

TREATMENT OF ACID MINE WATER

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Bodenmais is a health resort in the Bavarian wood. In the nearby Silberberg there was over a long period mining on pyrite and pyrrothine for the production of ferric oxide and ferric sulfate and secondary sphalerite, galenite and chalcopyrite for winning of silver, copper and lead.

The problem is that sulfide minerals react under the influence of oxygen to sulfate (oxidation). Maybe some kind of bacteria is able to speed up this process.

In aqueous solutions the pH-value is lowered to a value of 2–3 because of the resulting diluted sulfuric acid. In the same time different metals (e.g. aluminium, cadmium, chrome, copper, iron, lead, manganese, mercury, nickel, zinc) are mobilized.

The resulting solutions have temporary different concentrations of these metals and some of these concentrations are too high relating to effective limiting values and so they are not allowed to be mixed with surface water.

Important parameters for the characterization of water are the pH-value and the conductivity. The pH-value differs between 2.64 and 2.9 and the conductivity between 796 and 1224 $\mu\text{S}/\text{cm}^2$. The reason therefore depends on the current season, e.g. dilution by melted snow and ice.

Because of this conditions the mine water must be treated. An option is the percolation of the mine water through chalky limestone. This limestone is porous and so shows a very reactive surface which is important to neutralize the mine water to a pH-value of 6–7, so the metals are precipitated as hydroxides.

Because of the high concentrations of iron and aluminium we need an adsorbing material e.g. glass wool which should precipitate those metal-hydroxides too.

The first step to treat the mine water, the neutralization, was no problem. Over a period of six hours the pH-value was constantly 6–7. But the second step, the precipitation of the metals is a problem. With the current test conditions the effective threshold values are not fallen short of but they are drastically reduced.

The following figures show the neutralization (fig. 1) and the measured values (with ICP-OES, fig. 2) of different samples. Probe 1 is taken after half an hour, Probe 5 is taken after two and a half hours and Probe 12 after six hours. In the original mine water the amount of aluminium differs between 15–27 ppm, the amount of copper between 0.29–0.44 ppm, the amount of iron between 21.3–41.6 ppm, the amount of manganese between 1.07–1.77 ppm and the amount of zinc between 4.90–8.49 ppm.

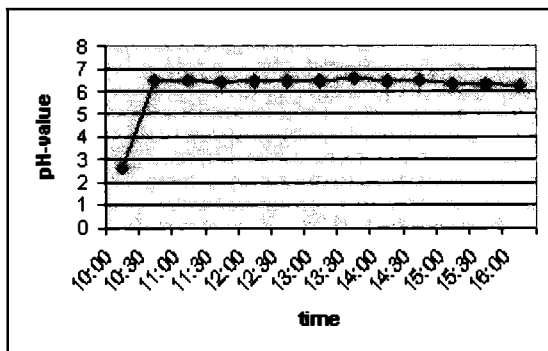


Figure 1
neutralization (pH-value on the y-axis).

The water analysis is carried out by ICP-OES (optical emission spectrometry with inductively coupled plasma), AAS (atom absorption spectrometry) and photometry (UV/VIS spectrometry) for cations and with IC (ion chromatography) for anions. The analysis for the chalky limestone

is carried out by XRF (X-ray fluorescence), XRD (X-ray diffraction) and SEM (scanning electron microscope).

element	Probe 1	Probe 5	Probe 12	threshold value
Al	5,89	3,21	3,63	< 3
Cu	0,078	0,063	0,097	< 0.05
Fe	9,62	4,39	3,35	<2
Mn	1,1	1,25	1,43	
Zn	3,53	4,63	5,68	< 1,5

Figure 2
values of different samples in [ppm]
(time on the x-axis).