polymetron

Wastewater treatment: ORP in Aeration

application note

9135 transmitter

8351 probe

1. THE PROCESS

In the «secondary treatment» phase, 2 main processes can be encountered :

- a biological treatment (for biodegradable products elimination)

* a physico-chemical treatment (for non-biodegradable pollutants or suspended solids elimination)

Their presence will of course depend on the nature of the waste water to be treated, but today, both are generaly used.

The biological treatment is also called aeration, as the principle is to put the waste water in contact with bacterias, which will «eat» the organic coumpounds (carbonaceous and nitrogenous) : these bacterias will need air or oxygen to stay active. These carbonaceous and nitrogenous coumpounds are successively and continuously oxydized in the same basin.

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A first reaction (and generaly the only one at that stage) is an «aerobic» reaction: the bacterias will consume the free O_2 and produce CO_2 (carbonaceous coumpounds oxydation) and water. In the same time the NH_4 is oxydised into nitrates (NO_3^-) then nitrites (NO_2) : this is the nitrification (nitrogenous coumpounds oxydation).

A second reaction which may sometimes happen after the denitrification in the same basin, is an **«anoxic»** reaction : as there is almost no more free O_2, the bacterias will now be forced to consume the oxygen of NO_2 & NO_3^-, and produce N_2 : this is the denitrification. But most often, a more complete denitrification occurs in the tertiary treatment, latter in the process.

Depending on the way that aeration is done, they exist 3 types of processes :

- the bacterial bed (the most simple)
- the activated sludge basin (the most used)
- the submerged bed (new)

In an activated sludge basin, the oxygenation can be made either by surface aeration (brushing) and/or diffusion of air bubbles from the basin bottom.
One of the main concerns is here to use the minimum of energy and therefore carefully control the oxygen or air injection.

For the aerobic phase, a dissolved oxygen measurement is generaly made, but a redox control may be considered as sufficient.
For the anoxic phase, as the oxygen is very low, a redox control is generaly prefered.

To give an idea, the expected average redox potentials (with reference to Ag/AgCl) are:

- aerobic phase : ~ 100 mV
- anoxic phase : ~ 0 mV

Of course, these values are just indications and can vary from a plant to another.
Occasionnaly, when the anoxic phase is made in the same basin, it can also be completed by an «endogenous» reaction, in order to eliminate the last nitrites or carbon coumpounds.
Remark : during the anoxic & endogenous phases, biological phosphorous can also be removed.

2. Interest of an ORP measurement Difficulties to be solved

➢ *Interest*

As it is explained hereover, it may be difficult to follow the biological reactions in an aeration basin only with a dissolved oxygen measurement, specialy for anoxic and endogenous phases : the signal is almost equal to zero. In addition, a representative probe installation is difficult to find. So generaly ORP is prefered, or added to dissolved oxygen measurement.
The ultimate goal of that control is of course to optimize the energy and/or reageants cunsumption: that part of the process is often the most expensive !

➢ ***Difficulties***

There is generally a strong stirring around the probes, which must be carefully fixed. On another hand, they must be easy to dismount for maintenance operation. Materials must be adapted to oxydation.

➢ ***ORP loop : 9135 + 8351 immersion***

System configuration :
It is made of 3 parts in standard : the 9135 transmitter + the 8351 combined sensor with its 10m cable + an immersion probe equiped with a loose flange (3 lengthes are proposed). These complete loops can be ordered under the following references:

9135/R01/1 or 9135/R01/2 : 0.5 m immersion
9135/R02/1 or 9135/R02/2 : 1 m immersion
9135/R03/1 or 9135/R03/2 : 1.5 m immersion

➢ ***Description of the optional cleaning device***

Air, water or chemical cleaning available.

➢ ***Advantages***

The 8351 is a combined ORP probe constituted by the following parts:

* a platinum measuring element
* a double junction reference system (KNO_3 then KCl)
* a built-in low noise 10 m cable

The process liquid junction is made of a special porous Teflon and the first stage of reference system of KNO_3 : these 2 features allows excellent results against polluting ions. For very dirty samples (coating mediums), an optional chemical cleaning kit can be installed. There is no maintenance needs on reference part (electrolyte supply).