

Plastic plate for lining concrete components

The invention relates to a plastic plate for lining concrete components, in particular concrete pipes, through which a flowable medium flows. Furthermore, the invention relates to an arrangement of plastic plates for lining concrete components.

For the purpose of lining concrete containers which contain liquid or gaseous chemicals, plastic plates are known which protect the concrete against the chemicals. Such plastic plates are repeatedly glued to the concrete component. Since the smooth surface of the plastic plates does not, however, enter into a firm mechanical connection with the concrete, there is a risk of the plastic plates becoming detached in the course of time.

There are known from WO 01/57340 A1 plastic plates which comprise a plurality of anchoring elements on the side facing the concrete component, said anchoring elements entering into a form-fit connection with the concrete during concreting. The anchoring elements are embodied as splayed wing elements which have support webs in their foot region.

The plastic plates with anchoring elements known from WO 01/57340 A1 have been tried and tested in practice for the lining of concrete containers which need to be protected against chemicals. Pipelines which convey a flowable medium, i.e. a liquid or gaseous medium, could in principle also be lined with the known plastic plates.

In order to offer the least possible resistance to the medium, an attempt is made in principle to design the surface of the lining as smooth as possible. The drawback, however, is that solid bodies which are contained in the medium can become deposited in the course of time at the pipe wall, especially in the region of pipe bends and branches as well as in sections with a reduced or widened cross-section. The deposits number among the typical damage patterns, especially in mixed sewage systems which are subjected to extreme fluctuations in the flow volume.

There is known from EP 1 194 712 B1 a pipeline whose wall has a structured surface, which comprises a plurality of parallelepiped- or pyramid-shaped raised portions. It has been shown that with the structured surface a boundary layer is formed at the pipe wall, the effect of which is that the capacity for entraining particles carried along in the medium is increased. The tendency for particles to adhere to the wall is accordingly greatly reduced. This effect is generally referred to as an increase in the entrainment effect of the particles carried along in the medium.

EP 1 194 712 B1 proposes either providing the wall of the pipe with the structured surface or pulling into the pipe a tubular stretched film or plate insert which is glued to the pipe.

The problem underlying the invention is to line in a straightforward manner concrete components of differing design through which a flowable medium flows, in such a way that the concrete components are protected against aggressive media, without the risk of particles contained in the media becoming deposited at the wall of the concrete components.

According to the invention, the solution to this problem takes place with the features of claims 1 and 22 respectively.

In order to line the concrete components, use is made according to the invention not of a tubular film or plate insert, but of plastic plates which are connected to one

another to form a body which lines the component. Since the plastic plates have a sufficient flexibility, there is the possibility of lining not only rectangular, but also tubular concrete components. After the insertion of the plastic plates into the concrete component, the plates are preferably welded together.

The plastic plate according to the invention has on the side facing the medium a plurality of flow elements arranged beside one another, which are embodied as raised structures with an upstream flank pointing in the flow direction and a downstream flank pointing against the flow direction, wherein the surface areas lying between the flow elements are smooth. The entrainment effect of particles carried along in the medium is thus increased even at low flow rates and with a discontinuous operation. On the side facing away from the medium, the plastic plate has a plurality of anchoring elements, so that the plastic plate can be connected in a form-fit manner to the concrete component.

It has been shown in numerous tests that the entrainment effect of the particles carried along in the medium can be increased if the raised structures offer a certain resistance to the flowable medium. This is achieved by the fact that the raised structures are embodied by an upstream flank pointing in the flow direction and a downstream flank pointing against the flow direction. This effect occurs especially when the flanks of the flow elements pointing in the flow direction are steeper than the flanks pointing against the flow direction. The flow elements thus exhibit a wedge-shaped cross-section. It has proved to be advantageous if the upstream flanks of the flow elements pointing in the flow direction form an angle of 70 to 90°, preferably 80 to 90°, in particular approx. 90°, with the smooth surface areas of the plastic plate. The downstream flanks of the flow elements pointing against the flow direction preferably form an angle of 30 to 60°, also preferably 40 to 50°, in particular approx. 45°, with the smooth surface areas of the plastic plate.

