

## SUPPLEMENTARY DATA

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### DERIVATION OF THE INTEGRATED RATE EQUATION

With a rate equation of the form:

$$\frac{dC}{dt} = -kCA$$

Where the rate constant  $k$  is a function of pH and has the units  $m^2s^{-1}$ . If the reactive surface area is lost due to the surface reaction of Cr (VI) with Fe (O), the surface area can be described by an equation such as:

$$A = A_0 - (C_0 - C)V/B$$

Where  $A_0$  is the initial reactive surface area ( $m^2$ ),  $B$  is the specific capacity of the iron surface to reduce Cr (VI) ( $mM.m^{-2}$ ), and  $V$  is the volume of liquid in contact with the iron.

Therefore:

$$\frac{dC}{dt} = -k \frac{C_0V}{B} C \left( \frac{A_0B}{C_0V} - 1 + \frac{C}{C_0} \right)$$

Defining the capacity ratio for the system as  $r = A_0B/C_0V$

$$\frac{dC}{dt} = -k \frac{A_0}{r} C \left( r - 1 + \frac{C}{C_0} \right)$$

Using substitutions  $D = (r-1)C_0$  and  $E = kA_0/(r.C_0)$  the equation simplifies to:

$$\frac{dC}{dt} = -E C (D + C)$$

Which, after variable separation can be integrated by use of partial fractions, provided  $D \neq 0$ :

$$\int \frac{dC}{C} - \int \frac{dC}{(D + C)} = -E D \int dt$$

Integration yields:

$$\ln C - \ln(D + C) = -EDt + \text{constant}$$

When  $t=0$ ,  $C=C_0$ :

$$\frac{C}{D + C} = \frac{C_0}{D + C_0} e^{-EDt}$$

Rearranging for C:

$$C = \frac{D \left( \frac{C_0}{D + C_0} \right) e^{-EDt}}{1 - \left( \frac{C_0}{D + C_0} \right) e^{-EDt}}$$

Substituting for D:

$$\frac{C}{C_0} = \frac{(r - 1)e^{-EDt}}{r - e^{-EDt}}$$

Where  $ED = kA_0(r-1)/r$ :

$$\frac{C}{C_0} = \frac{(r - 1)e^{-kA_0\left(\frac{r-1}{r}\right)t}}{r - e^{-kA_0\left(\frac{r-1}{r}\right)t}}$$

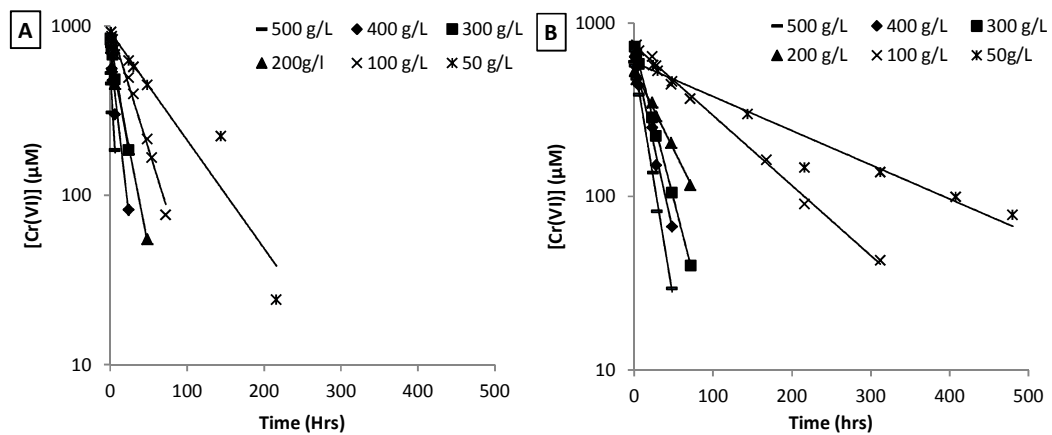


Figure S1: [Cr(VI)] vs. time for (A) 1 mmol.L<sup>-1</sup> chromate solution pH 12.0 ± 0.1 and (B) 1 mmol.L<sup>-1</sup> COPR leachate pH 11.9 ± 0.2.

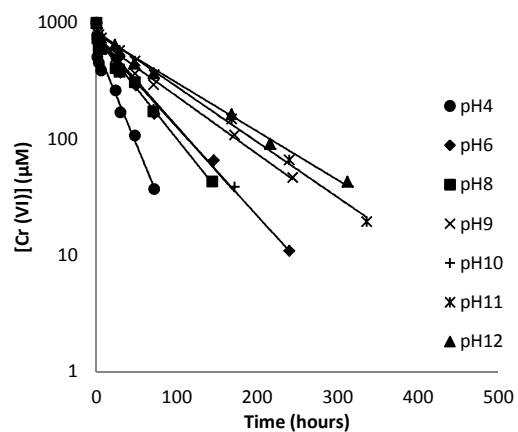


Figure S2: [Cr(VI)] vs. time for tests with  $100 \text{ g.L}^{-1}$  ZVI in COPR leachate containing  $1 \text{ mmol.L}^{-1}$  of Cr(VI) where the initial pH has been buffered to different values.