WATER QUALITY PARAMETERS

WATER QUALITY PARAMETERS

A symposium cosponsored by the Canada Centre for Inland Waters and the Analytical Chemistry Division of the Chemical Institute of Canada Burlington, Ontario, Canada, 19-21 November 1973

ASTM SPECIAL TECHNICAL PUBLICATION 573 Silvio Barabas, general chairman

List price \$29.50 04-573000-16



© BY AMERICAN SOCIETY FOR TESTING AND MATERIALS 1975 Library of Congress Catalog Card Number: 74-28980

NOTE

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

Printed in Baltimore, Md. June 1975

Second Printing, 1979 Baltimore, Md.

Foreword

The Symposium on Water Quality Parameters—Selection, Measurement, and Monitoring was held on 19-21 November 1973 at the Canada Centre for Inland Waters in Burlington, Ontario, Canada. The symposium was cosponsored by the Canada Centre for Inland Waters and the Analytical Chemistry Division of the Chemical Institute of Canada. Silvio Barabas, Canada Centre for Inland Waters, presided as the general chairman.

This publication was sponsored by the American Society for Testing and Materials' Committee on Publications.

Related ASTM Publications

Biological Methods for the Assessment of Water Quality, STP 528 (1973) \$16.25, 04-528000-16

Microorganic Matter in Water, STP 448 (1969) \$9.25, 04-448000-16

Manual on Water, STP 442 (1969) \$16.50, 04-442000-16

Contents

Introduction	1
Inorganic Analysis	
Asbestos Fibers in Lake Superior—R. W. DURHAM AND T. PANG	5
Analytical Method	6
Results Discussion	7 12
	12
Spectrophotometric Determination of Sulfide in Water—	14
F. A. J. ARMSTRONG	15
Experimental Recommended Method	15
Results and Discussion	16
Electrochemical Detection of NH ₄ +-NH ₃ Systems in Water—	~ ~
J. BARICA	20
Determination of Ionized NH ₄ + with a Univalent Cation	20
Electrode	21
Determination of Total Ammonia with an Ammonia Probe	23
Direct Determination of Free Unionized Ammonia	23
Discussion	24
Determination of Total Mercury Levels in Natural Waters—	
SUEO NISHI AND YOSHIYUKI HORIMOTO	25
Experimental	26
Results and Discussion	27
Analysis of Zn ⁺⁺ , Cd ⁺⁺ , and Pb ⁺⁺ in Natural Waters by Anodic Stripping Voltammetry Using a Rotating Pt:Hg Electrode—	
PIERRE PICHET AND MONIQUE GRANDMAISON	30
Experimental	30
Results and Discussion	31 34
Summary	34
Automated Method for Sulfate Determination in Lake Water—	25
M. A. SANTIAGO, SAUNDRA FIELEK, AND C. L. SCHELSKE	35
Experimental Results and Discussion	36 37
Conclusion	44
	• • •
Measurable Inorganic Carbon Parameters in Seawater— C. S. WONG, R. D. BELLEGAY, AND A. B. CORNFORD	47
Selection of Parameters	48
Experimental Techniques	49
Discussion	54

