AS 4969.0—2008

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Australian Standard®

# Analysis of acid sulfate soil—Dried samples—Methods of test

## Part 0: Introduction and definitions, symbols and acronyms

STANDARDS
Australia

This Australian Standard® was prepared by Committee EV-009, Sampling and Analysis of Soil and Biota. It was approved on behalf of the Council of Standards Australia on 30 September 2007.
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The following are represented on Committee EV-009:

- Australasian Institute of Mining and Metallurgy
- Australian Contaminated Land Consultant Association (Victoria)
- Australian Society of Soil Science Incorporated
- Department of Natural Resources and Water (Qld)
- Department of Primary Industries (Victoria)
- Environmental Laboratories Industry Group
- Environment Protection and Heritage Council (Victoria)
- Minerals Council of Australia
- National Association of Testing Authorities, Australia
- National Measurement Institute
- Queensland Health and Scientific Services
- The University of Sydney

Additional Interests:

- Southern Cross University
- University of Queensland

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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## Part 0: Introduction and definitions, symbols and acronyms

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# PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee EV-009, Sampling and Analysis of Soil and Biota, Working Group EV-009-02-01, Analysis of Acid Sulfate Soil.

The objective of this Standard is to provide industry bodies, consulting organizations and regulators with standard procedures for pre-treatment protocols and analytical methods that will assist them in setting a basis for acid sulfate soil assessment.

The methods are referred to in AS 4969, *Analysis of acid sulfate soil*. The Working Group EV-009-02-01 Analysis of Acid Sulfate Soil has endeavoured to align the requirements of these test methods with existing methods used by laboratories performing analysis on acid sulfate soil.

In Australia, it is estimated there are more than 9 million hectares of acid sulfate soil, mostly in coastal areas. Acid sulfate soil is a special group of soils that, because of the many complex chemical reactions associated with them, require specialized sampling, pre-treatment and analytical methods for their characterization so as to better understand appropriate management practices that will ensure they have minimal impacts on the environment.

It is assumed that the execution of the provisions of this Standard is entrusted to appropriately qualified and experienced people. This Standard includes the use of procedures that may be hazardous or injurious to health if adequate precautions are not taken. This Standard refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Procedures for the pre-treatment and analysis of wet samples of acid sulfate soil are not included in this Standard.

This Standard is Part 0 of the AS 4969 series of test methods as follows:

| AS | | |
|---|---|---|
| 4969 | Analysis of acid sulfate soil—Dried samples—Methods of test | |
| 4969.0 | Introduction and definitions, symbols and acronyms (this Standard) | |
| 4969.1 | Method 1: | Pre-treatment of samples |
| 4969.2 | Method 2: | Determination of $pH_{\mathrm{KCl}}$ and titratable actual acidity (*TAA*) |
| 4969.3 | Method 3: | Determination of peroxide pH ($pH_{\mathrm{OX}}$), titratable peroxide acidity (*TPA*) and excess acid neutralizing capacity ($ANC_{\mathrm{E}}$) |
| 4969.4 | Method 4: | Determination of 1 M potassium chloride extractable sulfur ($S_{\mathrm{KCl}}$), calcium ($Ca_{\mathrm{KCl}}$) and magnesium ($Mg_{\mathrm{KCl}}$) |
| 4969.5 | Method 5: | Determination of peroxide sulfur ($S_{\mathrm{P}}$), calcium ($Ca_{\mathrm{P}}$) and magnesium ($Mg_{\mathrm{P}}$) |
| 4969.6 | Method 6: | Determination of acid extractable sulfur in soil residue after peroxide oxidation ($S_{\mathrm{RAS}}$) |
| 4969.7 | Method 7: | Determination of chromium reducible sulfur ($S_{\mathrm{CR}}$) |
| 4969.8 | Method 8: | Determination of hydrochloric acid extractable sulfur ($S_{\mathrm{HCl}}$), calcium ($Ca_{\mathrm{HCl}}$) and magnesium ($Mg_{\mathrm{HCl}}$) |
| 4969.9 | Method 9: | Calculation of titratable sulfidic acidity (*TSA*) |
| 4969.10 | Method 10: | Calculation of peroxide oxidizable sulfur ($S_{\mathrm{POS}}$), reacted calcium ($Ca_{\mathrm{A}}$) and reacted magnesium ($Mg_{\mathrm{A}}$) |
| 4969.11 | Method 11: | Calculation of net acid-soluble sulfur ($S_{\mathrm{NAS}}$), calcium ($Ca_{\mathrm{NAS}}$) and magnesium ($Mg_{\mathrm{NAS}}$) |

