What are acid sulfate soils?

Acid sulfate soils (ASS) are naturally occurring soils and sediments containing iron sulfides, most commonly pyrite.

When ASS are exposed to air the iron sulfides in the soil react with oxygen and water to produce a variety of iron compounds and sulfuric acid. Initially a chemical reaction, the process is accelerated by soil bacteria. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment.

Potential acid sulfate soils

ASS which have not been oxidised by exposure to air are known as potential acid sulfate soils (PASS). While contained in a layer of waterlogged soil, the iron sulfides in the soil are stable and the surrounding soil pH is often weakly acid to weakly alkaline.

Potential acid sulfate soils:

- often have a pH close to neutral (6.5–7.5)
- contain unoxidised iron sulfides
- are usually soft, sticky and saturated with water
- are usually gel-like muds but can include wet sands and gravels
- have the potential to produce acid if exposed to oxygen.

Actual acid sulfate soils

When PASS are disturbed or exposed to oxygen, the iron sulfides are oxidised to produce sulfuric acid and the soil becomes strongly acidic (usually below pH 4). These soils are then called actual acid sulfate soils (AASS) – that is, they are already acidic.

Actual acid sulfate soils:

- have a pH of less than 4
- contain oxidised iron sulfides
- vary in texture
- often contain jarosite (a yellow mottle produced as a by-product of the oxidation process).

How are acid sulfate soils formed?

Although some ASS were formed millions of years ago and occur in ancient marine rocks, those of most concern were formed after the last major sea level rise - within the past 10,000 years (Holocene period).

When the sea level rose and flooded the land, sulfate in the seawater mixed with land sediments containing iron oxides and organic matter. The resulting chemical reaction produced large quantities of iron sulfides in the waterlogged sediments. When exposed to air, these sulfides oxidise to produce sulfuric acid, hence the name acid sulfate soils.

Where are acid sulfate soils found?

ASS commonly occur in coastal wetlands as layers of marine muds and sands which are deposited in protected, low-energy environments such as barrier estuaries and coastal lakes. In similar environments, they are still being formed.

ASS are a natural component of the landscape and may be found in a variety of waterlogged soil types. These include:

- dark organic rich soils and muds
- peaty wetland soils
- some pale grey sands (Bassendean sands and Spearwood sands)
- 'coffee rock' (cemented iron and/or organic rich sands) found below the water table.

ASS in Western Australia frequently occur in low-lying wetlands, back-swamps, estuaries, salt marshes and tidal flats, though are not limited to coastal regions. ASS may be found in:

Low-lying land fringing estuaries - typically grey silty or sandy sediments of alluvial origin commonly occurring in low-lying areas adjacent to estuaries.

Groundwater dependent wetlands - typically peaty and sandy sediments are associated with some wetlands on the Swan Coastal Plain. Pyrite in the sediments can acidify the wetland if the water table falls well below the base of the wetland due to dry weather or excessive groundwater pumping.

Former seashores - pyrite often occurs with heavy-mineral accumulations associated with former seashores. These seashores may occur several kilometres inland from the current seashore.

Inland ASS - there are inland forms of ASS occurring in agricultural areas well away from the coast. These soils appear to be forming in response to rising water tables and land salinisation in southern WA.

More information

DEC has published a series of fact sheets and guidelines to help with the identification, investigation and management of ASS in Western Australia. These are available at http://www.dec.wa.gov.au/ass

More information is available by mail from the address below or by calling the Acid Sulfate Soils Section on 1300 762 982.

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