

EUROGYPSUM

ASSOCIATION OF EUROPEAN GYPSUM INDUSTRIES

ASSOCIATION DES INDUSTRIES EUROPEENNES DU PLÂTRE

VERBAND DER EUROPÄISCHEN GIPSINDUSTRIEN

ENVIRONMENT AND RAW
MATERIAL COMMITTEE

POSITION PAPER – GYPSUM AND WATER

24 FEBRUARY 2006

Conclusions and recommendations

Calcium sulphate (gypsum) is the least soluble of the common sulphates.

The ion sulphate (SO_4^{2-}) has no adverse effect on health, even at concentrations much above the saturation of CaSO_4 (app. 1500mg SO_4^{2-} /l).

When a taste problem appears it is due to cations like sodium, potassium, ammonium, magnesium, iron or aluminium, but not to calcium.

Therefore considering SO_4^{2-} concentration as an indicator of water quality is a wrong approach.

The right approach should be to measure the conductivity of the water, and to investigate further about ion type and concentration if the conductivity is too high. A safe threshold for conductivity could be fixed at 2.5 mS/cm, which is the conductivity of water saturated with CaSO_4 at 25°C.

I. ABOUT EUROGYPSUM

Founded in 1961, **Eurogypsum** is a European federation of national associations of producers of gypsum products. Its prime aim is to promote both the products and the interests of these producers. It does this through joint research projects on relevant scientific, technical-economic and legal matters and by initiating information and public relations programmes.

With a turnover of well over 3 billion EURO, the European gypsum and anhydrite industry operates some 220 factories and generates employment directly and indirectly for 400.000 people.

It is **one of the few fully integrated industries within the construction products field**. The companies which mine gypsum also process it and manufacture the value-added products and systems used extensively in construction and other industries

II. BACKGROUND

Gypsum is one of the most common minerals in sedimentary environments. It is an evaporite and can be found in massive beds, formed after precipitation and evaporation of highly saline waters. Gypsum is usually white or grey, but can also have shades of red, brown and yellow.

Chemistry: CaSO₄.2H₂O - Hydrated Calcium Sulphate

Most common uses: plasters, blocks, plasterboard, cement, fertilizer, paint filler.

III. SULPHATE IN WATER

At 25°C a litre of water saturated with calcium sulphate contains 1.45g of sulphate (SO₄²⁻) and 0.65g of calcium (Ca²⁺). When the water is saturated, an addition of calcium sulphate will not change the concentration of sulphate. This concentration can only increase if another sulphate (e.g. magnesium sulphate) is added into the water. An example is seawater, which contains 2.65g of sulphate.

The concentration of sulphate in groundwater highly depends on the nature of the natural ground: in gypsum areas groundwater may be saturated (1.45g of sulphate per litre) and in this case the addition of gypsum will not change the sulphate concentration. This is typically the case for waste from gypsum mining.

Groundwater values of up to 2950mg of SO₄²⁻ per litre are reported in Belgium and up to 4300mg SO₄²⁻ per litre in France.

In South-East Lower Saxony, a maximum value of 1455mg SO₄²⁻ per litre is found, while 28.5 % of the drinking-water production installations show sulphate concentrations of over 250 mg/l.

In Thuringia, maximum values of up to 2496mg SO₄²⁻ per litre (Muschelkalk) are reported, as well as an arithmetical average of 683mg SO₄²⁻ per litre (Keuper).

Sulphate is proven to have no adverse effect on health, and some bottled mineral waters provide evidence of this:

	Concentration in mg/l		
	Sulphate	Calcium	Magnesium
Orée du bois (Delhaize)	641	235	66
Contrex (Pavillon)	1163	464	80
Hépar	1539	572	116

600 million bottles of Contrex mineral water are sold worldwide each year.

In Austria, the term 'Mineralwasser' can only be used for water with a minimum concentration of 200mg SO₄²⁻ /l.

In Germany new federal states, 20 % of the measured sulphate concentration in drinking water is higher than the norm of 240mg/l.

IV. SULPHATE AND HEALTH

An abundant bibliography exists to prove that, instead of having an adverse effect on health, sulphate is necessary to living organisms.

- Large fluctuations of sulphates in soils and groundwater are natural environmental characteristics^{i,ii,iii,iv,v,vi,vii,viii} and there is no evidence of toxicity caused by calcium sulphate in living organisms^{ix,x,xi}.
- Since sulphate constitutes a basic need for man and all living organisms^{xii,xiii}, its different levels of concentration are also a prerequisite for biodiversity.
- Man needs 2 to 3.5 g of sulphate a day¹⁵ and most foods contain substantial amounts of sulphate^{xiv} (typical values between 100 and 2000 mg/kg), likewise all biological fluids^{xv,xvi}.
- Sulphate conjugation is essential for biotransformation. It also allows elimination of xenobiotics and transformation residues through the kidneys^{11,15,xvii}.
- Calcium sulphate is registered under code E 516 as a food additive.