In a preferred embodiment, the plastic plate is divided into two halves, the flow elements being arranged in a mirror-inverted fashion on the two halves. The flow

elements are preferably arranged beside one another in individual rows in each case on a common axis. It has proved to be advantageous for the distance between the flow elements on a row to be smaller than that of the length of the flow elements.

In another preferred embodiment, the flow elements are embodied as elongated raised portions. Elongated raised portions are understood to mean raised portions which have an extension in the longitudinal direction that is a multiple of the extension in the transverse direction. The flow elements embodied as elongated raised portions preferably taper to a point at the ends. It is however also possible for the flow elements to be rounded off at the ends.

It has been shown in tests that a particularly great entrainment effect can be achieved if the longitudinal axes of the flow elements embodied as elongated raised portions form an angle of 30 to 60°, also preferably 40 to 50°, in particular approx. 45°, with the longitudinal direction of the plastic plates, which runs in the flow direction of the flowable medium. The elongated raised portions are preferably arranged in individual rows in each case on a common axis, the plastic plates preferably being divided into two halves on which the flow elements are arranged in a mirror-inverted fashion. A rib-shaped surface structure with narrow webs is thus created, wherein the axes on which the elongated raised portions lie run obliquely to the flow direction.

Further preferred configurations of the flow elements and the anchoring elements are the subject-matter of the sub-claims.

An example of embodiment of the invention is explained in detail below by reference to the drawings.

In the figures:

Fig. 1 shows a cutout of a plastic plate according to the invention in plan view,

Fig. 2 shows a section through the plastic plate from fig. 1 along line A-A in an enlarged representation,

Fig. 3 shows a section through the plastic plate from fig. 1 along line B-B in an enlarged representation,

Fig. 4 shows an enlarged cutout of the plastic plate from fig. 1 in plan view,

Fig. 5 shows a side view of adjacent anchoring elements of the plastic plate from fig. 1 in an enlarged representation and

Fig. 6 shows an enlarged cutout of the plastic plate from fig. 1 in a view from beneath.

Fig. 1 shows a cutout of the plastic plate according to the invention in plan view. The plastic plate is made of a thermoplastic material, in particular PVC, PE, PP, PVDF and ECTFE. The thickness of the plastic plate amounts to 1 to 5 mm, preferably 2 to 4 mm, so that on the one hand it exhibits sufficient strength, but on the other hand also sufficient flexibility for bending. In the example of embodiment, the plate is 2 mm thick. It can be made available as a strip material in different lengths.

The plastic plate has at side 1A facing the medium a region 1 with a structured surface, which is adjoined on both sides by non-structured smooth regions 2, which verge into smooth welding edges 3 at the upper and lower side. The surface structure, which occupies the major part of the total surface of the plastic plate, is

embodied by a plurality of flow elements 4 which are each arranged beside one another in individual rows IV.

Flow elements 4 are embodied as elongated raised portions, which taper to a point at the ends. They form narrow webs which are in one piece with the plastic plate. The narrow webs have a height of 2 to 8 mm, preferably 3 to 7 mm, also preferably 4 to 6 mm. In the example of embodiment, the narrow webs have a height a of approx. 5 mm. The webs have a length b of 20 to 140 mm, also preferably 40 to 120 mm, also preferably 60 to 100. In the example of embodiment, the narrow webs have a length of 85 mm. They preferably have a width c of 1 to 40 mm. The width of the webs is approx. 5 mm in the example of embodiment.

Region 1 with the structured surface is divided into a left-hand half 1' and a right-hand half 1''. Narrow webs 4 are orientated in the left-hand and right-hand half in a mirror-inverted fashion with respect to longitudinal axis 5 of the plastic plate. Longitudinal axes 6 of all the webs form an angle α of 30 to 60°, preferably 50 to 45°, with longitudinal axis 5 of the plastic plate, which corresponds to the flow direction of the medium. The angle is approx. 45° in the example of embodiment.

