**Cobalt biosorption in fixed bed column using greehouse crop residue as biosorbent**

The fitting in the present work was carried out for two different response variables: the percentage retained (% R) and the biosorption capacity ($q_e$). The response variables were recalculated with the ANFIS model based on three different operating variables (A: the feed flow rate, B: the inlet concentration and C: the bed height). Two levels were used for each input variables resulting in a model with 8 constants.

The response variable, y, was calculated using the following equation:

$$y = \frac{\sum_{l=1}^{8} a_l \cdot FR_l}{\sum_{l=1}^{8} FR_l} \ \text{(Eq. S1)}$$

where $a_l$ represents the single constant parameters (one per variable and level). Moreover, each $FR_l$ is the combination of levels (low and high) for each variable (the feed flow rate, the inlet concentration, and the bed height).

Table S1 shows the levels and variables that are related to each constant and rule.

**Table S1.** Levels, variables, constants, and rules of the ANFIS model.

| FR | Constants | Feed flow rate (mL/min) | Inlet concentration (mg/L) | Bed height (cm) |
|---|---|---|---|---|
| $FR_1$ | $a_1$ | Low | Low | Low |
| $FR_2$ | $a_2$ | Low | Low | High |
| $FR_3$ | $a_3$ | Low | High | Low |
| $FR_4$ | $a_4$ | Low | High | High |
| $FR_5$ | $a_5$ | High | Low | Low |
| $FR_6$ | $a_6$ | High | Low | High |
| $FR_7$ | $a_7$ | High | High | Low |
| $FR_8$ | $a_8$ | High | High | High |

For example, the first two rules would be calculated as follows:

$$FR_1 = \mu_A(low) \cdot \mu_B(low) \cdot \mu_C(low) \quad \text{(Eq. S2)}$$

$$FR_2 = \mu_A(low) \cdot \mu_B(low) \cdot \mu_C(high) \quad \text{(Eq. S3)}$$

Where μ represents the function of the model ("membership functions") and each subscript indicates which input variable it is. The rest of the "fuzzy rules" were calculated according to the levels shown in Table S1.

On the other hand, various methods are available to determine the fuzzy rule for the input data (linear, Gaussian, polynomial, logarithm, etc.) for independent variables. In this work, to reproduce experimental values, Gaussian member functions were used.

The Gaussian equations for the two levels (low and high) are defined as follows:

$$\mu(low) = exp\left(-0.5 \cdot \left(\frac{x - x_{low}}{L}\right)^2\right) \quad \text{(Eq. S4)}$$

$$\mu(high) = exp\left(-0.5 \cdot \left(\frac{x - x_{high}}{L}\right)^2\right) \quad \text{(Eq. S5)}$$

Where L is the width of the Gaussian function distribution and $x_{low}$ and $x_{high}$ are the values of each level (low and high) for each variable.

Taking all previous considerations into account, the equation for the calculation of the response variable can be simplified and expressed as:

$$y = \frac{a_1 \cdot FR_1 + a_2 \cdot FR_2 + \ldots + a_7 \cdot FR_7 + a_8 \cdot FR_8}{FR_1 + FR_2 + \ldots + FR_7 + FR_8} \quad \text{(Eq. S6)}$$

**Table S2.** Testing points used for training and testing the ANFIS model.

| Feed flow rate (mL/min) | Inlet concentration (mg/L) | Bed height (cm) | %R | $q_e$ |
|---|---|---|---|---|
| 2 | 18.75 | 8.25 | 52.19 | 6.81 |
| 4 | 18.75 | 8.25 | 43.02 | 8.62 |
| 3 | 12.5 | 5 | 45.41 | 7.57 |