Critical Review of Analytical Techniques for the Determination	
of Soluble Pollutant Heavy Metals in Seawater—	50
D. C. BURRELL AND MENG-LEIN LEE	58
Detection Limits and Applicability	59
Seawater Matrix Problems	63
Chemical Speciation of Soluble Fraction	64
Sampling and Pre-Analysis Processing	67
Survey Analyses of Trace Elements in Water by Spark Source	
Mass Spectrometry—I. H. CROCKER	71
Experimental	73
Results and Discussion	78
Nuclear Activation Determination of Heavy Metals in Great Lakes Sediments, Soils, and Vegetation—R. E. JERVIS,	
AMARES CHATTOPADHYAY, E. CSILLAG, AND B. TIEFENBACH	82
Nuclear Activation Techniques (NAA and PAA)	83
Studies of Lower Great Lake Sediments: Selenium and	65
	87
Antimony (NAA) Toxic Metal Accumulation in Accustic Species (NAA)	91
Toxic Metal Accumulation in Aquatic Species (NAA)	92
Studies of Heavy Metal Uptake in Marsh Soils: (IPAA) Conclusions	93
	73
Trace Elements in Molluscs in the Kingston Basin—	
D. A. LORD, W. G. BRECK, AND R. C. WHEELER	95
Experimental	98
Results and Discussion	100
Conclusion	108
Analysis of Total Mercury in Biological and Water Samples by	
Analysis of Total Mercury in Biological and Water Samples by an Ultrasensitive Kinetic Method—P. J. KE AND	
	112
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT	112 114
an Ultrasensitive Kinetic Method-P. J. KE AND	114
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental	
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion	114 115
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters—	114 115 116
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES	114 115 116
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental	114 115 116 122 124
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure	114 115 116 122 124 124
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration	114 115 116 122 124 124 124
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide	114 115 116 122 124 124 124 125
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide	114 115 116 122 124 124 124 125 126
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision	114 115 116 122 124 124 124 125 126 126
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy)	114 115 116 122 124 124 125 126 126 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions	114 115 116 122 124 124 124 125 126 126
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle	114 115 116 122 124 124 125 126 126 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA,	114 115 116 122 124 124 125 126 126 127 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA, A. A. SCHULDT, AND W. G. HINES	114 115 116 122 124 124 125 126 126 127 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA, A. A. SCHULDT, AND W. G. HINES Experimental	114 115 116 122 124 124 125 126 126 127 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA, A. A. SCHULDT, AND W. G. HINES Experimental Reagents	114 115 116 122 124 124 125 126 126 127 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA, A. A. SCHULDT, AND W. G. HINES Experimental Reagents Determination of Fluoride in HCl	114 115 116 122 124 124 125 126 126 127 127
an Ultrasensitive Kinetic Method—P. J. KE AND R. J. THIBERT Experimental Procedure Results and Discussion Rapid Determination of Cyanide in Waste Waters— OM P. BHARGAVA, G. W. DELINE, AND W. G. HINES Experimental Calibrations and Procedure Effect of Variation in NaOH Concentration Effect of Sulfide Effect of Thiocyanate, Thiosulfate, and Ferrocyanide Precision Recovery (Accuracy) Conclusions Rapid Determination of Fluoride in Hydrochloric Acid, Pickle Liquor, and Gaseous Emissions—OM P. BHARGAVA, A. A. SCHULDT, AND W. G. HINES Experimental Reagents	114 115 116 122 124 124 125 126 126 127 127

Iron Interference in F Determination in Pickle Liquor Effect of HCl Concentration Summary	132 133 134
Scanning Electron Microscopy and Energy Dispersive X-ray Microanalysis of Nuclear Reactor Corrosion Particles— A. G. WIKJORD, G. H. MAYOR, AND F. E. DOERN Experimental Discussion Conclusions	136 138 140 150
Preservation of Wastewater Effluent Samples for Forms of Nitrogen and Phosphorus—D. F. KRAWCZYK Experimental Results Conclusions	152 153 157 161
Organic Analysis	
Guidelines for Quantitative Liquid-Liquid Extraction of Organo- phosphate Pesticides from Water—I. H. SUFFET, C. WU,	
AND D. T. L. WONG	167
Method of Approach	169
Experimental	169
Results	174 181
Summary	101
Pesticide Residue Screening Methods Utilizing Multidetector Configurations—H. A. MCLEOD AND D. E. COFFIN	183
Analysis of Organochlorine Residues in Fish—L. M. REYNOLDS	400
AND T. COOPER	196
Cleanup of Biological Tissue Extracts	197
Analyses of Fat or Oil Samples for Low Levels of OC Residues	199 200
PCB Quantitation	200
Some Factors Affecting the Recovery of Polychlorinated Biphenyls (PCB's) from Water and Bottom Samples—	200
T. A. BELLAR AND J. J. LICHTENBERG	206 207
Experimental Results and Discussion	207
Conclusions	218
	210
Liquid Chromatography of Carbamate Pesticides— A. D. THRUSTON, JR	220
Experimental	221
Results and Discussion	221
Conclusions	223
Uncoated Teflon as Support and Stationary Phase for Liquid/ Solid Gas Chromatography—K. L. E. KAISER	227
Properties of Teflon as Support	228
Experimental	228
Results and Discussion	229
Direct Aqueous Injections	236
Conclusion	240

Applications of Direct Aqueous Injection Gas Chromatography	
and Freeze Concentration for the Determination of Organic Compounds in Water and Waste Waters—M. E. FOX	242
Residual Methanol in Sewage	242
Aircraft Deicer in Sewage	244
Kraft Pulp Mill Effluent Plume	248
Gas Chromatographic Determination of Low Concentrations of Hydrocarbons in Water by Vapor Phase Extraction—	
DONALD MACKAY, W. Y. SHIU, AND A. W. WOLKOFF Theoretical	251 252
Experimental	252 254
Results and Discussion	256
Polycyclic Aromatic Hydrocarbons in Lake Waters and Associated Sediments: Analytical Determination by Gas Chromatography-Mass Spectrometry—M. T. STROSHER AND	
G. W. HODGSON	259
Experimental	260
Instrumentation	262
Results	262 269
Summary	209
A Gas Liquid-Gas Solid Chromatographic Method for the Identification of Sources of Oil Pollution—A. E. GEORGE,	
G. T. SMILEY, D. S. MONTGOMERY, AND H. SAWATZKY	271
Experimental	273
Discussion	277
Quantitative Analysis of Petroleum Oil Pollutants by Infrared Spectrophotometry—MICHAEL GRUENFELD	290
Experimental	293
Results and Discussions	295
Biological Analysis	
Problems in the Monitoring of Biomass—N. H. F. WATSON,	
G. F. CARPENTER, AND M. MUNAWAR	311
Biomass Estimation	312
Procedure	312
Heavy Metal Toxicity and Algal Bioassays—T. C. HUTCHINSON	220
AND P. M. STOKES	320 321
Experimental Details Results and Discussion	325
Conclusion	342
Algal Assays: Development and Application—T. E. MALONEY	
AND W. E. MILLER	344
Experimental	346
Results and Discussion	347 353
Conclusion	353
Effect of Body Weight on Uptake of Methyl Mercury by Fish— A. S. W. DE FREITAS AND J. S. HART	356
Experimental	350 357
Results and Discussion	359

