Drinking water treatment report

Eco friendly, affordable and save alternative for water treatment

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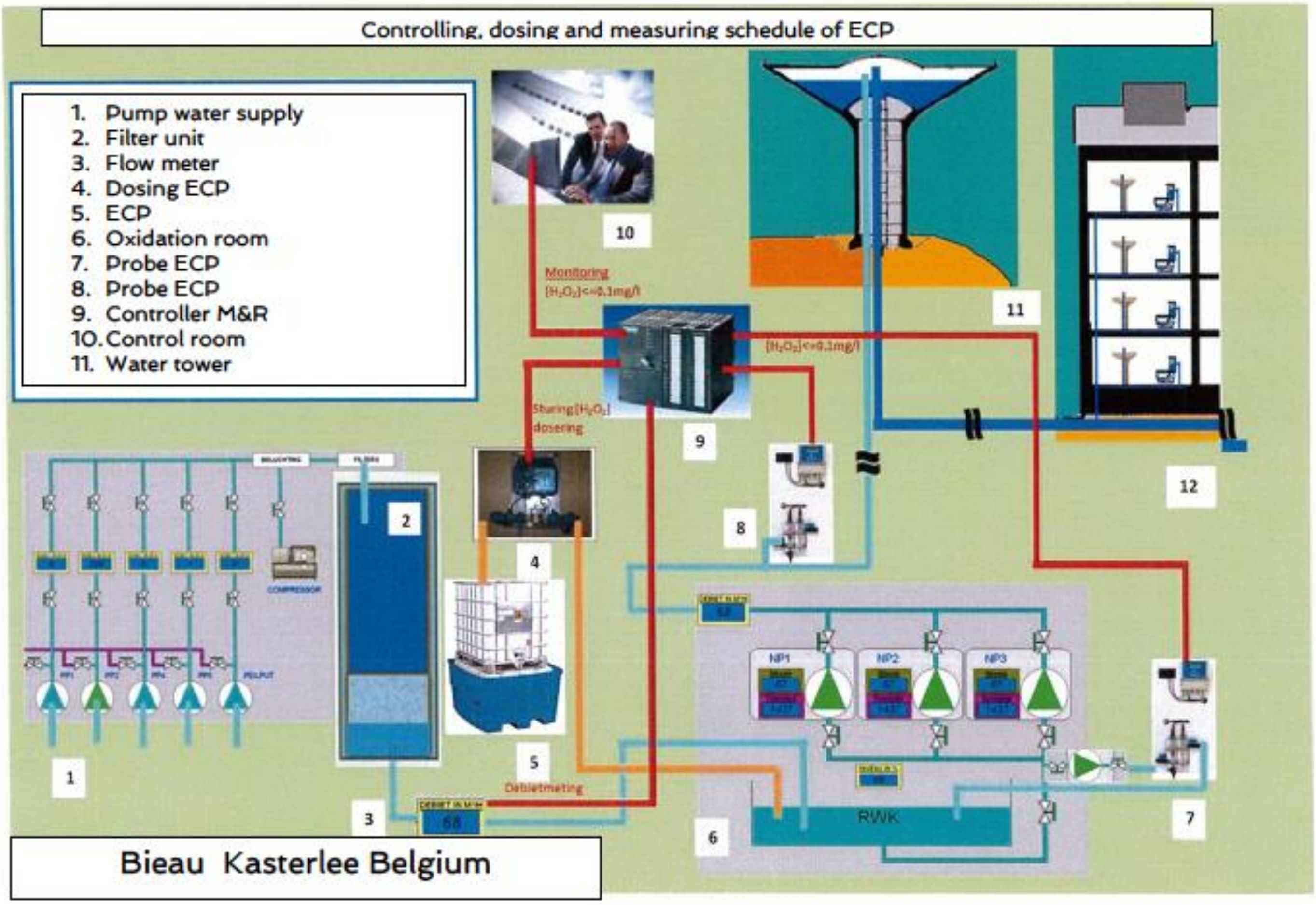
1.Introduction

Bieau comm v., received an additional request from the CAB (Advisory Committee on Biocides, your reference: MRB / AV / 2009/1045) regarding the application for authorization of EcoClearProx for PT05 (drinking water) on 13/04/2009 /) of the Federal Public Health Service, Food Chain Safety and Environment, Risk Management Service regarding the H_2O_2 dosing system, being: "The intention is to check whether the monitoring system is workable in practice During this test application, measurements in the treated water should be carried out to check whether the prescribed standard of 0.1 mg/l is not exceeded."
Based on these measurement results and the report that will be drawn up on this trial application, a decision will be taken on your application for authorization. "

In collaboration with I.W.M. (Intercommunale Watermaatschappij) the site "Kamp Leopoldsburg" located on the Kamperbaan in Leopoldsburg-Hechtel was chosen to carry out the test.
EcoClearProx®® is dosed to the drinking water and measurements are taken to check whether the standard prescribed by the CAB 0.1 mg H_2O_2/l is not exceeded.
The following report first explains the drinking water production and then shows the results of the measurement campaign during the period of 24 September - 30 November 2009, carried out by BIEAU in collaboration with I.W.M. and DDR-Systems.



<u>2. Protocol for controlling and monitoring the dosage of EcoClearProx® during the disinfection of water.</u>

EcoClearProx® is used in a controlled manner to disinfect drinking water during drinking water production. The process diagram shows how this can be carried out in consultation with the water companies or producers.

In the drinking water supplied by the water company (1) and (2), EcoClearProx® is injected with the aid of an injection pump (4) from an EcoClearProx® storage tank (5). The addition of the product EcoClearProx® takes place primarily by measuring the flow rate of the filling of the clean water cell (6) by means of flow meter (3). Proportional with that flow, the injection pump (4) will dose the product, controlled by the controller (9). The clean water cellar (6) functions as a pre-oxidation buffer, in which EcoClearProx® (active substance: H_2O_2) is mixed with the drinking water. The concentration of H_2O_2 can vary due to the oxidizing effect with components in the supplied water. The clean water cellar functions as an oxidation basin.

At the same time, the concentration of H_2O_2in the clean water cell (6) is measured and adjusted with the measuring probe (7). The H_2O_2 concentration measurement is carried out by means of a circulation pump that brings the water from the oxidation tank (6) to the probe (7) at a constant flow rate. When this measuring probe detects H_2O_2 , the measurement data is transmitted to the controller (9) which, if necessary, will adjust the injection pump (4) until the desired H_2O_2 concentration is reached.

When drinking water (12) is consumed, the level in the water tower (11) will drop. This is supplemented by pumping water from the clean water cellar (6) to the water tower. The permitted concentration of 1 mg H_2O_2/l in this water is controlled by means of a second H_2O_2 measurement (8). This is done by making a bypass on the departing main water line. The data from this measurement is also transmitted to the controller (6).

The measurements are processed by the controller (6) which will make a comparison between H_2O_2 concentration measured by probe the first (7) and the second probe (8). This results in whether the injection pump (4) is activated for dosing of EcoClearProx® in the oxidation tank. The necessary provisions have been made in the protocol of measurement and control so that the concentration does not exceed the norm of, 1 mg/l.

Since the measuring signal of the measuring probes can degenerate due to contamination or aging, cleaning and calibration of the measuring signal can be carried out at regular intervals.

