

# Handbook on the Selection of Methods for Digestion and Determination of Total Phosphorus in Environmental Samples

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## Contents and Objectives

The idea to compile various standard operating procedures, lab instructions, method descriptions and experiences developed from our joint work in the Leibniz ScienceCampus Phosphorus Research Rostock. This ScienceCampus connects researchers working on and with the element phosphorus, above all the Leibniz institutes LIKAT Rostock, INP Greifswald, IOW Warnemünde, IPK Gatersleben, FBN Dummerstorf and the University of Rostock. The aim of this work was and is to provide a variety of methods to digest different natural materials for measuring phosphorus. The user is guided to choose from the wealth of methods by material, lab equipment and experience. We further give many examples of method comparisons incl. digestion yield rates. Another hot topic is quality measurement. We provide a control chart system - similar to the one of the water analytics within the European Water Framework Directive -, which is composed of blank, standard and reproducibility charts. Distinct examples are given for the limits of detection and quantification, the combined standard deviation of controls and samples as well as measuring ranges.

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## Preface

Water and soil analytics have been performed at the Biological Station Zingst and at the department of Soil Science at the University of Rostock for decades. While doing so, students' insecurities in dealing with laboratory glassware, chemicals and other materials became obvious. Especially knowledge about the common practice of quality management, which is required by law, seemed to be little.

Another noticeable problem in today's scientific landscape and the environmental mentoring is the wide gap between scientific and technical work. This hampers the transfer of knowledge and experiences as well as the understanding of methods and complicates a problem-oriented allocation of resources (effort (method selection e.g. molybdenum blue vs. ICP-OES), accuracy, correctness, reproducibility).

Observing these deficiencies, the authors compiled this book on analytics, which not only contains a detailed description of methods but also compiles the most important terms and tools to ensure and illustrate precision, correctness, measuring range and specificity of analytic results. There are examples of the quality parameters and (in many cases) comparative measurements of different methods or versions for each method and each material. This book combines the underlying theory (often known for a long time) with detailed step by step instruction, materials, simple calculations, examples, photographs, tips and tricks.

Individual chapters are published sequentially as collection of pages, which are constantly updated on the intranet of the University of Rostock and of the Leibniz ScienceCampus Phosphorus Research:

[www.bsz.uni-rostock.de](http://www.bsz.uni-rostock.de) (see "Lehre")

[www.sciencecampus-rostock.de](http://www.sciencecampus-rostock.de)

All chapters will be available in German and English bit by bit. We welcome comments and additions by the readers at any time.

Rostock, April 2020

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### PD Dr. rer. nat. habil. Rhena Schumann

studied Aquatic Ecology at the University of Rostock, earned her doctorate in 1994 and habilitated in 2005 in Ecology and Microbiology. Her research foci are plankton ecology, microscopy and increasingly biogeochemical material cycles in coastal waters and the analysis of ecological long-term data. The latter has gained in importance since the take-over of the Biological Station Zingst and gave her the opportunity to work more deeply with analytical methods.

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### Dr. agr. Dana Zimmer

studied Agricultural Economics at the University of Rostock and did her doctorate in 2011 on phytoremediation of alluvial meadow soils with willows. She worked on a broad range of topics including native lupins as foodstuff, influence of humic substances on the compressive strength of stones, separation of digestates as P fertilizer, and gathered wide experience in different analytical methods (trace elements, granulation, SEM-EDX and others) by working in various projects in the professorships of Soil Science and Soil Physics. Due to the employment in the project "InnoSoilPhos", the focus has been on the research of phosphorus in soil, including phosphorus analytics since 2015. Since October 2018 she is coordinator of the Leibniz ScienceCampus Phosphorus Research Rostock.

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# Contents

## **1 P Concentrations in Environmental Samples**

### 1.1 Binding Forms of Phosphorus

#### 1.1.1 P Binding Forms in Soils

### 1.2 Concentrations in Mineral Rock Phosphates

### 1.3 Atmosphere and Precipitation

### 1.4 Waters

### 1.5 Sewage and Process Water

### 1.6 Soils

### 1.7 Sediments

### 1.8 Plant and Animal Biomass

#### 1.8.1 Plants

#### 1.8.2 Animals

### 1.9 Charcoal

### 1.10 Fertilizers

#### 1.10.1 Organic Fertilizers

#### 1.10.2 Mineral Fertilizers

## **2 Selection of Method**

### 2.1 General Approach

### 2.2 Influence of the Matrix

#### 2.2.1 Mineral Matrices: Soils, Sediments, Muds

#### 2.2.2 Organic Matrices (Biomass): Algae, Plants, Litter, Peat, Organic-Rich Muds, Manures, Compost, Bone Char, Bone Chips, Other Biochar, Mounting Resin