The longitudinal axes of webs 4 arranged in each case in a row IV lie on a common axis. Spacing d of webs 4 lying on common axis 6 is smaller than length b of the webs. Spacing e between individual rows IV of the webs is smaller than length b of the webs, but larger than spacing d between the webs.

Webs 4 arranged in left-hand and right-hand half 1', 1'' of the plastic plate are orientated in such a way that they point in flow direction 9. The webs each have an upstream flank 4A pointing in flow direction 9 and a downstream flank 4B pointing against the flow direction. The decisive factor is that flank 4A pointing in the flow direction is steeper than the flank pointing against the flow direction. In this regard, the webs have a wedge-shaped cross-section. In the example of embodiment, flanks 4A of the webs pointing in the flow direction form an angle of approx. 90° with the

surface of the plastic plate. Flanks 4B of webs 4 pointing against the flow direction form an angle of approx. 45° with the surface of plastic plate 1 in the example of embodiment. Flanks 4A pointing in the flow direction terminate at the foot point in a small radius, whereas flanks 4B pointing against the flow direction end in a sharp edge (fig. 3).

Rear side 1B of the plastic plate facing the concrete component is described below by reference to figs. 5 and 6. At the rear side, plastic plate 1 has, except in the region of welding edges 3, projecting anchoring elements 10 which are in one piece with the plastic plate. The anchoring elements located solely at the rear side of the plate are represented in outline in fig. 1. Anchoring elements 10 are embodied in each case as two splayed wing elements 11, 12, which are connected to one another by a support web 13. Wing elements 11, 12 transform continuously at the foot point in an arc 14 into the plastic plate. A relatively wide connection area of the wing elements with the plastic plate thus results. The height of support webs 13 amounts to at least 70%, preferably at least 80%, of the height of the wing elements. The wing elements in each case forming an anchoring element 10 are arranged offset with respect to one another.

The embodiment of anchoring elements 10 at the rear side of plastic plate 1 is described in detail in WO 01/57340 A1, to which reference is expressly made for the purpose of the disclosure.

The plastic plate is a co-extruded plate, which comprises a sandwich structure with a first layer comprising the flow elements (4) and a second layer comprising the anchoring elements (9). The first and second layer are made from materials with different mechanical and/or chemical and/or optical properties. The first layer with flow elements 9 is made from a coloured plastic material, whereas the second layer with the anchoring elements is made from a non-coloured plastic material. It is therefore possible in a straightforward manner to monitor optically the wear on the first layer coming into contact with the medium. Thus, on the basis of the colour, it

can be detected whether the first layer has been worn away. This monitoring can take place with a camera. Furthermore, the plastic material of the first layer is more abrasion-resistant than the material of the second layer.

For the lining of concrete components, in particular concrete pipes, the individual plastic plates are placed into the formwork of the concrete pipe and welded at their welding edges 3 to form a tubular lining. During concreting, the plastic plates are connected to the concrete component in a form-fit manner by means of anchoring elements 10. An increased long-term strength is achieved by this anchoring. Flow elements 4 at the inside of the tubular lining increase the entrainment effect of the particles carried along in the medium and thus prevent the formation of deposits at the inner side of the pipe.

The decisive advantage of the plastic plate according to the invention lies in the fact that concrete components can be lined cost-effectively in a straightforward manner, a high long-term strength and entrainment effect being achieved. It should be noted that the increase in the entrainment effect with the preferred embodiment of the flow elements has its own inventive significance. This is because it would in principle also be possible to fix the plastic plates to the concrete component in a different manner from that with the anchoring elements. The increased long-term strength would not then be produced, but the advantage of the increased entrainment effect would take effect.