To prevent contamination of the measuring probes (7) or (8), a continuous amperometry measurement with automatic cleaning was used for. the Dr A. Küntze Krypton K measuring equipment. When a probe is in the automatic cleaning mode, it is temporarily out of service. The setting of the time of cleaning measurements (7) and (8) are shifted in time so that at least one measurement remains available. If a detection of starting violation of the standard concentration, the active measurement, being the control measurement on the main water line (8) or the first measurement (7) the clean water cellar or both, immediately detect this and reduce or interrupt the dosage.

As additional safety, the amount of dosed concentrate per unit of time is calculated in the controller in function of the treated flow. If the amount of concentrate per unit of time exceeds a preset safety standard, the dosage will be interrupted, and an alarm message will be released.

Each alarm is made visible locally, (alarm contact) by connection with a building management system or other monitoring systems. Alarms can optionally be transmitted via MMS to the responsible persons.

The controller (9) stores the data concerning H_2O_2 dosages and measurements with date and time information. This information can be sent to a central server in a control room (10) for follow-up and alarm reporting via e.g. the internet.

3. Description I.W.M. test site at Leopoldsburg

For the description of the test installation, reference is made to paragraph 2,

'Process diagram for control and control of the dosage of EcoClearProx® in case of disinfection of water'.

Note: the block diagrams shown are from the automated system of I.W.M. for the water extraction at Hechtel-Leopoldsburg.

3.1 Pump station water extraction

Reference process diagram item 1: "Pump station Water extraction"

Antwerpian are wells that provide sand-free water and that were tapped to guarantee the operational security of the water extraction always and to reduce the shallow wells by maintaining the water level.

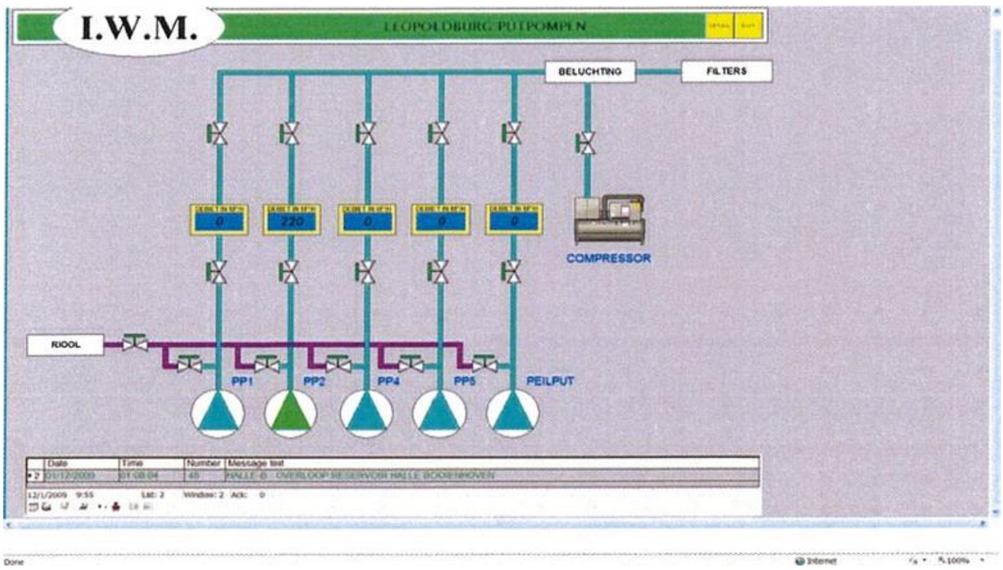


Figure 1: Process diagram of the Antwerpian water extraction

As the second source for drinking water supplies shallow well water is drilled.

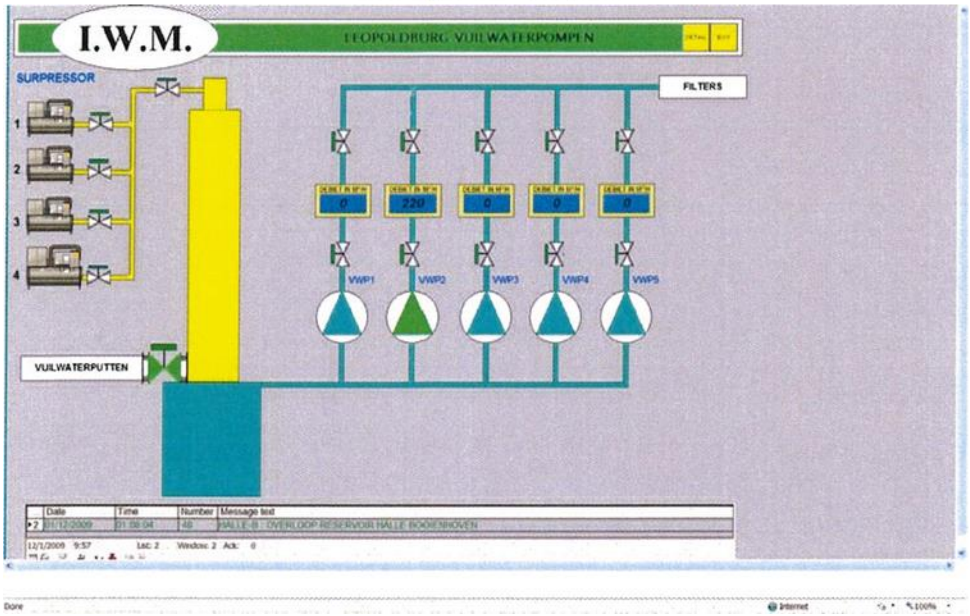


Figure 2: Process diagram of well water extraction

<u>3.2 Water treatment</u>

Reference process diagram item 2: 'Filter unit'

Both waters are mixed, after which aeration of iron is oxidized and removed via sand filtration. H_2S is also separated.

The water is pumped to regenerable sand filters. After filtration, the water meets the drinking water standard.

