



# MONITORING OF WATER QUALITY USING PHOTOMETRIC TECHNIQUE

## *CASE STUDY: APPLICATION OF HUNGARIAN DEVELOPED ROBOTIC WATER ANALYSER*



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# INTRODUCTION



- Water Framework Directive (2000/60/EC)
- Introduction of Robotic Water Analyser (RWA)

Measurement parameters:

- Ammonium-N
  - Orthophosphate-P
  - Nitrate-N
- Application of RWA- water quality of treated sewage
    - Wastewater Treatment Plant
  - Data acquisition and processing of the results

# WATER FRAMEWORK DIRECTIVE



The most essential objective of the modern society is to manage and find solutions for the environmental problems especially water pollution which is serious problem not only for present but future generations as well.



The **Water Framework Directive** (2000/60/EC) was created as the long-term water policy of the European Union. Aim of the WFD is that the quality of the surface water should reach the good ecological and chemical state by 2015.

- This WFD has a number of objectives, such as preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts.
- Member States have to identify all the river basins lying within their national territory and to assign them to individual river basin districts.



## **Hungary River Basin Management Plans (2009)**

# WATER FRAMEWORK DIRECTIVE



- Monitoring systems have been installed for assessing and following the condition of surface waters
- Traditional chemical and hydrological monitoring systems have been developed with biological and morphological components
- Multilevel system for state evaluation, analysis and impact assessment was set up

## Installing the 3-stage monitoring system

*Surveillance monitoring: wide range analysis at sampling sites*

*Operational monitoring: based on endangered water bodies*

*Test monitoring: not predictable, however, it is necessary to be well-prepared for certain situations (extraordinary events)*



# WATER MONITORING



- 60 % of nutrient load of water bodies in Hungary originates from point sources, mainly from the treated communal wastewater.
- Treated wastewater can significantly influence the surface water quality of storage reservoirs hindering to reach the good chemical and ecological status of waters specified by WFD regulations (e.g. in case of streams with small water flow or temporary streams)



Waste Water Treatment Plant

# WATER MONITORING



In several cases the analysis of water samples is carried out „**off line**” following the sampling procedure generally carried out in laboratory. Standard methods are used for analysis in laboratories in order to obtain accurate results.

There are several advantages of using **on-line analysis**. E.g.: when the laboratory analysis is not possible or can be accomplished with high cost.



Traditional method - Sewage sampling



On-line analysis



## Benefit of the continuous measurement

- Continuous data collection
- In case of measurement result over limit value **immediate technological interventions** are possible to be carried out. If the results are obtained after a longer period of time then there is no possibility to make interactions.
- The **sudden impulse type changes can be measured** and followed as well, while in case of laboratory measurements frequent sampling and lot of sample analyses are necessary with high additional expenditure.



Mobile station was installed in Waste Water Treatment Plant (Várpalota)

# AIMS of PROJECT



The project reviews both existing standard techniques and new innovative technologies with the focus on the on-line monitoring and control.

- ❖ The Robotic Analyzer developed was adjusted, which is suitable to carry out real time measurements on  $\text{NH}_4^+\text{-N}$ ,  $\text{NO}_3^-\text{-N}$ ,  $\text{PO}_4^{3-}\text{-P}$  concentrations in the treated waste water. The measurements of the parameters are carried out on the basis of photometry with use of minimum amount of chemicals.
- ❖ The accuracy of the RWA measurements was controlled by cross checking the data with standard laboratory measurements.
- ❖ The measuring system was used at Hungarian waste water treatment plant.



Standard techniques in Laboratory



Robotic Water Analyser (RWA)



