

The role of naturally occurring biofilm in the treatment of mine water in abandoned uranium mine

S. Mielnicki, A. Sklodowska, B. Michalska

University of Warsaw, Warsaw, Poland

E-mail address of corresponding author: asklodowska@biol.uw.edu.pl

The uranium mine in Kowary (SW Poland) was active from 1948 to 1967. After exploitation ceased the mine was abandoned and from the beginning of 21st century it is a touristic attraction of this region of Poland. The largest uranium mining fields, Kowary and Kowary-Podgorze, were located in southern part of the metamorphic cover of the Karkonosze Granite. In the mine dumps at Kowary-Podgorze ore fragments containing up to 0.15% of uranium can still be found. Several dumps have been left in the Kowary Podgorze vicinity as the post mining uranium waste. The dump of adits Nos. 19 and 19a at Kowary Podgorze is located in the Jedlica River valley. Water from adit No. 19a is still discharged by the pipe directly to the Jedlica River. In the end of this pipe a small dam was built to regulate the level of water in adit and small reservoir of mine water was created in this place. The level of uranium observed in water before dam is between $10 \mu\text{g}/\text{dm}^3$ and $670 \mu\text{g}/\text{dm}^3$. The bottom of reservoir is covered by strongly mineralized biofilm containing up to 60 mg U/kg (dry weight), 1 500 mg As/kg, 10 000 mg Al/kg and about 1700 mg Mn/kg. Water in Jedlica River contains $6-7 \mu\text{g U}/\text{dm}^3$, $16 \mu\text{g As}/\text{dm}^3$ and about $10 \mu\text{g Mn}/\text{dm}^3$ and these values are within the limits for non-contaminated surface water. The water from the reservoir together with the biofilm is discharged minimum twice a year immediately to Jedlica River causing a temporary increase of contaminants (beyond the limits) and dispersion of uranium and arsenic up to 20 km from the main source of pollution. It seems that biofilm from reservoir acts as an active filter that removes main contaminants from mine water mainly through biosorption. Laboratory studies show that sorption complexes are relatively stable. Maximum 10% of absorbed uranium was eluted by EDTA buffer or acetic acid (soluble and carbonate fraction). Arsenic was eluted in 25% by phosphate buffer (ion exchange) and almost all iron and cadmium (occurring in trace amount in biofilm and in mine water) was removed from sorption complexes by EDTA buffer. Sorption capacity of biofilm dry mass was estimated for As, Co, Mn, Cu and Cd at 5g/kg, 12 g/kg, 5 g/kg, 1 g/kg and 28 g/kg respectively. Presented results clearly show that mats from adit No.19 in uranium mine in Kowary-Podgorze have large capacity for biosorption of metals and metalloids and for this reason, special attention should be paid to discharging them immediately to Jedlica River. On the other hand, further studies are needed to develop method of culturing the specific biofilm for water filtration under controlled conditions.