#### 2.2.3 Water-rich Matrices: Animal Tissues and Tissue Fluids, Liquid Manure, Digestate

#### 2.2.4 Water-rich Matrices: Seston, Precipitation (Rainfall or Snow), Aerosols, Sludge, Waste Water, Liquid Manure, Slurry, Digestates

### 2.3 Importance of the Redox Potential and Effects on Sampling and P Binding Forms in Soils, Sediments and Similar Environmental Samples

### 2.4 Effects of Drying and Storage on P Binding Forms in Environmental Samples

### **3 Preparation of Samples**

#### **3.1 Sampling, Preparation and Storage**

3.1.1 Solid Sample Material (With Low Water Content)

3.1.2 Water-Rich Sample Material

3.1.3 Biomass: Algae, Plants and Animal Tissue

#### **3.2 Dry Matter and Dry Matter Density**

#### **3.3 Ashing and Loss of Ignition**

#### **3.4 Removal of Carbonate**

#### **3.5 Homogenisation**

### **4 Digestions**

#### **4.1 Microwave Digestions**

4.1.1 Estimation of Weight

4.1.2 Aqua Regia: Soil

4.1.3 Nitric Acid: Plant and Animal Tissues

4.1.4 Nitric Acid and Hydrogen Peroxide

4.1.5 Alkaline Persulphate: Seston

#### **4.2 Subboiling Digestions**

4.2.1 Acidic Persulphate: Ashes of Soils, Sediments, Tissues

4.2.2 Alkaline Persulphate: Seston

#### **4.3 Boiling Digestions**

4.3.1 Hydrochloric Acid: Sediments

4.3.2 Hydrochloric Acid: Plant Ashes

4.3.3 Digestion with  $\text{HClO}_4$ : Fish Meat and Fish Bones

#### **4.4 Neutralisation**

4.4.1 Neutralisation for Increased Iron Concentrations

4.4.2 Neutralisation for Measurement in Continuous Flow Analyser

#### **4.5 Methods for Determination of P Fractions and Binding Forms in Soils**

#### **4.6 Methods for Determination of P Fractions and Binding Forms in Sediments**

#### **4.7 Methods for Determination of P Fractions and Binding Forms in Water**

#### **4.8 Methods for Determination of P Fractions in Fertilizers**

## **5 Detection Methods**

### 5.1 Measurement with Inductively Coupled Plasma (ICP)

### 5.2 Photometry

#### 5.2.1 Elimination of interfering elements: Silicate and arsenate

#### 5.2.2 Effects of the salt matrix in the medium

#### 5.2.3 Molybdenum Blue: in Lowest Concentration Range, in Water Analytics

#### 5.2.4 Malachite Green in Lowest Concentration Range, in Soil Science

#### 5.2.5 Vanado-Molybdate-Yellow: in Medium Concentration Range

### 5.3 Element analyser

### 5.4 Autoanalyzer

#### 5.4.1 Continuous Flow Analyzer (Segmented Sample Processing)

#### 5.4.2 Flow Injection Analyzer (Unsegmented Sample Processing)

#### 5.4.3 Discrete Measurement

#### 5.4.4 Autoanalyzer for Digestions

### 5.5 Nanomolar Phosphate Concentrations

#### 5.5.1 Enrichment Methods

#### 5.5.2 Specific Equipment

### 5.6 Ion Chromatography

#### 5.6.1 What is Ion Chromatography?

#### 5.6.2 Ion Chromatography in the Working Group Soil Physics

#### 5.6.3 Phosphate Determination by Ion Chromatography – Sample Preparation and Measurement in the Working Group Soil Physics

#### 5.6.4 Limit of Detection and Quantification for Phosphate in Ion Chromatography

## **6 Quality Management**

### 6.1 Calibration

### 6.2 Limit of Detection (LOD) and Quantification (LOQ)

#### 6.2.1 Degrees of Freedom

#### 6.2.2 Limit of Detection and Quantification

#### 6.2.3 Flash Estimate of LOD and LOQ from Blank Values and Calibration Line



6.2.4 Calibration Line

6.2.5 Quality Management

6.3 Blank Value Target Maps

6.4 Set Point Target Maps

6.5 Range Target Maps

6.6 Standards

6.6.1 Certified Standards and Sources of Supply

6.6.2 Self-prepared Ashes and Dry Matters

6.6.3 Solved P Compounds

6.6.4 Internal Standards

## **7 Chemical Calculation**

7.1 Dilutions and Mixtures

7.2 Conversion of Measurement Values (per Litre)  
into the Concentration in the Environmental  
Sample (per kg)

## **8 Proposals for Forms upon Sample Delivery**

8.1 Examples from the Working Group Soil Science

8.2 Practice of the Biological Station Zingst

8.3 Procedures at IOW

## **9 Method Comparison**

9.1 Digestion Methods

9.2 Methods of Measurement

## **10 Infrastructure**

10.1 Contact Persons and Equipment Availability

10.2 Acknowledgement