Patent Claims

1. A plastic plate for lining concrete components through which a flowable medium flows, wherein the side (1A) of the plastic plate facing the wall of the concrete component has a plurality of anchoring elements (10), so that the plastic plate can be connected in a form-fit manner to the concrete component,
characterised in

that the side (1B) of the plastic plate facing the medium has a plurality of flow elements (4) arranged beside one another, which are embodied as raised structures with an upstream flank (4A) pointing in the flow direction (9) and a downstream flank (4B) pointing against the flow direction, wherein the surface areas of the plastic plate lying between the flow elements are smooth, so that the entrainment effect of particles carried along in the medium is increased, and

the longitudinal axes (6) of the flow elements (4) are embodied as elongated raised portions and form an angle of 30 to 60°, preferably 40 to 50°, in particular approx. 45°, with the longitudinal axis (5) of the plastic plate.
2. The plastic plate according to claim 1, characterised in that the upstream flanks (4A) of the flow elements (4) pointing in the flow direction (9) are steeper than the downstream flanks (4B) pointing against the flow direction.
3. The plastic plate according to claim 1 or 2, characterised in that the upstream flanks (4A) of the flow elements (4) pointing in the flow direction (9) form an angle of 70 to 90°, preferably 80 to 90°, in particular approx. 90°, with the smooth surface areas of the plastic plate.

4. The plastic plate according to any one of claims 1 to 3, characterised in that the downstream flanks (4B) of the flow elements (4) pointing against the flow direction (9) form an angle of 30 to 60°, preferably 40 to 50°, in particular approx. 45°, with the smooth surface areas of the plastic plate.
5. The plastic plate according to any one of claims 1 to 4, characterised in that the plastic plate is divided into two halves (1, 1'), the flow elements (4) being arranged in a mirror-inverted fashion on the two halves.
6. The plastic plate according to any one of claims 1 to 5, characterised in that the flow elements (4) are arranged beside one another in individual rows (IV) in each case on a common axis (6).
7. The plastic plate according to any one of claims 1 to 6, characterised in that the spacing (d) between the flow elements (4) on a row (IV) is smaller than the length (b) of the flow elements.
8. The plastic plate according to any one of claims 1 to 7, characterised in that the common axes (6) on which the flow elements (4) are arranged form an angle of 30 to 60°, preferably 40 to 50°, in particular approx. 45°, with the longitudinal axis (5) of the plastic plate.
9. The plastic plate according to claim 1, characterised in that the flow elements (4) embodied as elongated raised portions taper to a point at the ends.
10. The plastic plate according to claim 1, characterised in that the flow elements (4) embodied as elongated raised portions have a height (a) of 2 to 8 mm, preferably 3 to 7 mm, also preferably 4 to 6 mm, in particular approx. 5 mm.

11. The plastic plate according to claim 1, characterised in that the flow elements (4) embodied as elongated raised portions have a length (b) of 20 to 140 mm, preferably 40 to 120 mm, also preferably 60 to 100 mm, in particular approx. 80 mm.
12. The plastic plate according to claim 1, characterised in that the flow elements (4) embodied as elongated raised portions have a width of 1 to 40 mm, preferably 1 to 10 mm, in particular approx. 5 mm.
13. The plastic plate according to any one of claims 1 to 12, characterised in that the anchoring elements (10) are embodied as splayed wing elements (11, 12), which have support webs (13) in their foot region.
14. The plastic plate according to claim 13, characterised in that the height of the support webs (13) amounts to at least 70%, preferably at least 80%, of the height of the wing elements (11, 12).
15. The plastic plate according to claim 13 or 14, characterised in that the wing elements (11, 12) have arc-shaped transition portions (14) in their foot region.
16. The plastic plate according to any one of claims 13 to 15, characterised in that in each case two wing elements (11, 12) are arranged offset with respect to one another and are connected to one another by at least one support web (13).
17. The plastic plate according to any one of claims 1 to 16, characterised in that the plastic plate has welding edges (3), at which the sides (1A, 1B) of the plastic plate facing towards and facing away from the medium are smooth.

18. The plastic plate according to any one of claims 1 to 17, characterised in that the plastic plate comprises a sandwich structure with a first layer comprising the flow elements (4) and a second layer comprising the anchoring elements (9).
19. The plastic plate according to claim 18, characterised in that the first and second layer are made from materials with different mechanical and/or chemical and/or optical properties.
20. An arrangement of plastic plates according to any one claims 1 to 19, wherein the plastic plates are connected to one another to form a body which lines the component.