

**Advances in Water Pollution Control**

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# **INSTRUMENTATION AND CONTROL OF WATER AND WASTEWATER TREATMENT AND TRANSPORT SYSTEMS**

**Editor: R. A. R. DRAKE**



INTERNATIONAL ASSOCIATION  
ON WATER POLLUTION  
RESEARCH AND CONTROL

# **INSTRUMENTATION AND CONTROL OF WATER AND WASTEWATER TREATMENT AND TRANSPORT SYSTEMS**

Proceedings of the 4th IAWPRC Workshop held in Houston  
and Denver, U.S.A., 27 April – 4 May 1985

*Editor*

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## PREFACE

The contents of this book are the papers and posters presented at the fourth IAWPRC Workshop on 'Instrumentation and Control of Water and Wastewater Treatment and Transport Systems', held in Houston and Denver USA from 27 April to 4 May, 1985. This Workshop is the latest in a very successful IAWPRC series. By tradition the Workshops are held in two consecutive locations, the first part being given over to the main part of the scientific programme. In the second part the emphasis is on technical visits and a final plenary workshop session. Previous venues have included London/Paris in 1973; London/Stockholm in 1977 and Munich/Rome in 1981.

Although progress with automation has been considerably slower than expected at the first Workshop in 1973 (particularly so far as wastewater treatment is concerned) it does appear that at last there is recognition at the highest level of the potential benefits. The advent of the micro-processor and the ever increasing rapidity of technological advance have contributed to progress and will no doubt continue to do so.

Water and wastewater have many aspects of instrumentation and control in common and thus the Workshop encompasses both.

Improvement of communication is the most important function of the Workshop and, in particular, between those engaged in research, those engaged in practice and those responsible for regulation and it will be seen that the range of papers is very wide. There are several papers on the practical application of automation to both new and existing plants, showing that automation can be beneficially applied.

Since the previous Workshop in Munich/Rome, IAWPRC has established a Study Group on 'Instrumentation for On-line Measurement'. One of the group's tasks has been to oversee events such as the present Workshop. Another of its activities is the production of a regular Newsletter.

This book contains only those papers and posters which were submitted in good time, the book having been produced in time for distribution to delegates at the Workshop. The highlights of the Workshop and ensuing discussions, along with references to late papers, will be reported in the 1985 Study Group Newsletter.

Obviously, participation in the Workshop brings most benefit to the individual, but this book of papers amounts to an evaluation of the state of the art and, as the proceedings of previous Workshops have been, will no doubt be used a great deal for reference purposes.

# IAWPRC STUDY GROUP ON INSTRUMENTATION FOR ON-LINE MEASUREMENT

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## INTRODUCTION

This Study Group, amongst its other activities, has the overall responsibility for the 4th IAWPRC Workshop on 'Instrumentation and Control of Water and Wastewater Treatment and Transport Systems' - the proceedings of which are published in this book. This responsibility is likely to extend to future workshops in this series. As Chairman of the Group, I felt it would be appropriate at this point to provide some details of the background of the Group and its formation, to summarise progress to date and to give an indication, albeit brief, of the Group's future policies, broad aims and objectives.

## BACKGROUND

The series of Workshops on Instrumentation, Control and Automation (ICA) in Water and Wastewater Treatment held in London and Paris, 1973; London and Stockholm, 1977; and Munich and Rome 1981; provided the initiative for the formation of the Group which was formally established in September 1981. Much of the credit for the impetus in the early days of the Group's formation must go to Professor John F. Andrews who is an enthusiastic supporter of instrumentation, control and automation for the water industry and is Chairman of the Programme Committee for this Conference.

At present the Group comprises the relatively small number of enthusiasts listed in the Appendix at the end of this report. However we are already attracting a number of corresponding members and we hope to involve representatives of the instrument industry to a much greater extent in the future. The Group has met five times: in Cape Town in 1982 during the Biennial Conference; in London in September 1982; Vienna in September 1983; Amsterdam in September 1984; and Houston in October 1984. These meetings have produced two Newsletters. These have provided detailed terms of reference, a work programme, an indication of progress to date and a number of special features including details of test houses and their activities and a listing of variables of most significance, both in water and wastewater treatment and transport.

## FUTURE POLICIES AND OBJECTIVES

The principal objectives of the Group are set out below.

1. To develop a mechanism whereby IAWPRC can collect, collate and disseminate pertinent technical information to the international user community.
2. To provide a method of co-ordinating and encouraging international co-operative ventures relative to each part of these tasks.

To achieve these objectives the Group plans to study the following topics:-

- a) Develop or select scientifically defensible terms for the specification, installation and use of instruments.
- b) Establish guidelines for the development of test protocols for use in the evaluation of instrument performance at both laboratory and field test sites.
- c) Develop quality control and quality assurance procedures for collecting and analysing performance data provided by instrument users.
- d) Develop and publish guidelines for preparing effective performance specifications.

In the above context a short list of the more important variables of significance in water and wastewater treatment and transport is provided in Table 1 together with an indication of equipment availability.

Our Study Group is concerned with the need for prospective users of ICA systems to compare the reliability of available instrumentation with the potential advantages that could result from current research, and also to consider the likely advantages resulting from a consideration of a total systems approach to existing and anticipated problems.

It is of vital importance therefore to recognise internationally the need to establish procedures (protocols) by which available and potential systems can be evaluated. Only in this way will reliable and robust equipment be made available at an acceptable price.

In parallel with the above it is essential that relevant research must be properly funded and consequential exploitation by industry encouraged.

Although our Group is small at the present time we have every intention of ensuring that it will expand and thus provide the required impetus.