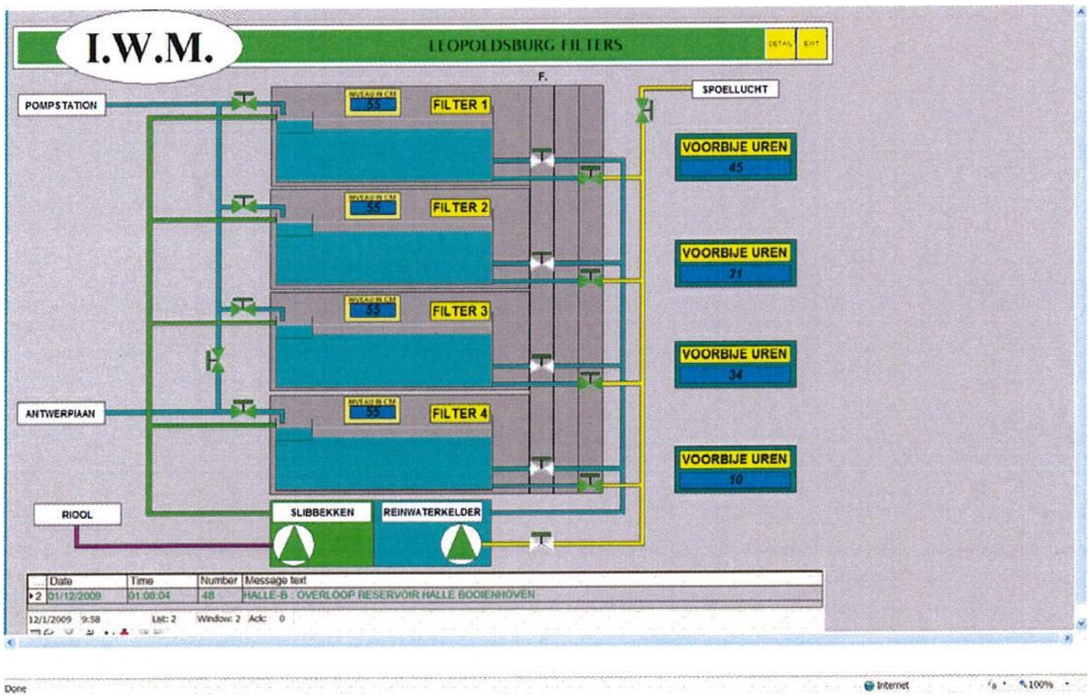


Figure 3: Process diagram of the water treatment in the sand filters

3.3 Reinforced water heater and pumping station

Reference process diagram item 6: "Reinforced water heater and pumping station"

The clean water cellar has a capacity of +/- 600 m^3. The filling can be adjusted to consumption, by using multiple suction pumps. On average the filling is 60m^3/ h.

Figure 4: View of the clean water cell and filters at l. W.M. Leopoldsburg

3.4 Power pumps to water tower

Reference process diagram item 6: "Reinforced water heater and pumping station"

Net pumps fill the water tower of Leopoldsburg from the clean water cellar. Depending on the water level in the water tower, the flow is adjusted.

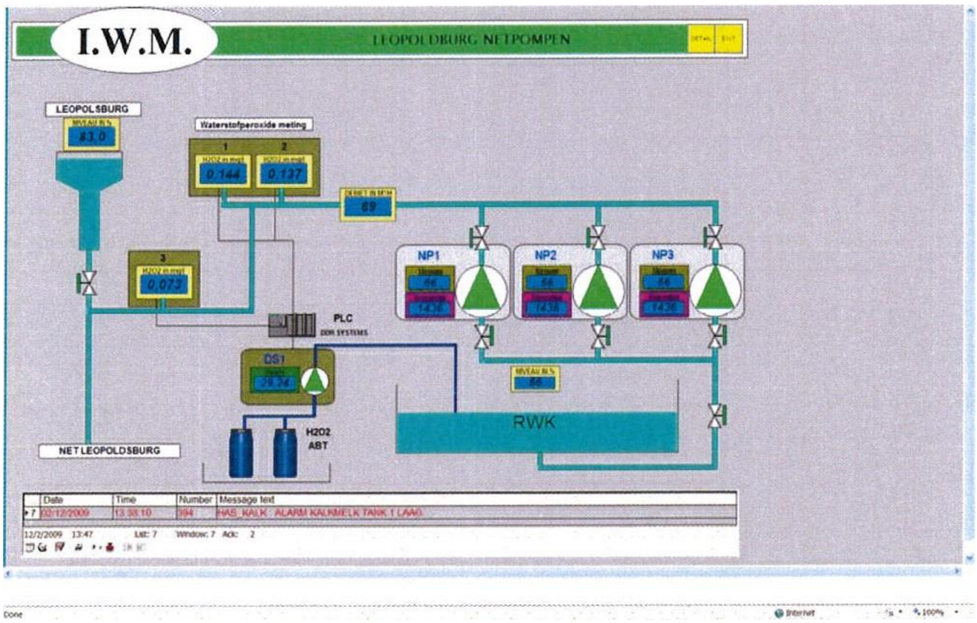


Figure 5: Diagram of the pumping station with the mains pumps and H_2O_2 measuring equipment

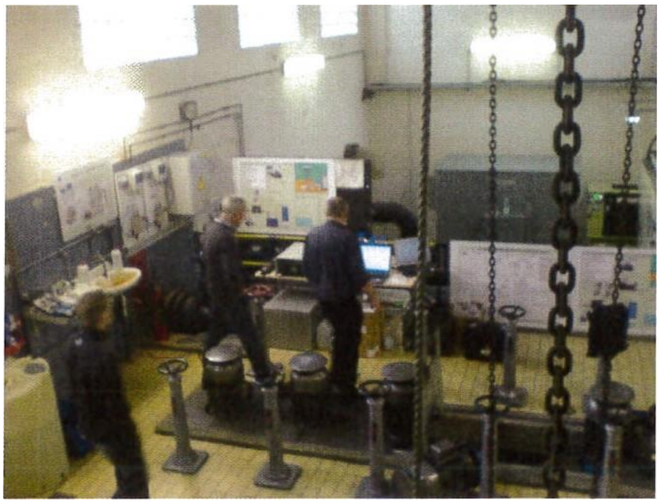


Figure 6: View of the pumping station with the mains pumps and H_2O_2 measuring equipment

4. Use equipment for dosage and measurement

4.1 Product EcoClearProx® 42.1%

Reference process diagram item 5: "Product EcoClearProx® 42.1% (42.1% H_2O_2)"

EcoClearProx® 42.1% is stored in 1 m 3 containers for dosing in the clean water cell.

Figure 7: EcoClearProx 42.1% in 1 m^3 containers

4.2 Injection pump for H_2O_2

Reference process diagram item 4: "Injection pump H_2O_2

In this set-up, a syringe pump of the BT-MG series from the Etatron brand was installed.

Figure 8: injection pump Etatron

This dosing pump has an adjustable stroke length and dosing frequency. Connection with the controller is done by means of electrical pulses. The injection is proportional to the flow rate for the filling of the clean water cellar.

<u>4.3 Automatic 1-12O2 concentration measurements</u>

Reference process diagram items 7 and 8: "Measuring probes H_2O_2"

<u>4.3.1. Continuous monitoring with amperometric H2Oz measurement</u>

The placed measurement is the Krypton K from the Dr. A. Küntze (Krôhne, Germany). It is a continuous amperometric measurement for H_2O_2. Krypton K H_2O_2 is a patented measurement with cleaning system for removing dirt residues and scale deposits on the probes.

Figure 9: Measuring equipment Krypton K - Dr. A. Küntze (Krôhne).

For the measurement of the hydrogen peroxide concentration with probe (7), a second automatic measurement (7bis) was placed in series as a control measurement. This second measurement ensures the maintenance of the measuring result when one of the probes is in automatic cleaning mode. In this mode, the measuring output is set to maximum scale (1 µg/l), which masks the measurement. The second probe (7bis) takes over the measurement results so that a continuous measurement result remains available in support of the test. The cleaning frequency is set at 1 time per 24 h and is shifted between the 2 measurements.

4.3.2 Control H_2O_2-measurements with Aqualytic

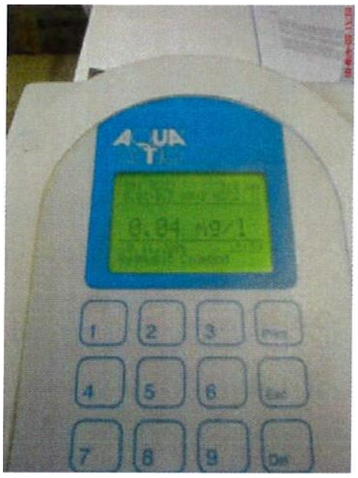


Figure 10: Aqualytic photometer for H_2O_2 measurements

This photometry is used as a reference for calibrating the amperometry measurement.

