

# Monitoring of Toxins in Drinking Water Quality by the *ToxProtect64* Fish Monitor

*Training Material for End Users  
(Deliverable 3.6.3.4)*



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# 1 INTRODUCTION

The *ToxProtect 64* fish monitor is used to detect toxins in the drinking water quickly and robustly by registering the movements of the fish using an array of light barriers. The system triggers an alarm when the movement of the fish changes or ceases due to the presence of toxins in the water.

The fish biomonitor is designed to protect water supplies against harmful toxic compounds that could lead to acute intoxication of humans, who all drink water. The system is designed as a robust, fast-reacting instrument with an alarm verification mechanism to trigger valid alarms, if necessary. Minor attention has been given to the detection of very low toxic concentrations. A video film has been recently produced to instruct potential users in the proper use of the *ToxProtect 64*.

## 2METHOD

A video film for installation, application and maintenance has been created.

Content of training material (video):

<b>Instructions</b>		
1.	General description	Normal working conditions of the fish biomonitor (with no harmful substances in the drinking water) are signalled by the green traffic light on the top of the instrument. Yellow light indicates the alarm verification mode or different hardware errors. The red light is the signal for a verified toxicity alarm.
<b>Alarm generation</b>		
2.	Alarm generation	<p>The alarm generation is generally based on the analysis of the swimming activity of the fish. The instrument looks for significant changes in the behaviour of the fish. The parameters speed and location within the aquarium are used for this purpose, calculations using the interruption of the light barriers determine whether the behaviour has become unusual and thus whether an alarm is triggered.</p> <p>Distinct alarm parameters are the 'Activity' - meaning the overall swimming activity of fish - and 'Specific activity' -representing the activity in the top region of the aquarium. Thus, the value of each relevant alarm parameter is compared to a threshold value.</p> <p>An integrated alarm verification system ensures a high reliability of the system's operation. In case the fish activity value falls below the defined threshold, a pre-alarm warning is generated by the instrument, signalled by a yellow lamp. This triggers the alarm verification procedure which changes the illumination inside the aquarium by switching the light off and on again. This normally leads to a dramatic increase in fish activity. In this case, no real alarm is activated and the lamp is switched back to green again. Under toxic conditions, this reaction does not normally occur and the alarm is verified by</p>

		the lamp switching to red.
3.	Threshold determination	<p>Alarm threshold values are pre-defined and can be adjusted depending on the fish species used and the pre-defined temperature.</p> <p>Relevant parameters are :</p> <ul style="list-style-type: none"> <li>• threshold activity</li> <li>• threshold top line coverage</li> <li>• threshold bottom line coverage</li> <li>• validation activity</li> <li>• activation time</li> <li>• validation time</li> </ul>
<b>Presets and adjustments</b>		
4.	User interface, system operation	<p>All adjustments and user inputs as well as the visualised measurements are accessible via the touchscreen panel in the front panel.</p> <p>Several main menu points can be selected: Readings, Parameters and Test. The "Readings" menu contains the measured values and detailed information. The "Parameters" menu shows the settings of the instrument and enables changes. The "Test" menu allows the user to test the instrument's functionality.</p>
5.	Communication	<p>The <i>ToxProtect 64</i> can be controlled remotely via LAN, cable-modem or GSM-modem.</p> <p>For the LAN connection the IP address has to be set correctly.</p>
6.	Operation modes	<p>One focus of the instrument is put on very simple operation principles. To run the instrument the use of a switch with three positions is completely sufficient after once defining the settings. This allows the maintenance to be carried out by operators after very little instruction.</p> <p>Three operating modes can be chosen by the Mode Selector switch: Stand-By, Start-Up and Run.</p> <p>The Stand-By mode is used for checks, maintenance, changes n parameters and calibration.</p> <p>The Start-Up mode is used to start the instrument and open the water supply valve to allow prepared water in the instrument.</p> <p>Only in the Run mode are the movements of the fish analysed and an alarm triggered in case of toxic influences.</p> <p>The <i>ToxProtect</i> switches automatically into the Toxicity Alarm mode or the Hardware Alarm</p>

