

## Resistance controlled sacrificial anode

The invention concerns a resistance controlled sacrificial anode for use inside pipe systems. Such an anode is fastened on a blind flange for installation in pipe nozzles, according to the  
5 preamble of patent claim 1.

### Background

Corrosion of metal structures which are laying in the ground or in water may be reduced or stopped by means of cathodic electro protection. According to known techniques, this may be  
10 carried out by establishing a small electrical current from a source outside the structure being corroded. In the case of cathodic electro protection, the current is passed through an anode. The current passing from the anode to the structure to be protected, also passes through an electrolyte, and the current maintains the structure cathodically, at the sacrifice of the anode. The anode will be progressively dissolved (sacrificed), so that the corrosion of the structure will be limited.

15 It is also known that these anodes may be resistance controlled, inter alia from Norwegian Patent Application nr. 911193 "Metode og arrangement for å hindre lokal korrosjon og galvanisk korrosjon i forbindelse med rustfritt stål og andre passive materialer" (eng. translation: "Method and arrangement to prevent local corrosion and galvanic corrosion in connection with stainless steel and other passive materials"), and the publication "Internal cathodic protection of seawater  
20 piping system by the use of the RCP method", R. Johnsen, P.O. Gartland, S. Valen and J.M. Drugli: NACE Corrosion '96, Paper No 559, Denver, Colorado, March 1996.

The presently available equipment for interior cathodic protection of pipe systems, for installation on blind flanges in pipe nozzles, are sold under the trademark RCP™ by the firm Corrocean ASA (Trondheim, Norway). This equipment is characterized in that the anode mass is  
25 moulded on a pole being fastened in the anode holder, which in turn is imbedded in an epoxy mass. Thus, the anode mass can not be replaced separately, and the anode must be replaced with a new complete anode with the same specific resistance, installed on a new blind flange.

It is further a problem that each sacrificial anode has a specific resistance. This means that, in pipe systems comprising a number of different anodes, one has often the need to keep storage  
30 of one spare anode for each anode.

When the anode mass in a sacrificial anode is consumed, the whole anode must be replaced with a new complete anode.

## Object

The main object of the present invention, is to provide a resistance controlled sacrificial anode that is simple to replace, and cost effective. Another object of the invention, is that the resistance of the anode should be easy to regulate or replace, without having to change or remove  
5 the whole anode.

## The invention

The object is fulfilled with a sacrificial anode according to the characterizing part of patent claim 1. Further advantageous features are stated in the dependent claims.

10 The sacrificial anode according to the present invention, comprises a replaceable unit to which the anode mass is fastened, or the anode mass itself constitutes the replaceable unit. In the following description, the phrase "anode mass unit" will be used to describe a unit comprising inter alia anode mass, or just anode mass. It will save cost to just replace the anode mass unit, compared to changing the whole anode, because the client avoids buying a whole new anode  
15 when the anode mass is consumed. It is only necessary to purchase a new replaceable unit, comprising a new anode mass.

The anode according to the present invention is fastened to a blind flange for installation in pipe nozzles, as with other known sacrificial anodes. The replaceable anode mass unit is provided with means suited for cooperation with corresponding means on an anode holder, the  
20 anode holder is in most cases fastened permanently to the blind flange. These means may be all releasable fastening means known to a person skilled in the art. However, the fastening means must also be sufficiently strong so that the unit comprising the anode mass does not unfasten from the anode holder unintentionally.

The anode according to the present invention has an adjustable or replaceable resistance on  
25 the outside of the blind flange, so that it may be replaced or changed without having to remove the anode from the pipe. Replacement of anode mass and replacement or adjusting of the resistance on the anode may be performed by ordinary maintenance workers, without special training. The benefits of a replaceable anode mass unit and a replaceable or adjustable resistance on the outside of the flange, are large cost savings at logistics, standardized anode mass and  
30 continued use of the expensive parts of the anode.

### Example

The invention will be described below with reference to a figure, showing a cross section of a preferred embodiment of a sacrificial anode according to the invention, mounted on a blind flange.

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A sacrificial anode according to the present invention, is fastened to a regular blind flange 1, known to persons skilled in the art, for example of the type ANSI B16.5. On the side of the blind flange 1 facing into the pipe, is fastened an anode holder 2, electrically insulated from the blind flange. In the illustrated example, the anode holder 2 comprises a protruding part with the shape  
10 of a cylinder, but the anode holder may have any shape suited to receive and hold the anode mass unit. The holder is provided with threads 15 at a distal end of the protruding part, and a tapered expansion 16 towards the blind flange, at the end of the protruding part fastened to the blind flange. In the embodiment shown by Figure 1, the anode holder 2 comprises mainly the protruding part and a flat area, onto which the tapered expansion 16 ends. The flat area forms a  
15 fastening area for fastening devices 3, with which the anode holder 2 is fastened to the blind flange 1.