The H_2O_2 concentration of a water sample to be measured is determined by the solution of reagents in a cuvette, resulting in discoloration. The intensity of the coloring is decisive for the concentration and is measured photometrically in this hand-held device.

Calibration of the device is based on an H_2O_2 solution with known concentration eg. 0.3 mg/l, where this measurement signal is in the range of the measuring range of the expected concentration of 0.1 mg/l.

4.3.3 Control H_2O_2measurements with Aerolaser

In addition to the verification of the H_2O_2 concentration with an Aqualytic hand photometer, a second verification was also carried out by way of experiment. Aerolaser (Aerolaser, Germany). The automated device used for the determination of hydrogen peroxide concentration. Its technique described in detail by "Lazrus et al. 1985, Analytical Chemistry, Vol 57, pp. 917-922 and Lazrus et al., 1986, Analytical Chemistry, Vol 58, 594597". It is a device that also requires a lot of manual interventions and has a considerable consumption of various chemicals for operating it.

The measuring principle described in these publications is automated within the device Aerolaser. As a result, a continuous measurement can be realized over a period that is in function of the quantity of reagents made available for the operation of the device. The measuring range is 10 to 3000 µg H_2O_2/l.

Figure 11: H_2O_2 measurement using AeroLaser (optional)

4.4 Registration of the measurements

Via the SCADA (Supervisory Control and Data Acquisition) system, the signals from the measurements are forwarded to the server in the control center of I.W.M. in Zoutleeuw.

The SCADA system is built around a Siematic PLC from Siemens with a link over VPN (Virtual Private Network) over the internet.

The following signals are measured and monitored: Signal from probe 7 and 7 bis for H_2O_2 measurement

Signal from measuring probe 8 for H_2O_2measurement

The information is stored in an SQL database whose results can be displayed in graphs, with X-axis the date and time and the Y-axis the concentrate H_2O_2 in mg/l.

With possibilities for zoom and "time date" picker, data can be extracted from the database to create a protocol.

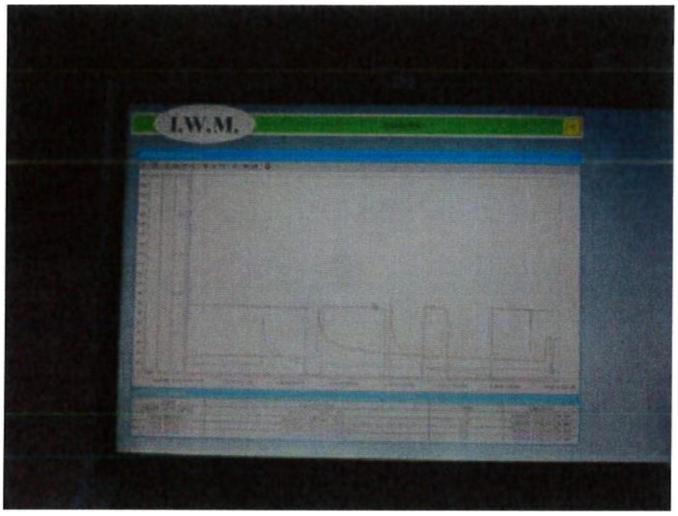


Figure 12: Results graph extracted from SQL database

5. Dimensioning

EcoClearProx® 42.1% contains 421 g H_2O_2 per liter of commercial product.

1 liter of commercial product weighs 1200 g.

Theoretical dosage:

For a set point of 0.1 mg H_2O_2/l drinking water, the dosage of the injection pump for the EcoClearProx in ml/m³ can be set as follows:

0.1 mg H_2O_2/l drinking water = 100 mg H2O2/m³ drinking water

100 mg H_2O_2 is contained in (1200/421) * 100 mg = 285 mg commercial product

If 1200 g commercial product is 1 liter then:

285 mg commercial product 285/1200 = 0.2375 ml

0.2375 ml EcoClearProx® must be dosed per 3 ml of water

The practical setting is 0.35 ml EcoClearProx® which gives a starting concentration of 0.35 ml EcoClearProx®/m³ of drinking water. Each liter of EcoClearProx® contains 421 g of H_2O_2. For 0.35 ml, 0.14735g of H_2O_2 0.147 g/m³ corresponds to 0.147 mg/l, 0.35 ml/m³, after a short residence time in the clean water cell, results in a concentration of <0.1 mg/l H_2O_2 at the departure to the feed lines of the water tower.

During the residence time in the clean water cell (Oxidation buffer), a part of the H_2O_2concentration is immediately consumed. The immediate consumption of H_2O_2in contact with drinking water is explained by the presence of organic substances in the drinking water.

The remaining hydrogen peroxide (<0.1 mg / l) remains available for disinfection of the drinking water in the distant pipe system. The dosage runs proportionally with the flow.

The factor ml/m³ is decisive for the setting of the dosing pump and is adjusted by the system controller as discussed in chapter 2.

6. Measurement results

6.1 Information about the measuring signals

Page | 17 The hydrogen peroxide concentration measurements are carried out using Dr A. Küntze's Krypton K amperometric measurements.

With reference to the data-logging graphs, the legend of the measurements is as follows.

H2O2 Measurement 1: - (red line)

Measure the concentration in mg H_2O_2/l water, in the starting line from the pumping station to the water tower.

H2O2 Measurement 2: - (blue line)

Is the parallel second measurement in the starting line from the pumping station to the water tower and measures in mg H_2O_2/l water.

H2O2 Measurement 3: - (green line)

Is a control measurement downstream at 200 m from the pumping station in the departure line from the pumping station to the water tower.

Measurement 4: (violet line)

Is a calculated value resulting from the arithmetic mean of H_2O_2.

Measurement 1 and H_2O_2 Measurement 2. This when both measurement results are available (no cleaning). During the cleaning cycle of Measurement 1 or Measurement 2, no signal is available (shown in data logging as 0 mg H_2O_2/l water).

If only one signal is available, the measured value of the active measurement will be taken over so that a continuous measurement result is made available.

6.2 Discussion of the measurement results

The measurement results are displayed per month over the months of September, October and November.

