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In-vitro investigation of the trace element accumulation on artificially grown biofilms

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Monitoring of pollutants in the aquatic environment is an important topic, since many pollutants enter the trophic chain via aquatic biota. Biofilms (periphyton communities) are quite ubiquitous and very abundant in many freshwaters and they represent a very early stage of the trophic chain. Since biofilms are highly capable to absorb trace elements, they play an important role to bring the pollutants into the trophic chain. For this reason, biofilms are widely used in biomonitoring studies (Jang, 2001; Mages, 2004)].

Often mining activities are combined with the emission of high amounts of various pollutants, especially metals and metalloids into surface waters. In the Elbe river catchment area of German Democratic Republic heavy metals and Arsenic have been deposited as sediments in the rivers from former mining activities. During flood events like in 2002 at the Elbe river and main tributaries these sediments have been mobilized and transported among the rivers. In the case of the "century flood" furthermore erosion from arsenic and heavy metal containing tailings have been observed in the upper part of Freiberger Mulde near Freiberg (Hofmann, 1992; Kluge, 1995).

To investigate the hazardous potential of Arsenic in the Mulde surface water in relation to the biofilm freshwater from the river Freiberger Mulde, Germany, was filled into a reactor and biofilms were cultivated completely in-vitro, on artificial polycarbonate supports. After reaching the plateau phase, As was dopped, and the bio-accumulation determined using the total reflection X-ray fluorescence (Petterson, 1998; Friese, 1997). To investigate, which role has the chemical form, As(III) and As(V) was added in parallel experiments. The addition was carried out at two different concentration levels for both species. With a blank experiment we have established that the reactor walls eliminate about the half of As(V), for this reason, we have doped this species at double concentration as As(III), which was only slightly adsorbed.

Investigation of the original surface water of the Freiberger Mulde have shown that about three quarters of As was present as As(V), and more than 80 % of the total As was bound on suspended matter.

The bioaccumulation experiments have shown that biofilms accumulate arsenic mostly as suspended matter. Using the confocal laser scanning electron microscopy (CLSM), we have established that the biofilms had high number of embedded particles originating from the highly abundant suspended matter of the water. We did not found any regular influence of the doped dissolved arsenic on the measured mass fraction in the biofilms.

On the basis of the results we can conclude that the surface water of the Freiberger Mulde is highly polluted with suspended arsenic. This suspended matter will be taken up by the biofilms, however, only as embedded particles into the extra cellular polymer matrix (EPS). An uptake of dissolved arsenic could be not observed.

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