice the layer thickness t , a kiss-off will be formed, wherein the support structure 8 and the dedicated section 5 will locally melt together so as to become bonded to one another. No plastic layer will be formed against the top layer 27 of the core 24, because its surface temperature will be too low to have the plastic melt and adhere thereto.

Next, the mould assembly 20 is cooled down, causing the plastic layer to solidify and shrink away from the mould 22. However, in the gap 30, the dedicated section 5 is prevented from backing away from the mould 22 by the support structure 8, which in turn is prevented from shrinking inward by the core 24. As a result, the outer contour 6 of the dedicated section 5 will maintain its moulded shape, as determined by the inner contour of the mould 22, more particularly rib 25. In addition, absolute shrinkage will be smaller at the bonded regions 18 than at the single walled portions due to the increased wall thickness at said bonded regions. As a result, the deviation margin on the shrinkage will be smaller as well, resulting in better reproducibility.

After cool-off, the core 24 is removed. At the location of the top layer 27, an opening will have formed in the pipe part 1. As the support structure 8 will have solidified by then, it will be able to take over the task of the core 24 and prevent deformation of the dedicated section 5. Next, the mould 22 is

removed. To that end, the mould 22 may be composed of at least two segments, which may be pulled away in a substantially radial direction.

Figure 5 shows a shaft 30 comprising a pipe part 1 with a spigot end 2 similar to that shown in Figures 1 and 2. Like parts are denoted with like reference numerals. The shaft 30 is at its other end provided with a socket end 32. This socket end 32 comprises a dedicated section 35 with an inner contour that has accurately controlled dimensions so as to effect a close fit with an external part, e.g. a seal or a spigot end. This dedicated section 35 may for instance feature a smooth surface or a groove for accommodating a seal (not shown). During rotation moulding, the inner contour will bear against a core, which will prevent shrinkage of the dedicated section 35. Accordingly, during moulding, no support structure is needed to keep the dedicated section into contact with the core because this happens already naturally. However, the socket end 32 may be provided with a reinforcement structure 38, as shown, that may provide for reinforcement and support of the dedicated section 35 once the shaft has been removed from the mould assembly. The reinforcement structure 38 may comprise one or more circumferential ribs that bear against the dedicated section 35 and preferably are bonded thereto, at least locally.

According to a preferred embodiment, the reinforcement structure 38 may be bonded to the dedicated section 35 along staggered bonded regions that together span the entire circumference, but without forming a closed ring, as described in the aforementioned patent application NL 1036127 and as best seen in Figure 6, indicated with reference numerals 39. Thanks to the staggered arrangement, the dedicated section 35 may be adequately reinforced. At the same time, complete filling of the mould will remain possible during rotation moulding, even those parts of the mould that in fill direction are located behind said bonded regions, i.e. the parts of the mould in which edge portion 34 of the socket end 32 of Figure 5 is formed.

Of course, in an alternative embodiment, the reinforcement structure 38 may be bonded to the dedicated section 35 along its entire

circumference so as to form a closed ring. Such closed ring generally offers maximum stiffness and form stability to the dedicated section 35. However, filling of the mould may become more difficult, in that the aforementioned parts of the mould could become prematurely cut off from filling. This may
5 result in the edge portion 34 having a wall of reduced thickness.

The shaft of Figure 5 may for instance form part of an inspection chamber assembly 40 as shown in Figure 6, which may further comprises a bottom part 42 and a transition part 44.

The bottom part 42, in the illustrated embodiment comprises a
10 circumferential wall 43 with one or more openings 46 for connection to a pipe of for instance a sewer system. The bottom part 42 may further comprise a bottom (not visible in Figure 6) and/or a flow profile, e.g. a channel that connects the respective openings 46 with one another. The circumferential wall 43 is at its upper end provided with a socket end 32, comparable to the one
15 shown and described with reference to Figure 5. Like parts have been denoted with like reference numerals. In an alternative embodiment, the circumferential wall 43 can be provided with a pipe part 1 according to the invention, with a spigot end 3 replacing the socket end 32. Such pipe part could be rotation moulded as described with reference to Figures 3 and 4.

20 The transition part 44 serves to connect the bottom part 42 or the shaft 30 to an access provision at street level (not shown) and to overcome any diameter differences between said parts. To that end, the transition part 44 comprises a first end 47 for connection to the shaft 30 and a second end 48 for connection to said access provision. In the illustrated embodiment, said first
25 and second ends 47, 48 are both shaped as sockets, which may be similar to the ones 32 of the bottom part 42 and the shaft 30 of Figure 5. In an alternative embodiment, one or both sockets could be replaced by a pipe part 1 with a spigot end 3 according to the invention, which could be rotation moulded as described before, with reference to Figures 3 and 4.