BIEAU
a clear solution
Your 100% organic biocide for water, air, surface

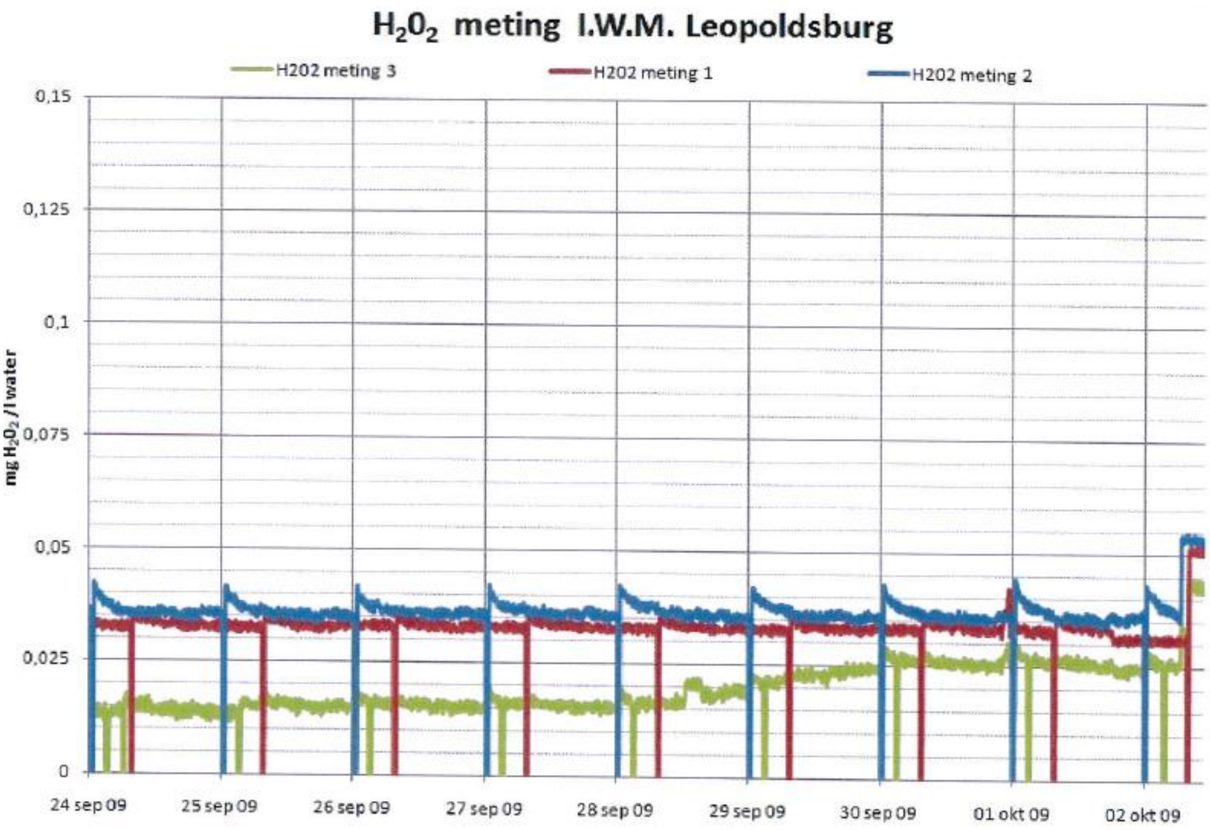


Figure 13:

During commissioning, it was decided to gradually increase the concentration to the maximum permitted concentration of 0.1 mg / l.

In the month of September, the set point for the dose was 0.03 mg H_2O_2/l water.

This is maintained in the departure pipe. (See Measurement 1 and Measurement 2)

The control measurement of H_2O_2

Measurement 3: (green line) shows a structure of the concentration H_2O_2. Over a period of 1 week, the concentration reaches a stable final value of 0.025 mg/l slightly lower than at the departure at the pumping station where the concentration is 0.03 mg/l. This can be explained by the oxidation of the present organic fractions (biofilm) by the hydrogen peroxide in the pipe network, which is steadily degraded.

Note that every 24 hours an automatic cleaning of the H2O2 probes is provided, where the signal periodically drops to zero. An offset is provided so that the zero displays are shifted in time with respect to the different measurements.

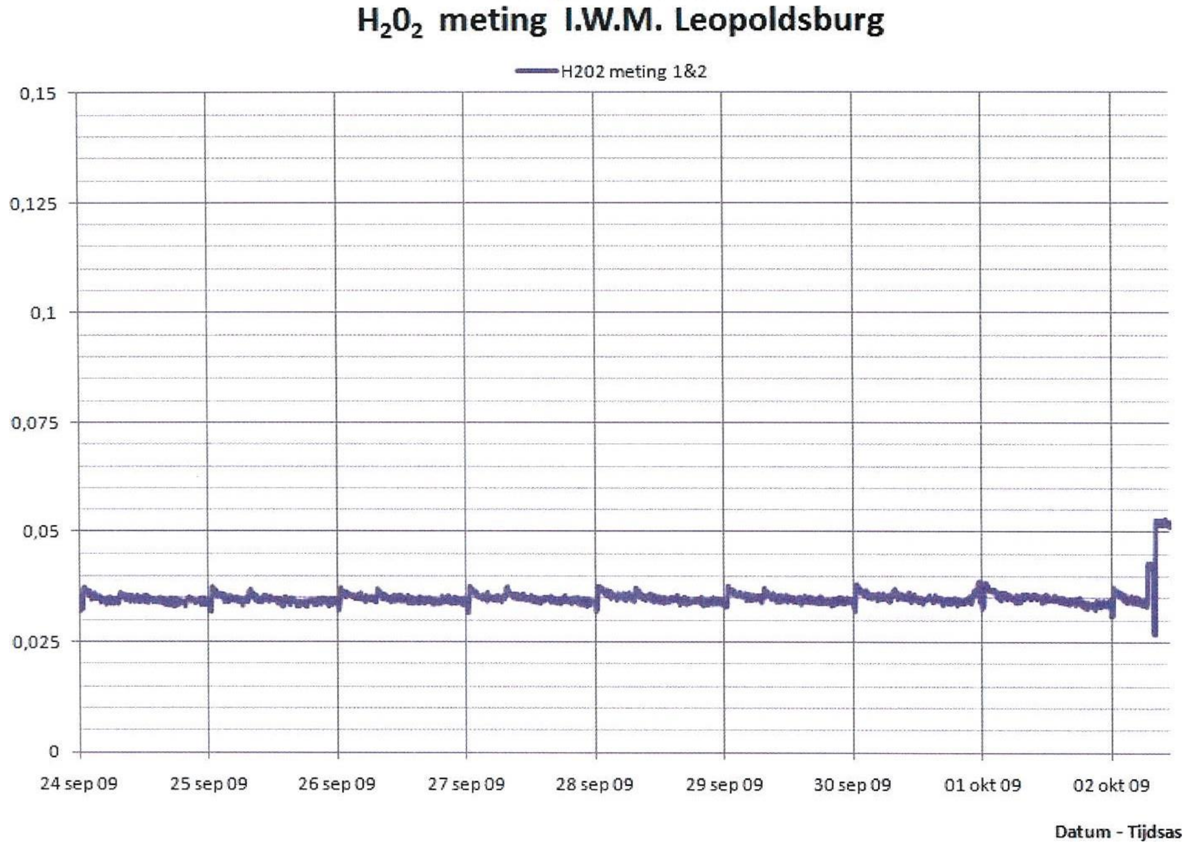


Figure 14:

The combination of the measurement with Measuring Probe 1 or Measuring Probe 2 provides a continuous measurement in which the zero measurements are eliminated