The anode mass 5 constitutes the main part of the replaceable unit, the anode mass unit, and is in the illustrated case moulded around a sleeve 6. The anode mass unit may also comprise just the anode mass 5. In the case shown, the anode mass unit (that is the anode mass 5 and the sleeve  
20 6) has the shape of a cylinder with a through hole, the hole being centered axially. The diameter of the hole in the anode mass 5, i.e. in the sleeve 6 in the case shown, must be larger than the outer diameter of the protruding part of the anode holder 2, because the protruding part is supposed to project through the hole. In cases where the anode mass 5 is moulded on a sleeve 6, as shown in Figure 1, it advantageous if the sleeve is provided with means 17 to reinforce the  
25 fastening of the anode mass 5.

The end of the protruding part of the anode holder 2, being provided with threads 15, is lead through the hole in the anode mass 5, i.e. in the sleeve 6 in the illustrated embodiment, until the anode mass or the sleeve is bearing against the tapered expansion 16 of the protruding part of the anode holder 2. In the case shown, the anode mass is locked in this position by a fastening means  
30 having interior threads in a hole or groove, such as a nut 8, which is fastened in the threads 15 on the end of the protruding part of the anode holder 2, turning away from the blind flange 1. The outer diameter of the fastening means 8 should be larger than the diameter of the hole in the

anode mass 5, i.e. the sleeve 6. If a washer between the fastening means 8 and the anode mass unit is used, the outer diameter of the fastening piece may of course have any size.

In order to secure electric connection between the anode mass 5, the sleeve 6 (if any), and the anode holder 2, it may be advantageous to place a cone 7, with an axially centred through-hole, between the anode mass 5 and the nut 8. The largest diameter of the cone 7 must be larger than the diameter of the hole in the anode mass 5, meaning the hole in the sleeve 6 in the illustrated example. The tapered end of the cone is received turning into the hole. In cases where such a cone 7 is being used, the nut 8 may have any size of the outer diameter.

When changing the anode mass 5, the blind flange 1 is removed from the pipe nozzle, the nut 8 and the cone 7 (if any), are removed from the anode holder 2, and a new anode mass 5 is threaded onto the anode holder 2. In cases where the anode mass is moulded on a sleeve 6, as shown in Figure 1, the old sleeve must be removed before a new anode mass is threaded onto the anode holder 2.

Secured in the part of the anode holder fastened to the blind flange 1, is an electrical conductor 9. The conductor 9 passes electrically insulated through the blind flange 1, to a replaceable or adjustable resistance 10, via a resistance holder 14. The resistance holder 14 is fastened to the blind flange 1, on the side facing out of the pipe line, for example with screws 11. A conductor of electricity connects the resistance 10 to the blind flange 1, and thereby earthing the electrical circuit to the surface of the blind flange. Thus, a continuous electric circuit is established, from the anode mass 5, to the blind flange 1, through a resistance 10, and the current and consumption of anode mass 5 will be limited by the resistance 10. In order to simplify replacement of the resistance 10, it is advantageous that the conductors to and from the resistance 10, are coupled through electrical contacts in the resistance holder 14. An adjustable resistance 10, or other electronic components may also be used suited to limit the current, for example a diode, or a combination of resistance and diode in series, or parallel.

With good electrical connection between the anode mass 5 or the sleeve 6, and the anode holder 2, a continuous circuit through the pipe wall, the fluid in the pipe, the anode mass 5, the sleeve 6 (if any), the anode holder 2, the conductor 9, the resistance 10 and the blind flange 1, will be established. The blind flange is in contact with the pipe wall.

If the anode holder 2 is not electrically insulated from the blind flange 1, the anode will be short-circuited. The anode mass will then be consumed very rapidly, and would need to be replaced before long. The Figure shows a solution to this, by fastening the anode holder 2 to the blind flange 1, via an insulating plate 4, with insulating fastening devices 3. The conductor 9

from the anode holder 2 to the resistance 10, may be insulated or lead through a pressure barrier. In both cases there must be a gasket, for example one or more O-rings 18 between the anode holder 2 and the resistance holder 14, in order to prevent leakage through the blind flange 1.