| AS | |
|---|---|
| 4969.12 | Complete suspension peroxide oxidation combined acidity and sulfur (*SPOCAS*) method |
| 4969.13 | Determination of acid neutralizing capacity by back-titration ($ANC_{\mathrm{BT}}$) |
| 4969.14 | Calculation of the acid-producing potential of acid sulfate soil using an acid base accounting method |

NOTE: AS 4969.12 comprises Test Methods 2, 3, 4, 5, 6, 9 and 10 which make up the *SPOCAS* suite of analyses.

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## Part 0: Introduction and definitions, symbols and acronyms

## 1 SCOPE

This Standard provides a general introduction to acid sulfate soil and the approaches that can be used to measure the various components of this special group of soils and their potential to produce acidity. It provides a compilation of the test methods, identification and definitions of the symbols, terms and acronyms used in the AS 4969 series. While part of the decision-making process can involve the analysis of prepared wet or dry samples this Standard specifically outlines the procedures that are involved for preparing and analysing dried samples (see Figure 1).

NOTE: Standards for the pre-treatment and analysis of wet samples are under development.

## 2 INTRODUCTION

### 2.1 Choice of method

Acid sulfate soils are a complex group of predominantly low-lying coastal soils and sediments that contain iron sulfides and/or their oxidation products. Typically the sulfide present is pyrite, ($FeS_2$) though in some instances iron 'monosulfides' may be important. Acid sulfate soil are most prevalent in tropical and sub-tropical regions, but also occur in temperate and sub-arctic regions. When maintained in reduced and waterlogged conditions, the pyrite and other sulfides in these soils will not oxidize and when they are in this state the soils are generically termed potential acid sulfate soils. However, when these soils are exposed to atmospheric and dissolved oxygen by any disturbance, the sulfides they contain oxidize to sulfate and ferric ions producing acid at the same time. The complete oxidation of pyrite by oxygen is generally represented by the following equation:

$$FeS_2 + {}^{15}/_4\,O_2 + {}^{7}/_2\,H_2O \rightarrow Fe(OH)_3 + 4\,H^+ + 2\,SO_4^{2-}$$

However, the oxidation of pyrite does not always go to completion in the short term, with oxidation products other than ferric hydroxide and sulfuric acid often forming. The iron hydroxy-sulfate mineral *jarosite* $[KFe_3(SO_4)_2(OH)_6]$, can be a conspicuous product of the oxidation process in acid sulfate soil. These oxidation products, as well as other metal ions from the soil (e.g. aluminium) that are dissolved by the acid, can have deleterious environmental, agronomic and economic impacts. Where the pH of these soils falls to 4 or below (as a consequence of sulfide oxidation) they are generically termed actual acid sulfate soils AASS. When potential acid sulfate soil contains carbonate or other minerals with an acid neutralizing capacity (*ANC*) (e.g. calcite in the form of finely divided shell material), they may not become acidic when they oxidize.

Because of the many possible complex chemical reactions, the characterization of acid sulfate soil using analytical methods can be a complex process, but accurate characterization is crucial to the management of these soils. Chemical analysis provides the data necessary to assess the acid-producing potential of these soils. From these data acid base accounting can be used to determine the dosing rate of alkaline ameliorants needed to fully treat any net acidity. Once dosed accordingly, these soils should not generate acidity, thereby minimizing potential adverse impacts on the environment and/or infrastructure.