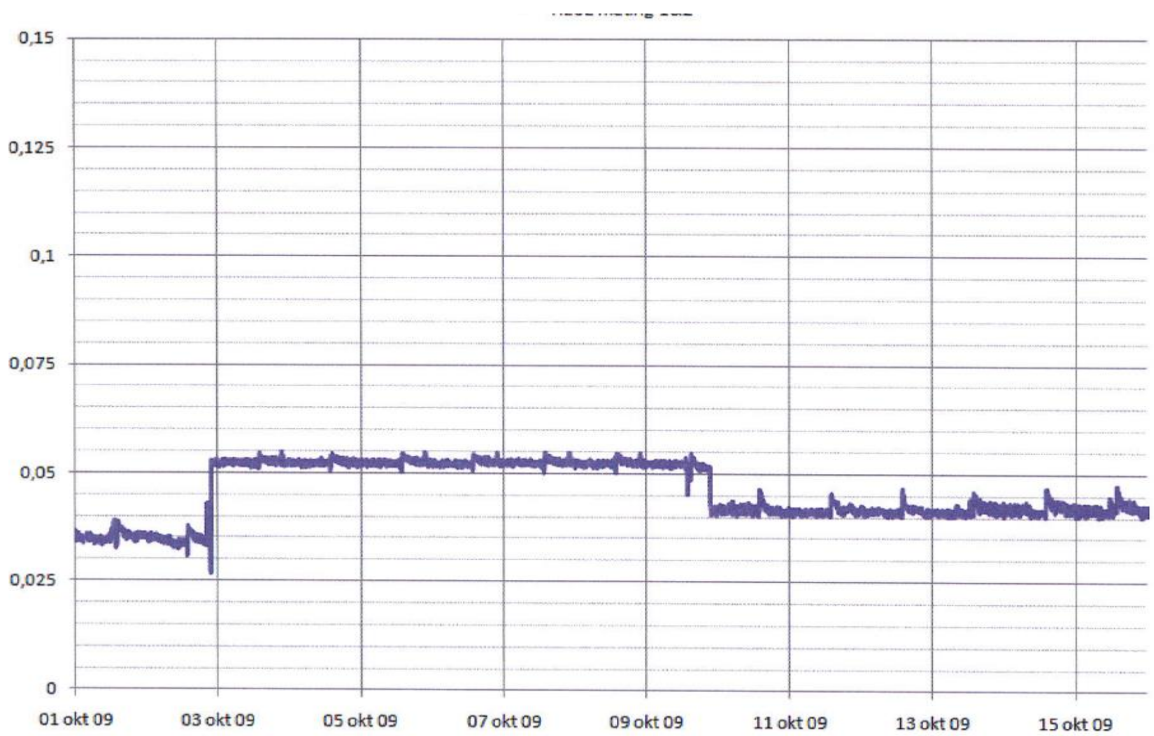


Figure 15:

From the beginning of October, the set point for the dosage will be increased to 0.05 mg H_2O_2/l water.

There is a continuous measurement until October 10, after which a small adjustment is made after the calibration of the Küntze measuring equipment. Here, a comparative measurement was made with photometric measurement (Aqualitic measuring device) and the 3 Küntze measuring probes were calibrated to the red concentration. This was 0.04 mg / l for Measurement 1 and Measurement 2.

Measurement 3 (remote control measurement) follows measurements 1 and 2 with a slightly reduced concentration.

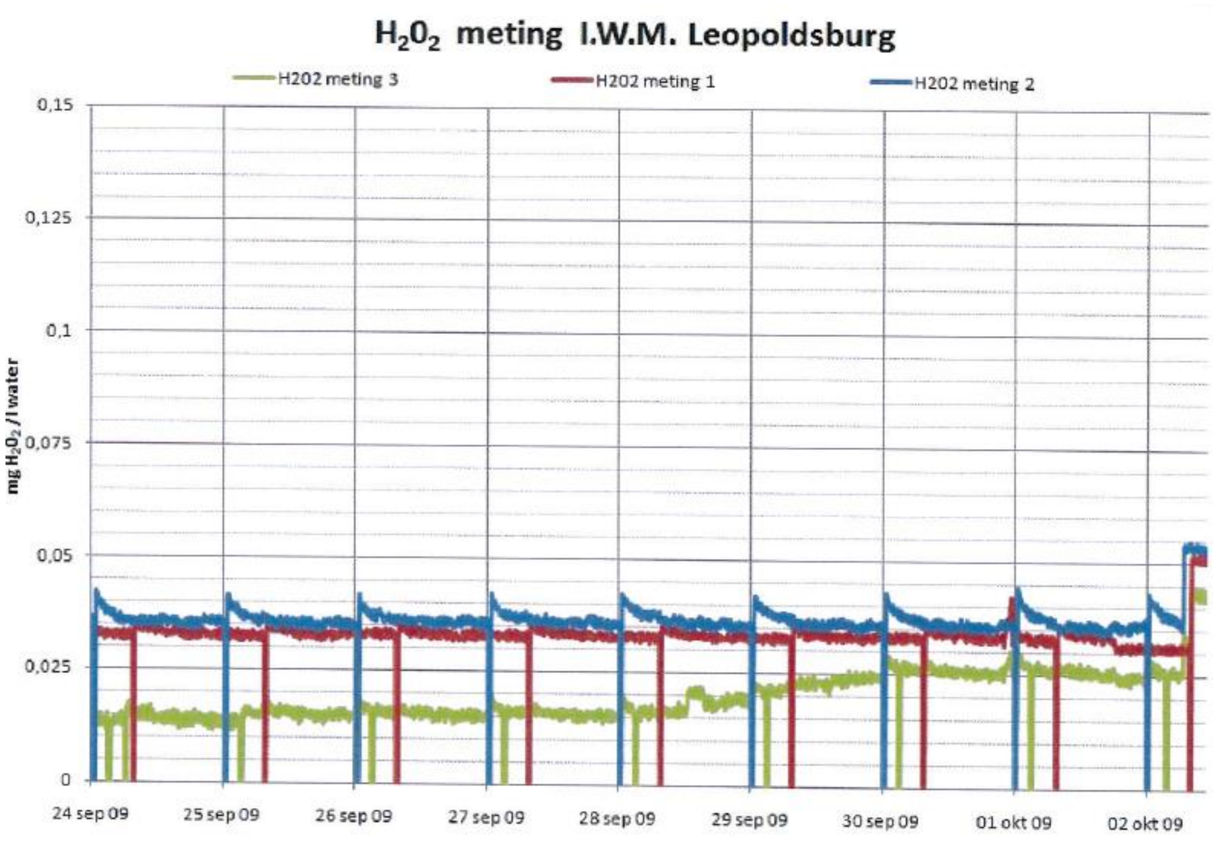


Figure 16:

In the second half of October there was a small disturbance on Measurement Probe 1. During this period experiments were done with the cleaning mechanism of the probe. The measurement results remain stable available by means of Measuring probe 2. At the end of October, the dose of the hydrogen peroxide is increased to a set point of 0.07 mg/l. The remote measurement 3 follows the Measurement 1 and Measurement 2.

