

# FACT SHEET



## Acid Sulfate Soils - WA

### What are ASS's

The draft Department of Environment and Conservation Acid Sulfate Soil Guideline Series (Jan 2009) defines an Acid Sulfate Soil (ASS) as “naturally occurring soils, sediments and peats that contain iron sulfides, predominantly in the form of pyrite materials” . Typically they often show orange / red mottle or buttery yellow colour characteristic of jarosite.

By definition these soils contain iron sulphides. In some cases soils contain other acid forming ore and minerals that behave similar to ASS's. These are not often seen in the eastern states but are significantly more prevalent in the central and western states. A more appropriate term maybe acid soils rather than acid sulfate soils.

### Where do they occur?

In an anoxic state, these materials remain benign, and do not pose a significant risk to human health or the environment. However the disturbance of ASS, and its exposure to oxygen, has the potential to cause significant environmental and economic impacts including fish kills and loss of biodiversity in wetlands and waterways; contamination of groundwater resources by acid, arsenic, heavy metals and other contaminants; loss of agricultural productivity, and corrosion of concrete and steel infrastructure by acidic soil and water. Projects involving the disturbance of ASS must therefore assess the risk associated with disturbance through the consideration of potential impacts .

Successful management of ASS depends on the results of a detailed investigation to determine the most appropriate management strategy for a site.

Many local Western Australian sites including the Ellenbrook residential developments have impacted on the Gngangara lake (pictured below) and aquifer and demonstrate the potential risk and impact ASS's can have on the broader community.

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## What is the Analytical Process in identifying ASS's?

In broad terms the chemistry identification of ASS's is two fold;

- Firstly it relies on in-situ field pH and oxidised field pH testing as a screen to identify actual acidity (pH) and potential acidity by oxidised pH of a 1:5 soil extract. Visual fizzyness is a coarse indicator of the rate of reaction.
- Secondly, various parameters are tested using a decision tree approach with the aim of showing the net amount of acid that will be produced via the acid base account (ABA) methodology. It is a DEC requirement in Western Australia that this testing should be undertaken by a NATA accredited laboratory.

The Acid Base Account is as follows:

$$\text{Net Acidity} = \left[ \begin{array}{c} \text{Potential sulfidic} \\ \text{acidity} \end{array} \right] + \left[ \begin{array}{c} \text{Actual} \\ \text{acidity} \end{array} \right] + \left[ \begin{array}{c} \text{Retained} \\ \text{acidity} \end{array} \right] - \text{Acid Neutralisation Capacity} / \text{FF}^*$$

\* FF = Fineness Factor

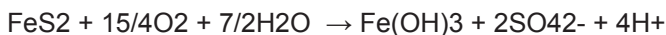
The two main testing suites utilized are the SPOCAS (Suspension Peroxide Oxidation – Combined Acidity and Sulfate) and Chromium suite.

The SPOCAS suite measures both the 'acid trail' and the 'sulfur trail'.

The Chromium suite measures the required components of the Acid Base Account. Only acidity (H+) or sulfur (%S) is measured at each step.

## What is the Chemistry?

The complete oxidation reaction of pyrite is detailed below:



1 mole pyrite ultimately produces 4 moles acidity (H+), 2 moles sulfuric acid.

The acid may be neutralised as it is produced by the acid neutralisation capacity of the soil. This can be influenced by natural geology of the soil or by extraneous matter eg shell content.

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SPOCAS measures both the 'acid trail' and the 'sulfur trail'.

- 'Acidity trail' involves direct titrimetric determination of the acidity produced by oxidation.
- 'Sulfur trail' involves the determination of sulfur and stoichiometric relationships to predict 'potential acidity'.

Chromium suite:

Chromium suite only measures the required components of the Acid Base Account. Only acidity (H+) or sulfur (%S) is measured at each step.

A key parameter is the Liming Rate or the rate at which lime needs to be applied to neutralise potential net acidity, and is estimated from the net acidity. This value is not stoichiometric and incorporates a safety factor to allow for non-homogenous mixing of the soil and lime, and poor reactivity of lime. This factor varies from state to state. Eg QLD use 1.5, WA use 2.0.

## What are the difference and limitation of the methods?

- SPOCAS tend to bias slightly high and is less useful in higher organic soils
- Chromium suite is better suited to soils with higher organic material but tends to bias slightly low
- The method is based on sulfidic acidity, other non sulfidic acid generated is not accurately accounted for
- The PQL of the methods are insufficient for some benign soil types. The current DEC guideline value of <0.03% sulphur can translate into significant amounts of actual acid being generated. eg Bassendean sands in Western Australia are particularly problematic.

Because there are differences in the analytical methods, soil geology and characteristics that impact on the results the NATA accredited testing facility of choice should be fully conversant with the local geological morphology and idiosyncrasies.

## Is Acid Sulphate Soil Identification just about SPOCAS and Chromium Suites?

No. Management of dewatering and ground water investigations are a critical part of the larger management program. The current Western Australian guidelines also require the identification of the vulnerability of the groundwater to acidification, ground water levels and flow patterns and the determination of ground water quality. Recommended testing suites are

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covered in section 5.3.1 of the guideline. Key components include ground water alkalinity, acidity, buffering capacity and metal concentration.

## Sampling, Holding Times and Preservations

The Envirolab group recommends the collection approx 200g in zip lock bags to avoid contact with air. (Remove large shells, wood, charcoal, stones but leave roots). If coarse shells are left in it will overestimate the ANC (Acid Neutralising Capacity). The holding time is 24 hrs at 4 deg or 6 months frozen or dried at 85deg.

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### Reference:

- i. Draft - Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (Contaminated Sites Branch Environmental Regulation Division DEC WA) Jan 2009
- ii. Guidelines for sampling and Analysis of lowland Acid Sulfate soils in Queensland (Ahern et al, 1998), Queensland Acid Sulfate soils investigation Team
- iii. Queensland Acid Sulphate soil Technical manual 2002, Soil management guidelines Queensland (Dear et al. 2004) Acid sulfate soil management committee
- iv. Draft - Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (Contaminated Sites Branch Environmental Regulation Division DEC WA) Jan 2009

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