Mobile Station



# ROBOTIC WATER ANALYZER (RWA)

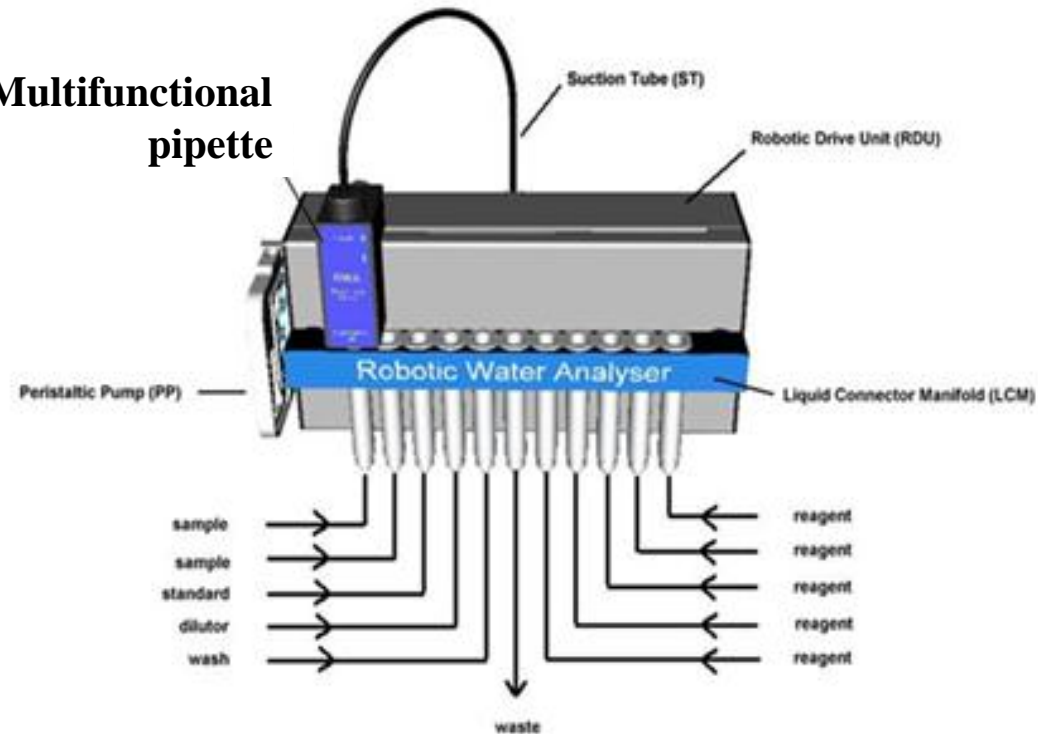


This device carries out measurements on the basis of photometric measurement principle. RWA is basically a cost effective, universal, automatic device equipped with sensor(s) for water analytical purposes.

*RWA is a Hungarian development*

- Wet chemical process /portable analyzer with less tubing and valves.
- Extremely low reagent consumption (50 – 100 ml/month)

**Multifunctional pipette**



**RWA photometer has 11 channels.**

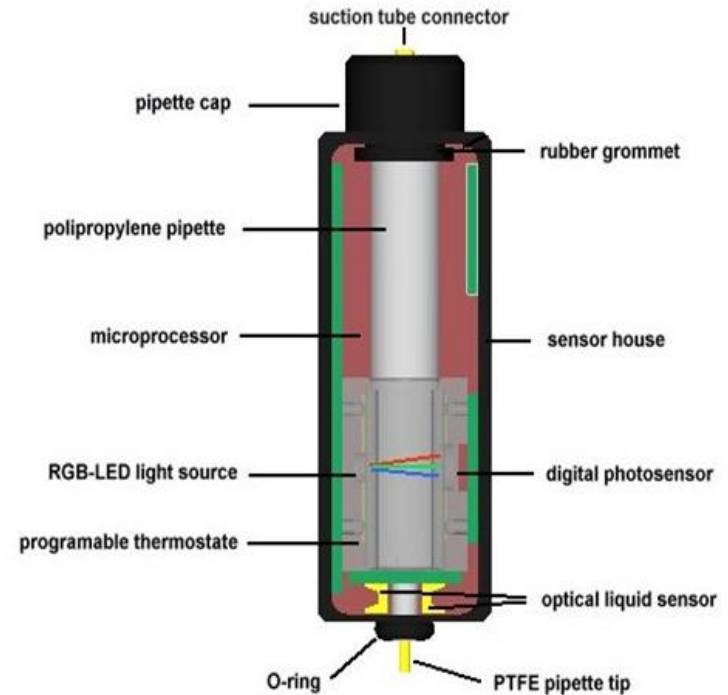
- 4 channel (Global parameter: sample, waste, standard, dilution)
- 7 channel (Test of three parameters : reagent)