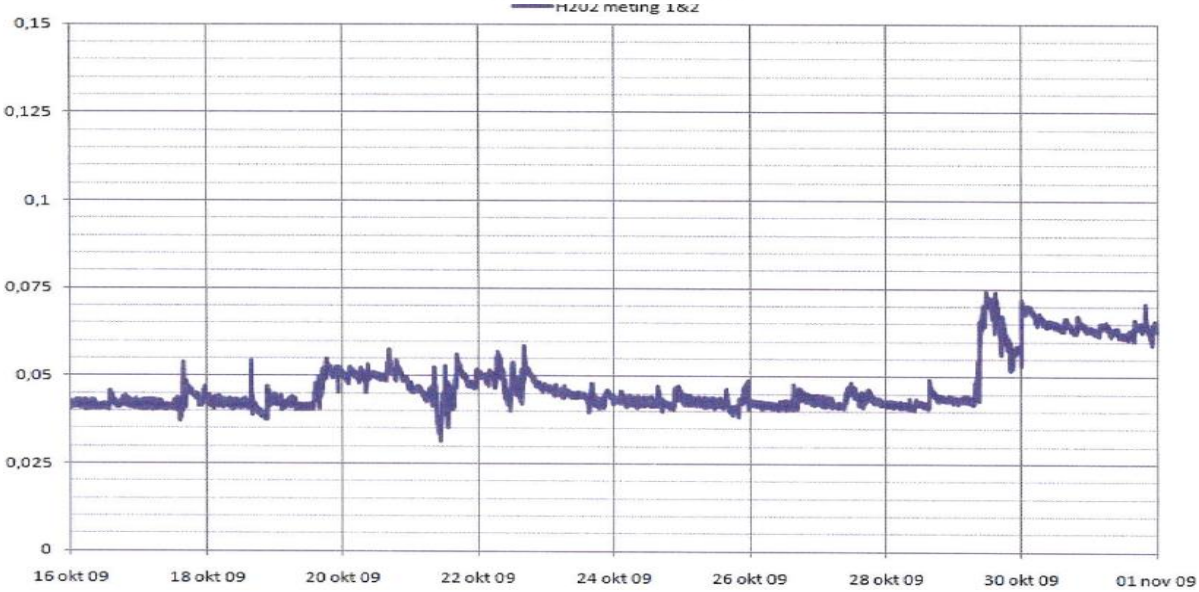


Figure 17:

Displays the combined measurement of measuring probes 1 & 2 for a continuous measuring signal.

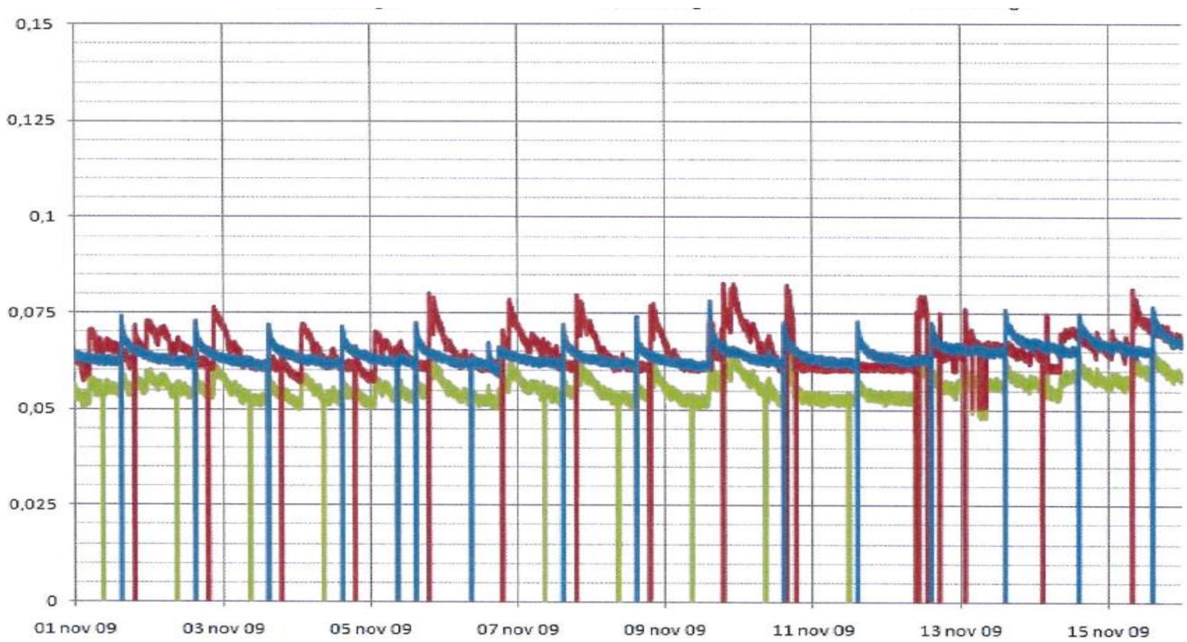


Figure 18:

Displays the measurement for the 3 probes for the period 1 Nov - 15 Nov 2009. At the beginning of November the set point for the hydrogen peroxide concentration will be increased to 0.07 mg/l. The measured concentration fluctuates around 0.07 mg/l to mid-November 2009. Deviating measurements are the result of the cleaning mode of the measuring devices.

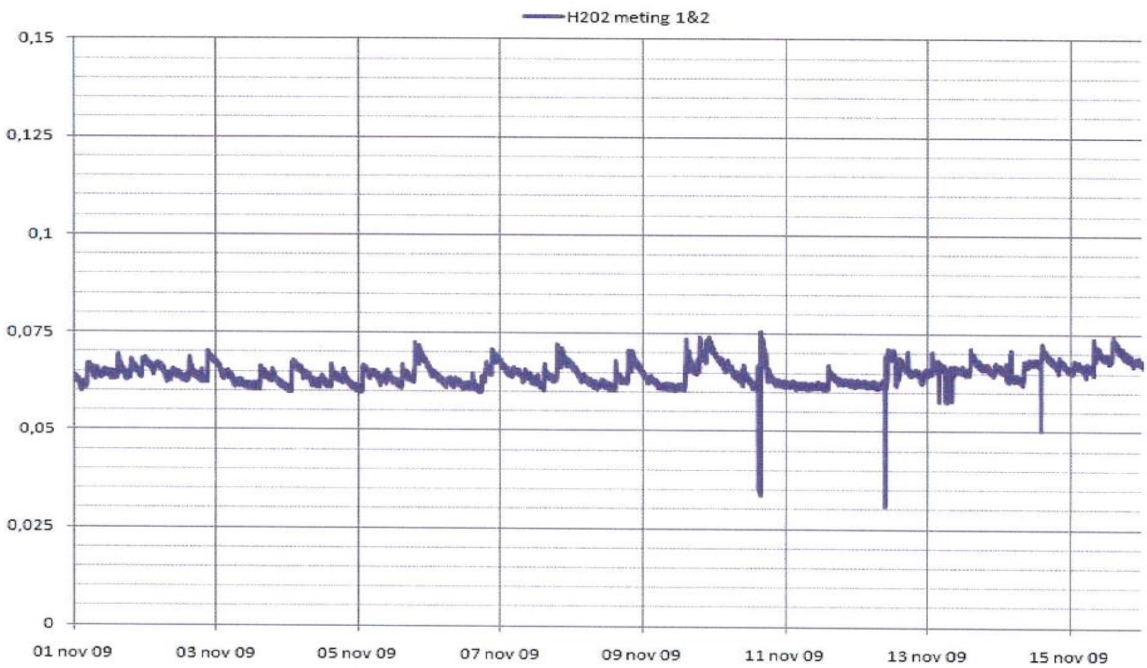


Figure 19: Shows the combined measurement probes 1 & 2 for a continuous measurement signal during the period 1 Nov - 15 Nov 2009.

