Respirometric measurements of toxic effects on iron-oxidizers

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Biohydrometallurgy is nowadays an accepted technique, which is mainly applied in heap leaching of copper ores [1], but also in recovery of cobalt [2] or even in gold [3] exploitation. However, there are still several possibilities for improvement. Especially sufficient leaching of chalcopyrite, a quite important Cu-mineral, is quite hard to achieve. It already has been shown, that the addition of some detergents like chloride or silver can enhance the Cu-liberation from chalcopyrite [4] [5]. Unfortunately these elements are quite toxic for the used microorganisms [6]. Consequently it is necessary to find the maximum concentration where no inhibition occurs.

Since the capacity of iron-oxidation plays the key role in bio leaching the iron-oxidation rate can be taken into account as a possible indicator for toxicity. Unfortunately sampling as well as iron measurements are quite time consuming, therefore we propose to use the respirometric measurement inside the OxiTop© system. Given that 1 mol O_2 is used by the oxidation of 4 mol Fe^{2+} it is possible to observe the iron-oxidation in a sealed batch indirectly by a pressure decrease. Due to automated recording of the pressure values, it is not necessary to take care for the samples for several days.

Acidithiobacillus ferrooxidans DSM14882 was grown in 300 mL DSMZ medium no. 882 (2.5 mmol Fe^{2+}), remaining 200 mL air. After a significant pressure decrease, all batches were opened and up to 1% (w/v) NaCl was added. Afterwards all batches were closed air-tight again. The same test was repeated with two mixed cultures from the Mine “Reiche Zeche” (Freiberg, Saxony, Germany).

With this procedure we were able to observe a change in the iron-oxidation rate as well as in the amount of oxidised iron with increasing NaCl concentration. With this system it was, as proposed, quite easy to determine toxic concentrations of possible detergents. Furthermore it will be possible to apply this procedure to other aerobicly growing autotrophs.

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