Monitoring and Remote Sensing

Experiences in Operating a Continuous Water Quality	
Monitoring Network-J. E. HAGAN AND R. L. ESTES	367
The System	368
Procedures	373
Cost	373
Automatic Water Quality Monitoring Within the Saint John	
River Basin—D. H. CULLEN	375
Monitor Purchase	376
Physical Arrangement and Operation of Monitors	376
Monitor Locations	380
Field Monitor Services Operational Problems and Applied Corrective Measures	381 384
Monitoring Servicing	388
Data Output	388
Assessment	389
Future Outlook for AWQM's	390
Field Analysis of Dissolved Gases in Lake Waters by Gas	
Chromatography—D. A. J. MURRAY, D. POVOLEDO, AND	
R. V. SCHMIDT	391
Experimental	392
Calibration	394
Discussion	395
Underwater Probing with Laser Radar—s. SIZGORIC AND	
A. I. CARSWELL	398
Lidar Design Considerations	399
The Marine Lidar System	403
Measurements	406
Conclusion	412
Fast Kinetic Spectrometry and Automated Trace Analysis—	
C. H. LANGFORD	414
Sensors for Monitoring Water Quality—R. S. INGOLS AND	
T. F. CRAFT	418
Design Considerations	418
Sampling	421
Conclusion	423
A Remote Sensing Laser Fluorometer—R. A. O'NEIL,	
A. R. DAVIS, H. G. GROSS, AND J. KRUUS	424
Fluorescence	424
Remote Sensing	427
The Laser Fluorosensor	427
Field Trials	429
Conclusion Possible Future Development	434 434
Possible Future Development	434
REX, A Computer Controlled Robot for In Situ Water Quality	427
Monitoring—k. N. BIRCH	437
The Basic System Configuration	438
The Robot Sensing Head The Measurement of Water Quality Parameters	441 445
Conclusions	443 453

Utilization of Data from Continuous Monitoring Networks-	
C. G. GUNNERSON	456
Data and Analyses	458
Discussions and Conclusions	474
Parameter Selection and Quality Control	
Environmental Impact of Experimental Oil Spills in the Canadian Arctic—W. A. ADAMS, B. F. SCOTT, AND	400
N. B. SNOW	489
Study Area	491 492
Methods Function and a Cit Spills	492 498
Experimental Oil Spills Discussion and Conclusions	510
Investigation of the Weathering of a Selected Crude Oil in a	
Cold Environment—B. F. SCOTT	514
Study Area Preparation	515
Analytical Procedures	515
Results and Discussion	516
Summary	522
Sampling Techniques in Urban Runoff Quality Studies—	=0.
J. MARSALEK	526
Composite Sampling Techniques to Determine the Total	527
Pollutant Yield from a Runoff Event	527
Sampling Techniques to Determine the Pollutant	530
Concentration Variation Practical Aspects of Sampling Installations in Urban Runoff	330
Studies	536
Conclusions	541
Stable Carbon Isotope Ratios as Water Quality Indicators—	
F. C. TAN AND G. J. PEARSON	543
Carbon Isotope Ratios of Various Carbon Reservoirs	544
Principles of δC ¹³ Technique	544
Analytical Techniques	546
Application	547
Selection of Background δC ¹³ Values	548
Limitations and Applicability of the Method	549
Data Are for Looking At or Quality Control Through	
Interpretation—J. M. BEWERS, I. D. MACAULAY,	550
BJØRN SUNDBY, AND D. E. BUCKLEY	550 551
Data Interpretation and Corrective Feedback	552
Input Data Inspection	554
Data File Interpretation Sediment Data	563
Conclusions	565
Interlaboratory Study of the Cold Vapor Technique for Total	
Mercury in Water—1. A. WINTER AND H. A. CLEMENTS	566
Experimental	567
Results	569
Discussion	579
Conclusions	579