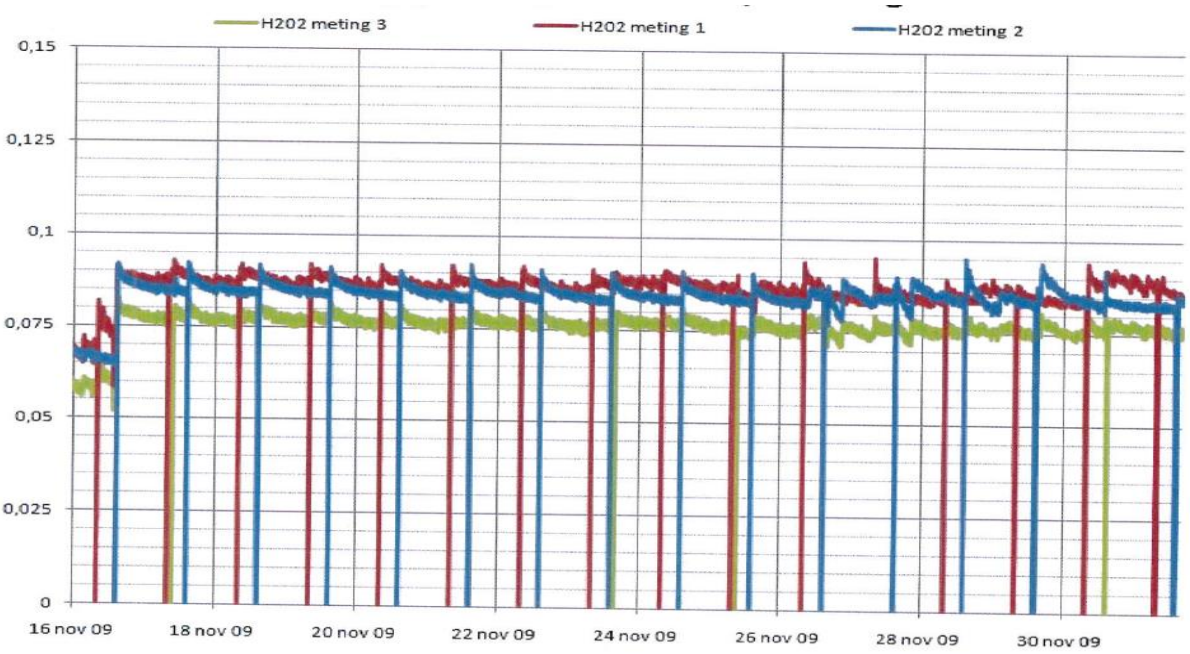


Figure 20: indicates the measurement for the 3 probes for the period 16 Nov.- 30 Nov 2009. After 16 November 2009, the set point of the dose will be increased to 0.09 mg/l. The measurements remain constant and <0.1 mg/l.

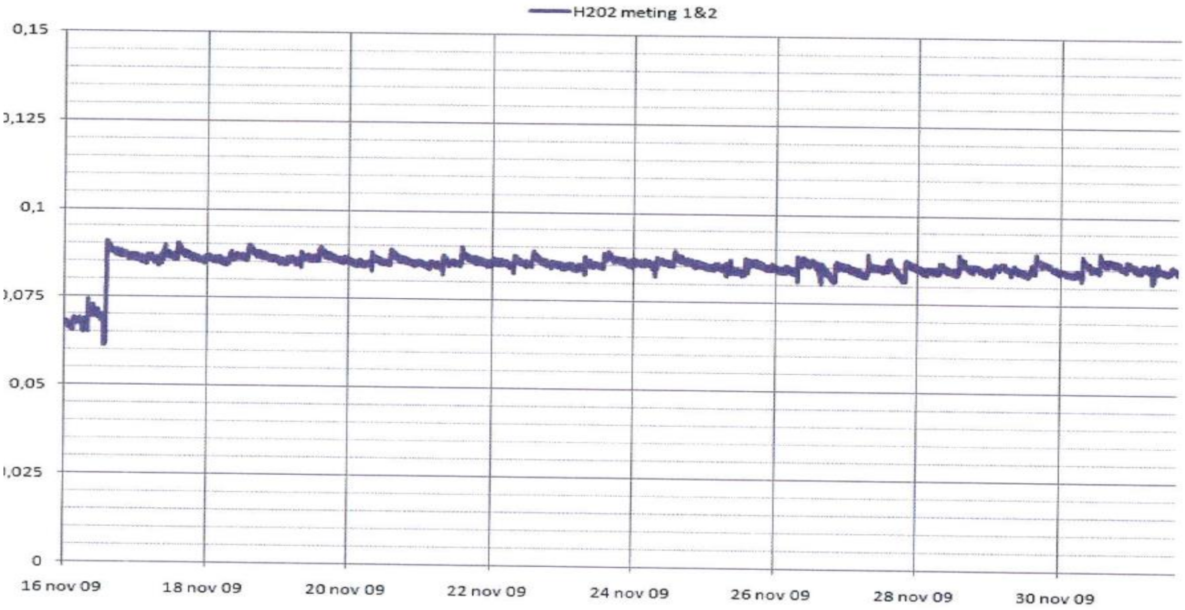


Figure 21: Show the combined measurement of the probes 1 & 2 for a continuous measurement signal during the period 16 Nov- Nov. 2009.

Figure 23: Provides an overview of the H2O2 measurements for the 3 probes for the period 24 September - 30 Nov 2009.

6.3 Bacterial water analyses

Test have been conducted to protect the public health.

Colony Forming units (CFU) were measured from the water leaving the production facility, giving values between 26 and 66 CFU's and at the end at the users outlet in the houses values between 4 and 55 CFU's where detected.

Furthermore, a significant and unexpected fact occurred, as the biofilm which was cumulated over the years in the concrete and metal tubing, came loose.

7. Conclusions

For the authorization request of EcoClearProx® for PT05 (drinking water) by BIEAU, an additional request from the CAB (Biocides Advisory Committee: your reference: MRB / AV / 2009/1045 /) of the Federal Public Service Health, Food Chain Safety and Environment, Risk Management Service regarding the H2O dosage system submitted, being:

1. 'The intention is to check whether the monitoring system is workable in practice.'
2. 'By carrying out a test application in the treated water to check whether the preset standard of 0.1 mg/l is not exceeded "

We conclude with this extensive report that the set criteria are met. Namely, over a period of more than 3 months, the dosage was continuously monitored and recorded. It was opted to gradually increase the concentration to just below the permitted standard, avoiding any risks of overdose. During the last 14 days of the test, the EcoClearProx® dose was controlled in such a way that the permitted H_2O_2 concentration of 0.1 mg/l was never reached. Figures 24 and 25 give a complete overview of the H_2O_2 measurements of the complete measurement campaign.

The automatic measurements of Dr. A. Küntze (Krôhne) were checked manually at regular intervals by taking water samples and analyzing them with an independent photometric measurement (Aqualytic) for verification. For an additional verification, the AeroLaser, an automated photochemical measurement, showed the stability of the Dr. A. Küntze measurements. In addition to this measuring equipment, there are several other H_2O_2 measuring systems on the market, and we should not consider the measuring equipment proposed in this report as a mandatory component.

Contact us for more detail, product assortment and questions.

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