- Sulphate is one of the four basic plant nutrients and is essential for crop growth^{xviii}.

Several studies failed to find any association between exposure to high levels of sulphates (i.e. sodium and/or magnesium sulphates in concentrations mostly up to 1200 mg/l, sometimes up to 2000 and more mg/l) and diarrhoea or other adverse health issue^{xix}.

Neither the WHO nor the EC-directive on drinking water creates a limiting parameter for sulphate^{xx,xxi}. However, the sulphate indicator parameter in these documents has been frequently misinterpreted as a parameter that should be regulated.

Due to misconceptions on taste and aggressiveness of drinking water, sulphate content has been limited for water instead of the accompanying cations (H⁺, Na⁺, K⁺, Mg²⁺, Al³⁺ ...) that really matter. In the most abundant sulphate deposits on earth, i.e. gypsum and anhydrite, sulphate combined with calcium is showing neither taste deviations^{xxii,xxiii}, nor aggressiveness.

IV. SULPHATE AND TASTE

Sodium, potassium, ammonium, magnesium, iron and aluminium sulphates are much more soluble than calcium sulphate (gypsum) and are known to have some adverse effect on the taste of water. They have also been suspected of causing diarrhoea by ingestion of water containing high concentrations of these sulphates.

ⁱ BRGM, *Sulphate concentrations in groundwater in France, data from. „Ministère de l'Environnement, Observatoire National de la Qualité des Eaux Souterraines“*. Cfr. Attachment 1.

ⁱⁱ G.Holzhey, *Geogener Sulfat-Gehalt im Bereich der Hautgrundwasserführung, Figures for Thuringia*.

ⁱⁱⁱ *Grundwasser in Bayern, Wasserbeschaffenheit 1993/97, Informationsberichte Heft 1/98*.

^{iv} *Untersuchung der Veränderung von Wasserinhalstoffen in rinkwassergewinnungsanlagen im Raum Süd-Ost-Niedersachsen, Siedlungswasserwirtschaft, TU Braunschweig, 1984*. Cfr. Attachment 2.

^v *UBA-Jahresbericht 95, p.191, Häufigkeit von Überschreitungen des Grenzwerts der Trinkwasserverordnung im Grundwasser (in %) bezogen auf die Zahl der durchgeführten untersuchungen in den neuen Ländern*. Cfr. Attachment 3.

^{vi} A. Forster et al., *Regional distribution of sulphate in rocks and soils of Britain, Geological Society Engineering, Special Publication No.10, pp 95-104*.

^{vii} BGR, *Geotechnologien, VIII. Stoffkreisläufe: Bindeglied zwischen Geosphäre und Biosphäre, Projektskizze, Quantifizierung und Modellierung des geogenen, biogenen und anthropogenen Schwefelkreislaufs, Stand 12.10.00*.

^{viii} AMINAL, *Gegevens van het grondwatermeetnet voor de provincies Antwerpen en Limburg. Values between 0.05 and 2920 mg sulphate per litre*.

^{ix} *Internal test Bayer AG: LC₀ >2000 mg/l, Poecilia reticulata, 96h*.

Patrick et al., Progressive Fish-Culturit, 30, 137-140 (1968): LC₅₀ 2980 mg/l, Lepomis macrochius, 96h.

^x *Wallen et al., Sewage and Industrial Wastes, 29, 695-701 (1957): TLm >56000 mg/l Gambusia affinis, 96h*.

^{xi} *BIBRA toxicity profile calcium sulphate: NOEC > 2000 mg/l rainbow trout, 28d*.

^{xii} *Ullmann's Encyclopedia of Industrial Chemistry, 1995, Vol. B28, Water, p.23*.

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- xiii *The Biological Chemistry of the Elements*, 1991.
- xiv Florin et al., *Journal of Food Composition and Analysis*, 6, 140-151 (1993): *The Sulphate Content of Foods and Beverages*
- xv Robert F. Pitts, *The physiological basis of diuretic therapy*, Charles C. Thomas, Publisher, 1959.
- xvi M. Arnaud, *Water Institute, Perrier Vittel*, Vol.1, No.2, September 1999. Cfr. Attachment 4.
- xvii *Ullmann's Encyclopedia of Industrial Chemistry*, 1995, Vol. B7, pp 195-6.
- xviii *Ullmann's Encyclopedia of Industrial Chemistry*, 1995, Vol. A25, Sulfur, p.563.
- xix *Health Effects from Exposure to High Levels of Sulfate in Drinking Water Study*, U.S. Environmental Protection Agency, Office of Drinking Water and Ground Water, 21 January 1999.
- xx WHO, *Guidelines for Drinking-Water Quality*, April 1993.
- xxi Directive 98/83/EEC on
- xxii WHO, *Guidelines for Drinking-Water Quality*, 2nd edition, Vol.2, Health criteria and other supporting information, 13.30 Sulfate, p.351.
- xxiii *Martindale, The Extra Pharmacopoeia*, 26th Ed.