The shaft 130 in Figure 6 is at both ends provided with a pipe part 1 according to the invention. The main body 2 of the shaft 130 is of corrugated configuration. These corrugations offer the advantage that during installation they may fill up with sand or soil, which may help to anchor the assembly, and
5 also may increase its resistance against external loads, such as traffic load. Of course, in alternative embodiments, the shaft 130 could be smooth or profiled differently.

The shaft 130 may further serve to adjust the overall height of the inspection chamber assembly 40 so as to match the intended installation
10 depth. Therefore, in practice, shafts 30 of different heights may be needed. To produce such shafts 30 in an economical way, a mould assembly according to the invention may be of modular configuration, comprising a primary module for forming the spigot end 3, and a number of secondary modules for forming the main body 2. Any suitable number of secondary modules may be combined
15 so as to compose a mould assembly of a desired axial length. Thus shafts 130 of different heights can be moulded, with a minimum of different modules. The mould assembly may further comprise an additional primary module and/or one or more tertiary modules for forming a socket end 32.

The invention is not in any way limited to the exemplary
20 embodiments presented in the description and drawing. All combinations (of parts) of the embodiments shown and described are explicitly understood to be incorporated within this description and are explicitly understood to fall within the scope of the invention. Moreover, many variations are possible within the scope of the invention, as outlined by the claims.

Claims

1. Method of making a pipe part comprising a main body and a spigot end, said spigot end having at least one dedicated section with an outer contour that in use is to effect a close fit with an external part, wherein the pipe part is rotation moulded in a mould , and wherein at least during cool-off a support structure is provided in the pipe part, which support structure keeps the dedicated section into contact with the mould, so as to have the outer contour of the dedicated section conform to the inner contour of the mould, wherein
the support structure extends along an inner side of the dedicated section,
the dedicated section comprises a circumferential groove, and
the support structure is locally bonded to the dedicated section in the area of said groove.
2. Method according to claim 1, wherein the support structure becomes part of the pipe part during moulding.
3. Method according to claim 1 or 2. wherein the support structure is integrally moulded with the pipe part.
4. Method according to anyone of the preceding claims, wherein the support structure is rotation moulded against a core.
5. Pipe part obtainable or obtained with a method according to anyone of the preceding claims.
6. Pipe part according to claim 5, wherein the support structure comprises a circumferential wall or rib.
7. Pipe part according to anyone of claims 5 and 6, wherein the dedicated section and/or the support structure are adjoined by a single walled pipe portion, as seen in axial direction.
8. Pipe part according to anyone of claims 5 to 7, wherein the main body is single walled.

9. Pipe part according to anyone of claims 5 to 7, wherein the main body has a corrugated wall.
10. Pipe part according to anyone of claims 5 to 9, wherein the dedicated section and/or the support structure are adjoined by a double walled pipe portion, as seen in axial direction.
11. Pipe part according to anyone of claims 5 to 10, wherein the free end of the spigot end is double walled.
12. Pipe part according to anyone of claims 5 to 11, wherein the pipe part is part of an inspection chamber assembly, more particularly part of a shaft, a bottom part and/or a transition part of such inspection chamber assembly.
13. Pipe part according to anyone of claims 5 to 12, further comprising a socket end with a dedicated section of which the inner contour, in use, is to effect a close fit with an external part, wherein the dedicated section along its outer side is provided with a reinforcement structure that during use limits deformation of the dedicated section, in particular its inner contour.
14. Pipe part according to claim 13, wherein the reinforcement structure comprises a circumferential wall or rib.
15. Pipe part according to claim 13 or 14, wherein the reinforcement structure is bonded to the dedicated section along staggered regions that together span the circumference of the dedicated section, but without forming a closed ring.
16. Mould assembly for rotation moulding a pipe part according to anyone of the preceding claims 5 to 15, wherein the assembly comprises a mould against which at least the dedicated section is formed and a core against which the support structure is formed, wherein in assembled condition, a gap is formed between the core and the mould which is dimensioned such that during moulding the support structure is at least locally bonded to the dedicated section.

17. Mould assembly according to claim 16, wherein the core-mould combination is designed such that during moulding a circumferential bonded region is formed between the support structure and the dedicated section.

- 5 18. Mould assembly according to claim 16 or 17, wherein the mould is of modular design, comprising a primary module for forming the spigot end and a series of secondary modules for forming the main body, wherein any number of secondary modules may be combined so as to form a mould of a desired axial length.