# ROBOTIC WATER ANALYZER (RWA)



## Multifunctional pipette

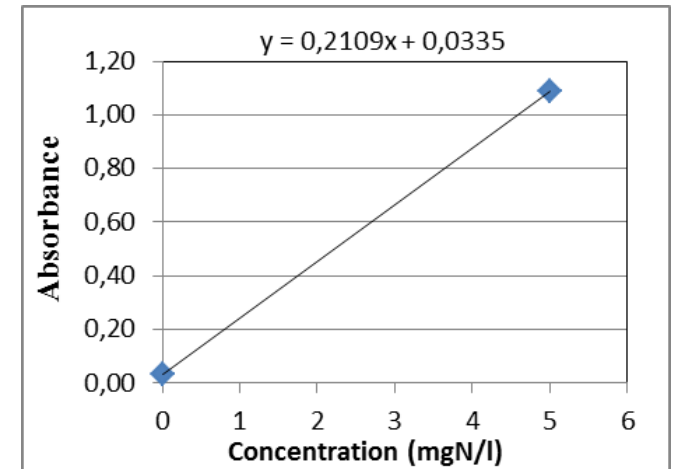
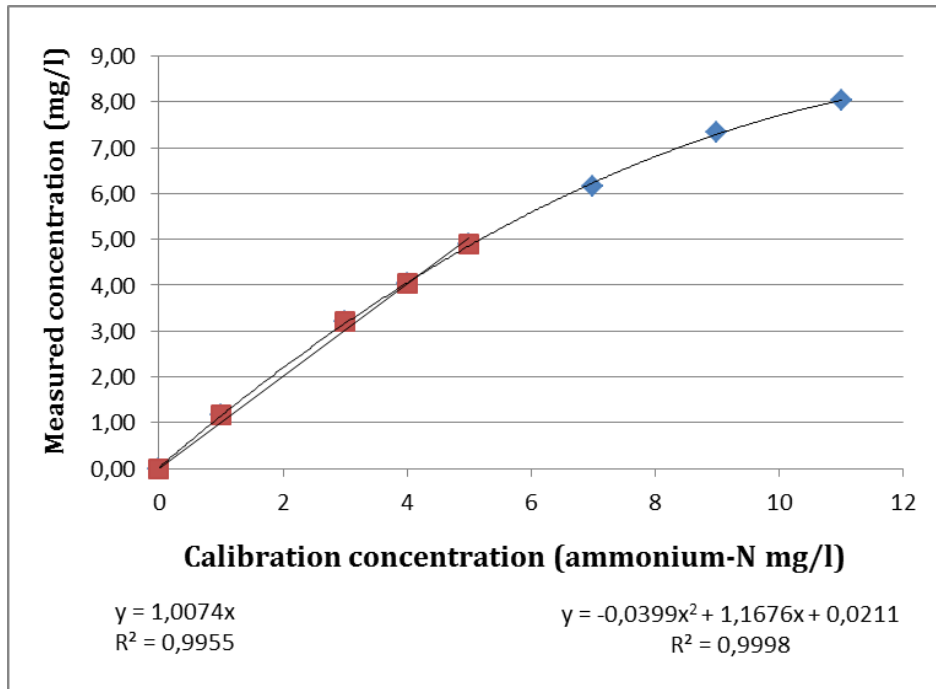
The innovative technique provides the feed of the fluids without cross-contamination applying a multifunctional pipette which functions - as a dosing pipette,  
- heated and thermostatic reaction vessel and  
- as photometric cell.



# RWA CALIBRATION



## Determination of ammonium-N (0-5 mg/l)



RWA measured standard solution concentration (5 mg/l ammonium-N) which results 4,92 mg/l.

Dilution factor: no  
Reagent rate: 1/10  
Colour reagent rate: 1/10

Test temperature: 65 °C  
LED colour: red  
Wavelength: 660 nm

# WASTE WATER TREATMENT PLANT



## Municipal Waste Water Treatment Plant in Várpalota

Monitoring period: **29.02.2012 – 07.03.2012**

Municipal waste amount: **2500 m<sup>3</sup>**

The Robotic Water Analyser was used for treated sewage quality monitoring.

