Techneau,
23. September 2008

Portable Monitoring Station

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Colophon

Title
Portable Monitoring Station

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Quality Assurance
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PU = Public

Summary

A portable monitoring station is a tool that allows quick, unprepared, field measurements. This capability is especially valuable in case of emergencies, where a quick reaction is required and measurements in the field / distribution network might be needed.

The system presented in this deliverable consists of a number of components that together constitute a portable monitoring station. The station consists of a sensor (spectro::lyser™ spectrometer probe) a controller to operate the sensor, a battery pack suited for use in the field and a compressor unit for automatic cleaning of the sensor. Each of these components can be transported easily by one person, and the entire system fits easily in a passenger car. The station, running of the battery pack, can be operated unattended for hours – weeks depending on the circumstances (measurement frequency, need for cleaning).

In the activity described here, the controller and compressor unit were adapted for the need of field with only a battery as power supply.

Contents

Description of Workpackage 3.5, component 3.5.2

Development of a new alarm system for detecting quality changes during distribution

The task of this component is the combination of the new methods "on-line delta spectrometry" and "on-line integrated UV-Vis-Spectrometry and the evaluation of a new warning and alarm system for drinking water distribution networks. In order to prove practicability of this theoretical concept and advantages compared to conventional methods in real world case under diverse conditions the primary targets of this activity has to be:

- *develop a monitoring system consisting of several monitoring stations located close to the points of water access ("tap") building up a monitoring network*
- *develop monitoring stations being ready for operation within shortest time and providing automated data transfer to one central station*
- develop one portable monitoring station
- *building up an alarm system by linking up these monitoring stations to a central station*
- *develop a central station for centralised data storage, handling and access, for providing remote access to several monitoring stations for alarming and for calculating "virtual parameters" by comparison of parameters of several monitoring stations*
- *web application providing access to database of central station*
- *research for comprehensive "virtual parameters" providing distinct information needed for operating distribution networks with respect to drinking water security*

1 Introduction

1.1 General Introducton

The main goal of the s::can contribution within workpackage 3.5 is the creation of a network of monitoring systems that provide their measurement data, automatically, to a central station. The central station then fulfils the following functions:

1. collect data from all connected monitoring stations
2. check data for completeness
3. import data into a central database
4. visualisation of the measurement results via terminal access and/or via a web-interface
5. present the ability to perform calculations with the results stored in the database, making possible new alarm parameters and comparison of results from different sites ('integrated parameters')

In addition to this, s::can has committed to develop and build one portable monitoring station. A portable system can be used to take onto a measurement site for immediate application (for example in case of an emergency) without the need for any infrastructure on site.

This portable station should consist of at least all key components in an s::can monitoring system: spectrometer probe, controller + software for operation of the probe, automatic cleaning system, power supply.

The deliverable presented here, describes the results of the development of the portable station only. Information on the central station can be found in the deliverables 3.5.2 (published), 3.5.5 and 3.5.8.

1.1.1 State of the art in December 2005

At the start of the TECHNEAU project, several components that are necessary for the realisation of a portable monitoring station were unavailable.[1] A key requirement for a portable station is that it can be operated using a portable power supply. The s::can systems available at the start of the TECHNEAU projects all depended on a controller that required mains power (110 – 220 V),[2] therefore making applications limited to fixed installation where a connection to the power supply network is available. Furthermore, in many applications it is necessary to use the automatic cleaning system of the probe. This cleaning system requires compressed air, which is typically supplied from a compressor.[3] No compressor that could be used in the field and could be run off a battery was available.

1.1.2 Progress towards Objectives

In this deliverable the missing components for a portable monitoring station have been implemented; a new version of the controller, that can also be run off a 24V DC power supply, has been developed. Furthermore, a compressor

package suitable for field use has been developed. These developments are described in more details in this document.

2 Requirements

2.1 The station

The definition of a portable station is the following:

1) the station can be operated without the need for a mains power supply, i.e. it can be run from a portable power supply such as a battery pack.

2) the station, or its single components, must be portable by one man. Therefore, single components should not weigh more than 20 kg.

3) the total system must be easily transportable, i.e. the total system when broken down into its single components should fit into a passenger car

4) the sensor(s) in the system can be applied without the need for sample preparation, pumps, etc. This means that the instrument must be able to function by simply submersing it into the water

The requirement no. 4 has already been solved: the spectrometer probe used for the monitoring station can be operated by simply submersing it in the water without the need for any further infrastructure (see also Deliverable 3.2.1). A battery pack that is suited for use in the field is also already available at s::can. This battery pack is weather proof and weighs approx 10kg. The battery provides 24V DC power.