		<p>mode in the case of alarm events. A different screen then appears indicating alarm source and time.</p> <p>The Test mode can be entered only from Stand-By mode by selecting TEST from the displayed menu. It is used to check the correct function of different components of the instrument (e.g. feeding, flow rate, traffic light functions).</p>
7.	Flow rate	The flow of water through the aquarium influences the reaction time of the instrument but also the swimming behaviour of the fish. The recommended flow rate is therefore 100-120 l/h.
8.	Chlorination	If there is chlorine in the water, this needs to be washed out continuously by the dechlorination unit while retaining fish into the biomonitor.
9.	Calibration of the sensors	Sensors for flow rate, temperature and chlorination have to be calibrated according to the manual. The Stand-By mode is used to do this.
<b>Fish species, maintenance and handling measures</b>		
10	Fish species	Test species with an appropriate size are preferred which normally show a constant swimming behaviour, are adapted to the normal local drinking water temperatures, are commonly available and easy to keep under aquarium conditions. The species sunbleak, bitterling and stone moroko for instance were found to be usable for an automated biomonitoring of drinking water. We recommend monitoring a group of 10 fish (maximum: 20) with a body length of approximately 4-6 cm.
11	Temperature acclimatisation	The fish have to be slowly adapted to the temperature regime of ToxProtect.
12	Handling, restocking	All fish have to be handled carefully. Any transport even over distances of a few meters has to be made in water-filled buckets or plastic containers with the appropriate temperature. Remove the lid of the aquarium before beginning the stocking procedure. Soft mesh nets have to be used for stocking or exchange of fish. Dead or ill fish have to be removed as fast as possible from the aquarium.
13	Feeding	Please check once per week whether there is enough food in the automatic feeder and refill if necessary. The food has to be of appropriate size, structure and composition. We recommend

		granulated dry food of 0.5 to 2 mm size. Feeding times can be adjusted in the Start-Up mode. Recommended are 2 to 4 feedings per day of low food amounts.														
14	Temperature regulation	<p>The minimum temperature which is recommended for the biomonitor is 13°C. For this purpose, at least a 500 W heater should be used in the aquarium of the biomonitor for mid-European groundwater supply conditions. Recommended ranges for different species are listed in the table (or in the manual)</p> <table border="1"> <thead> <tr> <th>Water temperature</th> <th>Species</th> </tr> </thead> <tbody> <tr> <td>13-20°C</td> <td>Sunbleak</td> </tr> <tr> <td>13-20°C</td> <td>Bitterling</td> </tr> <tr> <td>13-20°C</td> <td>Minnow</td> </tr> <tr> <td>15-20°C</td> <td>Stone moroko</td> </tr> <tr> <td>15-20°C</td> <td>Fathead minnow</td> </tr> <tr> <td>20-28°C</td> <td>Zebra fish</td> </tr> </tbody> </table>	Water temperature	Species	13-20°C	Sunbleak	13-20°C	Bitterling	13-20°C	Minnow	15-20°C	Stone moroko	15-20°C	Fathead minnow	20-28°C	Zebra fish
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15	Support	Access via telephone and Internet allows the user to obtain intensive support by the company bbe Moldaenke. The sensor system which stores a broad variety of signals in the database allows immediate analysis for better support. Help for parameter settings or hardware malfunctions can be supplied.														
16	Cleaning	<p>Before cleaning the unit should be switched out of the run mode.</p> <p>The user should clean the bottom of the aquarium by siphoning the mud when necessary</p>														
Quick-Start of the system																
17	Starting	<ul style="list-style-type: none"> <li>• The necessary hose connections are prepared. Take care that the drain is really free.</li> <li>• Bring the mode switch in the "Start-Up" position. This will start the instrument, but without giving toxicity or hardware alarms. The green traffic light will blink in this mode.</li> <li>• Regulate the control valve to the designated flow (recommended are 100-120 l/h). The measured flow value is shown on the display.</li> <li>• Please check whether there is enough food in the automatic feeder or refill if necessary.</li> <li>• Disconnect the light and automatic feeder and</li> </ul>														



		<p>take away the lid of the aquarium.</p> <ul style="list-style-type: none"> <li>• If the system is working correctly and a constant water flow is established, the fish can carefully be put into the aquarium.</li> <li>• Mount the lid with feeder and light.</li> <li>• Close the front door of the device.</li> <li>• Bring the mode switch in the "Run" position..</li> <li>• Some questions appear on the front panel which need to be answered: Please ENTER whether there are new fish in the instrument or you are continuing with the fish of a prior operation. ENTER the number of fish. Confirm with ENTER.</li> <li>• Now the measurement starts.</li> <li>• In case of no inputs by the user, each screen is skipped after 60 s. It is assumed that the fish are still those used before and the number has not changed. This is important for starting the measurements after a power failure.</li> </ul>
Overview of the time scale for maintenance		
18	a) Maintenance 1 time per week	<ul style="list-style-type: none"> <li>• Check the aquarium for dead or injured fish</li> <li>• Clean the aquarium</li> <li>• Check and refill the automatic feeder</li> <li>• Check the pressure</li> <li>• Check and refill the dechlorination agent (option)</li> <li>• Clean the input filter for the sample water (option).</li> </ul>
	b) Maintenance 1 time per month	Replace the pump tube in the peristaltic pump (option)
	c) Maintenance 1 time per 6 months	<p>Replace the fish</p> <p>Replace the filter of the fan (option)</p> <p>Replace the membrane of the chlorine electrode (option)</p> <p>Calibrate the chlorine electrode (option)</p>

## 4 RESULTS

A video film is attached. It contains instructions for handling, maintenance and start up of the *ToxProtect 64* instrument.

## 5 CONCLUSIONS

The aim to provide the user of the *ToxProtect64* fish monitor with a comprehensive video film for application and maintenance has been achieved.