It is an advantage if the anode is provided with an outer mantel 13, of a non-conducting material, such as plastic. This mantel 13 prevents the anode mass 5 from getting in touch with the pipe walls in the pipe nozzle, in which the blind flange 1 is installed, for example if parts of electrical conducting material jam between the anode mass and pipe wall. This would short-circuit the electrical circuit, so that the current is no longer limited by the resistance. The mantel 13 may be fastened to the plate 4, between the anode holder 2 and the blind flange 1, for example if the plate were circular and provided with threads on the vertical edge. Use of such a mantel is known in the art.

The anode mass 5 may advantageously be coated with a non-conducting material (not shown) on the outside, with the exception of the side turning away from the blind flange 1, towards the pipe. Such a coating will ensure that the anode mass 5 is consumed from the top, in a controlled manner. The non-conducting coating may for example be an epoxy paint or similar, known to persons skilled in the art. In this case, the coating will crumble away with the anode mass 5. The material may also be a heat shrinkable tubing, for example of plastic. However, such a tubing will not crumble away, and when the anode mass 5 is replaced, the tubing must be removed. The tubing will have nearly the same function as the protection mantle 13, and the mantel may therefore be omitted. There is, however, a risk that the tubing will loosen from the anode, and flow around in the pipe system. With the techniques of today, it is thus preferred to use a coating of epoxy paint and/or a protection mantle.

In the example described above, a preferred embodiment of the anode according to the present invention is discussed with a preferred releasable connection between the anode mass and the anode holder. Other cooperating means for another releasable connection between the anode mass unit and the anode holder may be achieved by a recess in the anode mass unit, and a protrusion on the anode holder, wherein the protrusion is engaged in the recess. In this case the replaceable unit may comprise just the anode mass, wherein the recess is formed directly in the anode mass, or the unit may comprise, for example, anode mass and a body having a recess, wherein the anode mass is moulded around it or secured to the body in some other way. The recess in the replaceable anode mass unit and the protrusion on the anode holder may for example be provided with reciprocal threads, as a snap connection, or with other known solutions, in order to obtain a releasable fastening between these parts.

Another solution to the fastening between the anode mass unit and the anode holder, is that the unit has a protrusion, fitting into a recess in the anode holder. In one case, the anode holder may be just a through hole in the blind flange, and the protrusion on the anode mass unit is protruding through the hole and fastened on the outside of the blind flange. The fastening  
5 between the anode holder and the anode mass unit may however be performed in many ways, as described above.

As an anode mass in the anode according to the present invention, any known anode material may be used, for example zinc-Noranode<sup>TM</sup>, iron or zinc to US MIL specifications. In order to prevent self-corrosion, it is an advantage that the anode holder and other parts of the  
10 anode be manufactured from stainless steel.

Persons skilled in the art will understand that the present invention is not limited to only what is shown and described above. The invention also comprises combinations, modifications and variations of this, which are obvious for a person skilled in the art, and within the scope of the following claims.

**Claims:**

1. Resistance controlled sacrificial anode for use inside piping systems, comprising a blind flange (1) for installation in pipe nozzles, an anode holder (2) fastened to the blind flange, a replaceable anode mass unit with anode mass (5), where the anode holder (2) and the anode mass unit are  
5 secured by means of releasable connection means, and the sacrificial anode further comprising a resistance (10) electrically connected between the blind flange (1) and the anode holder (2),  
characterized in that the anode mass (5) is secured to a sleeve (6), the sleeve (6) being tensioned to the anode holder (2) by means of the releasable connection means, to ensure electrical contact between the anode mass (5) and the anode holder (2).
- 10 2. Anode according to claim 1, characterized in that the anode holder (2) comprises a protruding part, wherein the protruding part of the anode holder projects through the sleeve (6).
3. Anode according to claim 2, characterized in that the connection means comprises a cone (7),  
15 having a through hole, being placed with its tapered end towards the sleeve (6) on the anode holder (2), to ensure the tensioning of the sleeve (6) to the anode holder (2).
4. Anode according to claim 3, characterized in that the protruding part of the anode holder (2) is provided with a thread on an end extending away from the blind flange (1), and that a fastening  
20 means (8) having an inner thread in a hole or recess, is secured with the thread on the anode holder (2).
5. Anode according to either one of claim 3 or 4, characterized in that the protruding part of the anode holder (2) is provided with a tapered expansion (16) towards the blind flange (1),  
25 preferably at the end towards the blind flange (1), the expansion constituting support to the anode mass (5).
6. Anode according to anyone of the preceding claims, characterized in that the anode mass (5) is moulded around the sleeve (6).