The other 3 requirements are addressed in the developments described in this report.

2.2 Contoller

The controller is an industrial PC that can operate multiple sensors, runs the software to control these sensors and to analyse their data, and that offers interfaces to external monitoring networks and process control systems. The controller (figure 1) is built so that it is weather proof (IP65) and suited for outdoor installation and operation.

Figure 1: The s::can con::stat in the version available at the start of the TECHNEAU project.

A power supply for this controller needs to meet various specifications: it must be able to supply to power to the controller plus all connected probes (peak power consumption), must be functional in the temperature range specified for the controller (-20 – 60°C), size has to fit the space available, cooling must prevent (over)heating, it must support potential separation (separate circuits for different instruments, to prevent electrical currents from influencing measurements). A power supply that meets all these requirements, once found, must be installed in the redesigned instrument and tested under various conditions. If satisfactory, the redesigned controller has to go through approval testing by an authorised institute to obtain the required certificates for electrical instruments.

2.3 Compressor

The supply of compressed air for automatic cleaning of the spectrometer probe as well as other sensors connected to the controller, can be provided in two different ways: 1) use of a compressor to produce pressurised air on-site 2) use of bottles with compressed gas (for example air or CO_2). The use of a compressor is normally preferred as this is less expensive and logistically less demanding. Therefore it was decided that the portable monitoring station should also have a compressor. The use of gas bottles was already possible, and is not affected by the availability of the compressor: the user will now have the choice which of the options to use. The requirements for the compressor were the following: it needs to be able to supply sufficient pressure (3 bar during cleaning), have a small pressure reservoir (to keep pressure stable during cleaning) and require little maintenance (oil free compressor), and has the same environmental rating as the other system components (IP65).

3 Results and Discussion

3.1 Controller

A DC power supply meeting the set specifications was identified and tested (figure 2). A redesigned controller was then equipped with supply and elaborately tested. Finally, the system was subjected to electromagnetic compatibility testing by TGM (www.tgm.ac.at), a technical institute in Vienna (figure 3).

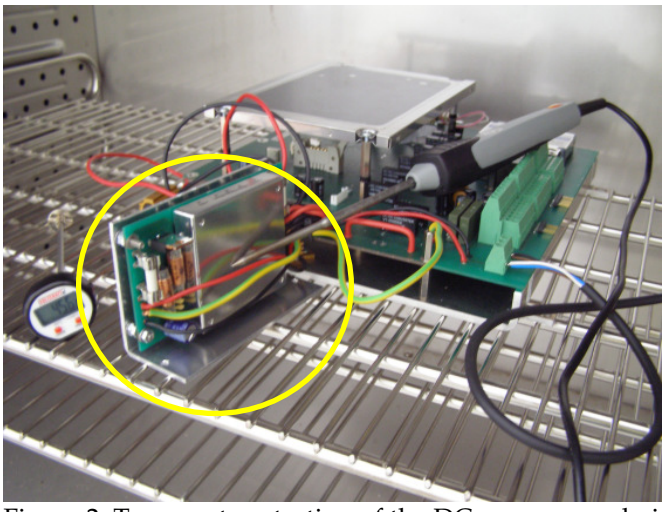
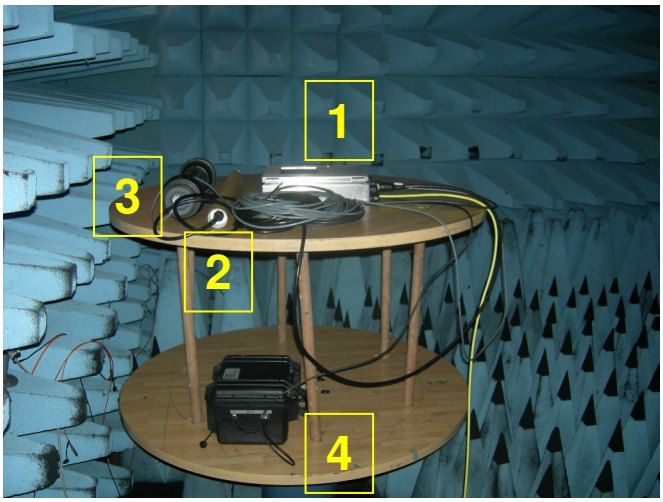


Figure 2: Temperature testing of the DC power supply in a climate control chamber.