Treated sewage to the  
Lake



# On-line Monitoring Station



- Equipment and analysers installed into container are able to carry out continuous measurements and collect data even under extreme weather conditions.
- Measuring station is suitable to carry out automatic on-line measurement on the main components of wastewater during 24 hours a day 7 days a week.
- The mobile station made sampling of treated wastewater in every 2 hours.
- Transportation of water sample to laboratory was carried out in mobile refrigerated water sampler



**RWA**



**Distilled water**

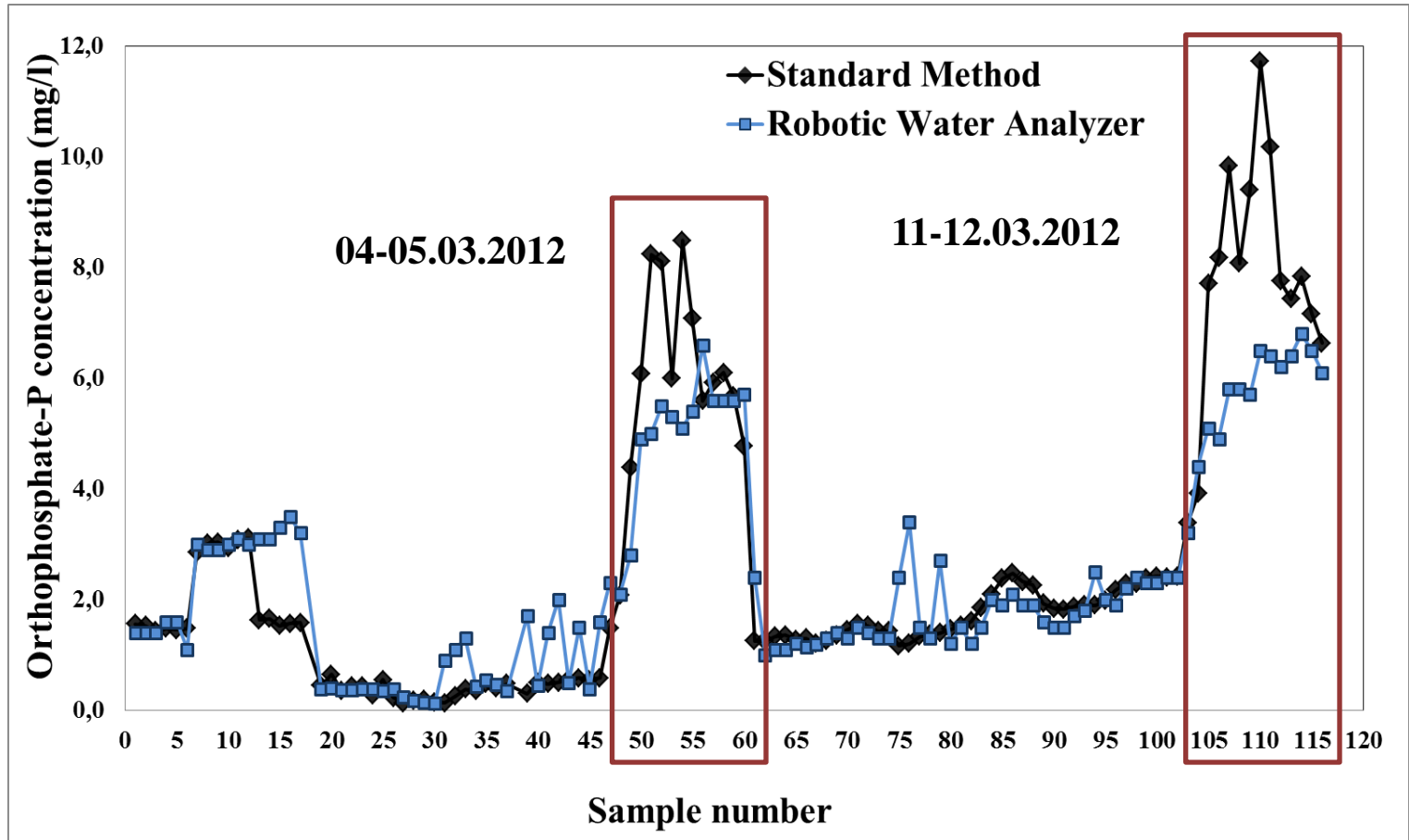
**Sample vessel**

# Orthophosphate-P concentration



Determination of Orthophosphate-P concentration with application of standard method and on-line device.

Orthophosphate-P  
concentration  
0,5-12 mg/l



# Conclusions



- ✓ The Robotic Analyser responds to changes in the wastewater treatment process.

## *Future Plans:*

- Investigation measurements on waste water treatment plants and water streams
- Identification of the pollutants





**Thank you for your kind attention!**

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