TABLE 1  
Variables of Highest Importance and Availability of Equipment

Area of Application	Variable	Equipment Availability
Water treatment and water distribution systems	liquid flow	1
	liquid level	1
	pressure	1
	temperature	1
Water Quality Monitoring Applications	chlorine residual	2
	iron	3
	manganese	3
	aluminium	3
	heavy metals Cu, Cd, Hg etc.	3
	sludge blanket level	2
	turbidity	1
	colour	2
	organic matter	2
	(UV absorption)	2
	taste	-
	odour	-
	toxic organics	3
	treatability	3

	ammonia	2
	nitrate ion	2
Sewerage systems	liquid flow	3
	liquid level	2
	liquid pressure	2
	treatability	3
	toxicity	3
Gases	flow/pressure	1
	dissolved oxygen	2
	hydrogen sulphide	2
	methane	2
	carbon monoxide	2
	carbon dioxide	2
	stress cracking	3
	voids	-
Sewage treatment	liquid flow	2
	liquid level	2
	sludge blanket level	2
	sewage (suspended solids)	3
	mixed liquor (suspended solids)	2
	returned sludge (suspended solids)	2
	surplus sludge (suspended solids)	2
	dissolved oxygen	1
	treatability/toxicity	3
	gas flow and pressure	1
	oxygen	1
	flow (sludge gases)	2
	pressure (sludge gases)	2
	calorific value (sludge gases)	2
	methane (sludge gases)	2
	carbon monoxide (sludge gases)	2
	carbon dioxide (sludge gases)	2
	oxygen (sludge gases)	2
River management	flow	1 & 2
	level	1 & 2
	temperature	1
	dissolved oxygen	1
	ammonia	2
	nitrate ion	2
	chloride ion	2
	conductivity	1
	heavy metals	3
	trace organics	3
	biologically based sensors	3

- 
- Availability Code:-
1. Readily available.
  2. Sensors available, not necessarily in a form suitable for the application; therefore, the system requires development.
  3. In experimental or prototype stage.

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# INSTRUMENTATION, CONTROL AND AUTOMATION — THE U.K. INITIATIVE

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## ABSTRACT

The paper outlines the background to the instrumentation, control and automation initiative taken in the U.K. jointly by the government, manufacturing industry and the water industry. It describes the problems and requirements of the water industry, and how the Group aim to improve this by the preparation of Guidelines on purchase, user specification, appraisal, and maintenance etc of systems. In addition the provision and use of Evaluation and Demonstration Facilities (EDF) for the proving of systems and instrumentation by the automation of real works in the fields of sewage treatment, water treatment, supply and distribution and river management, and defines the way ahead and what still remains to be done.

## KEYWORDS

Instrumentation, control and automation; (abbreviated to ICA in what follows). Water Research Centre; ( - the national organisation for water research in the U.K.; abbreviated as WRC in what follows). Evaluation and Demonstration Facilities; (an automated water industry plant designed for demonstration and evaluation purposes; abbreviated as EDF in what follows).

## INTRODUCTION

Following the reorganisations of the British Water Industry in the early 1970's which included the creation in 1974 of the 10 Water Authorities in England and Wales dealing with the whole water cycle, and the rapid development of automation and new technology, both the water industry and the government were looking at ways to further these techniques.

In early 1979 the Department of Industry commissioned Environmental Resources Ltd and Watson Hawksley to examine the potential for the exploitation of ICA techniques in the management of the water industry and the size of the market for ICA products that such exploitation would create. The findings, published in December 1979, suggested that there were large opportunities and a market size for ICA systems of £40-£50 million could be expected by 1984.



Since then pressure to reduce costs and to become more efficient, as well as to offer better consumer service, and the rapid emergence of other new techniques, e.g. map digitising and computer aided design, has shown these estimates of modest size to be far too low.

The findings of the report were presented and discussed at a seminar in London in the early summer of 1980 and it was evident that there was considerable interest from both potential users and from manufacturers.

In order to maintain the momentum created by these initiatives, the former National Water Council, with strong support from the Department of the Environment and the Department of Industry, decided to create a National Steering Group on ICA under the Chairmanship of a Chief Executive of a Water Authority. The role of the Group was to ensure that the U.K. water industry and its suppliers would be able to derive maximum benefit from the application of these new technologies in the shortest possible time by taking maximum advantage of progress made in other industries. The Group was intended to provide the framework for the development of ICA, remove any bottlenecks to progress and generally accelerate the introduction, rather than to produce detailed specifications of equipment.

It was recognised that to be effective the Steering Group should have wide representation including senior water industry managers, manufacturing industry, government ministers and the Water Research Centre.

#### TERMS OF REFERENCE

In abridged form were:-

To determine priorities for action and research, to draw up user requirements for ICA equipment and systems, including overall design and cost factors.

To require the Water Research Centre (WRC) to link with U.K. manufacturing industry for these requirements, to set up evaluation and demonstration facilities (EDF's) in concert with the water utilities and manufacturers to co-ordinate the evaluation programme and to assist in export sales.

To fund, with government assistance, the development of necessary new ICA equipment.

To keep government informed on public/private sector co-operation in this field and to make recommendations, and to make recommendations to the Water Industry on policy implications, including staff recruitment and training.

#### METHOD OF WORKING

First the group surveyed the main concerns of water industry users which included:-

- concern about whether the industry had a sufficient understanding of its processes to be able to design control systems, i.e. one needs to know what parameters need to be measured, and how to react to such parameters with more confidence than was available at that time.

- where there was confidence about what parameters to monitor there was doubt about the availability and reliability of on-line instrumentation to measure such parameters as DO, pH, NH<sub>3</sub>, colour, turbidity, sludge density etc. Instruments