1: controller con::stat 3.3

2: spectro::lyser™ spectrometer probe

3: ammo::lyser™ ammonium probe

4: battery pack

Figure 3: DC power supply controller during EMC test.

3.2 Compressor

For the compressor suitable for field use, a commercially available compressor was selected and a custom housing was designed around this unit. The housing had to ensure: protection of the compressor against mechanical damage, sufficient cooling of the unit, provide environmental protection grade IP65.

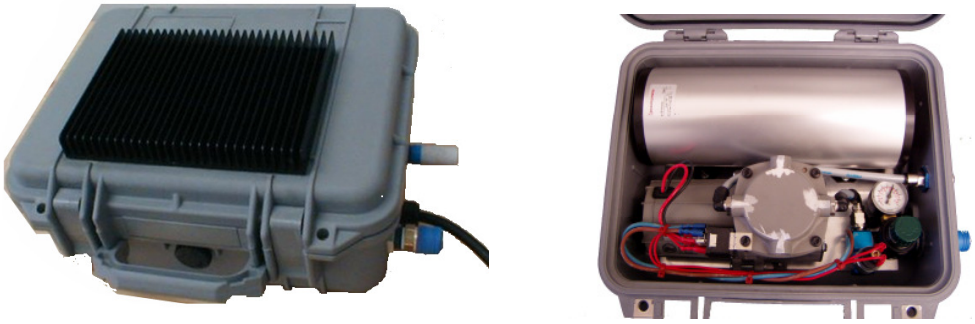


Figure 4: The compressor unit for field use. Left: exterior view. Right: view of internal parts of the unit.

3.3 Portable monitoring station

The complete monitoring station has to consist of the following items: sensors (at least on spectrometer probe), controller, portable power supply, compressor/air bottle. With the adapted controller and new compressor unit all individual parts are available.

When combining all units, the following has to be noted:

1) although the system is portable, meaning it does not need fixed infrastructure to operate, it is not a handheld system. The total weight of all components is approximately 30 kg (with one spectrometer probe only, additional sensors will add further weight).
2) the lifetime of the power supply, before it needs recharging, is limited. Depending on the measurement frequency, cleaning frequency and settings of several power saving features, battery lifetime can vary between:
    a. up to 7 days when using spectrometer probe only, measuring every 10 minutes, between measurement probe is in sleep mode
    b. less than 1 day when operating a spectrometer that measures every 2 minutes and is cleaned before every measurement.

Battery lifetime can be extended by using solar cells for recharging, but this was not explicitly implemented or tested in the work presented here. Furthermore, in case frequent cleaning is required, it is possible to use a

separate battery pack for the compressor, which will significantly extend the time the system can run unattended.

Under all circumstances the system is suited for rapid deployment from a vehicle, e.g. an automobile, and to start measurements immediately upon deploying it on the measurement site. However, the measurement requirements of the user and the site will determine how long the system will be able to operate unattended.

Figure 5: All components of the portable station assembled. From left to right: (1) weather proof battery pack, (2) weather proof compressor unit, (3) spectro::lyser™ spectrometer probe and (4) con::stat controller.

4 Conclusions and Future Work

The objective of the activity described here was the development of a portable monitoring station. The components that were required for this have been developed and tested individually. The station in its entirety must now be tested in a real application. This evaluation will have to include both operational testing (ease of use, reliability, issues with hardware) as well as performance testing. Although a huge number of applications have been installed already, a further test within the TECHNEAU project could be use to (re)verify the algorithms on the instrument against reference analytics. The latter are necessary in any case to calibrate the instrument to achieve optimal performance under local conditions.

This type of evaluation could take place in TECHNEAU working area 7.

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[1] Pricelist s::can Messtechnik, 4th Quarter of 2005.

[2] van den Broeke, J.; Hofstädter, F. "Monitoring the full range of water quality parameters – online, easy and cost-efficient" *International Environmental Technology*, **2006**, *16(4)*.

[3] Winkler, S., Rieger, L., Thomann, M., Siegrist, H., Bornemann, C. and Fleischmann, N. (2002). In-line monitoring of COD and COD-fractionation: Improving dynamic simulation data quality. In: IWA (ed.). Preprints of the 3rd IWA International World Water Congress, April 7–12, 2002, Melbourne, Australia (paper no. e21604a).