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List of Symbols

Symbol	Name	Units
A	The cross-sectional area of the bed	cm ²
A _T	Temkin isotherm constant	lg ⁻¹
a _e	The initial adsorption rate. Elovich Model	mg g ⁻¹ min ⁻¹
B	Temkin constant	J mol ⁻¹
b _T	Temkin isotherm constant	-
b _e	Desorption constant. Elovich Model	g mg ⁻¹
C	Intercept of intraparticle diffusion	-
C _b	Effluent conc. at breakthrough point	mg l ⁻¹
C _t	Total metal concentration in the solution phase	ppm
C _o	Initial concentration of potassium dichromate	ppm
C _e	Ion concentration in bulk solution at equilibrium.	ppm
C _{ad}	The concentration of metal removal	mg l ⁻¹
D	The mass diffusivity	cm ² s ⁻¹
E	Activation energy	kJ mol ⁻¹
h	Initial sorption rate	mg g ⁻¹ min ⁻¹
K	Rate constant of adsorption (BSDT)	lmg ⁻¹ h ⁻¹
K _f	Freundlich isotherm adsorption coefficient	lg ⁻¹
K _L	Langmuir isotherm parameter	lg ⁻¹
k ₁	Rate constant of pseudo first-order kinetic model	min ⁻¹
k ₂	Rate constant of pseudo second-order kinetic model	g mg ⁻¹ min ⁻¹
k _i	Intra-particle diffusion rate constant	mg g ⁻¹ min ^{1/2}
k _{AB}	Adam-Bohart Model constant	lmg ⁻¹ min
k _{Th}	The Thomas model constant	ml min ⁻¹ mg
k _{YN}	Yoon-Nelson constant	min ⁻¹
m _{total}	Total amount of metal ion sent to column	g
n	Freundlich isotherm constant	-
N ₀	The saturation concentration	mg l ⁻¹
q _m	Langmuir isotherm parameter	mg g ⁻¹
q _e	Metal concentration in the resin phase at equilibrium	mg g ⁻¹
q _t	Metal concentration in the resin phase at reaction time t	mg g ⁻¹

q_0	Adsorption capacity, Thomas model	mg g^{-1}
q_{total}	The total mass of metal adsorbed	mg
q_{eq}	Maximum capacity of the column	mg g^{-1}
Q	The volumetric flow rate	$\text{cm}^3 \text{min}^{-1}$
R	The gas constant	$8.314 \text{ Jmol}^{-1} \text{ K}$
R_L	Separation factor	-
R^2	R-square value, correlation coefficient	-
t	Time	min
T	Absolute temperature	K
t_{total}	The total flow time	min
U_0	The superficial velocity	cm min^{-1}
V	Volume of the solution	l
V_{eff}	the effluent volume	ml
W	dry weight of the ion-exchange resin	gm.
Y	the removal percent of Cr(VI) ions	%
Z	the bed depth of the fix-bed column	cm
Z_0	Critical bed depth	cm

abbreviation	Name	Units
DF	Decontamination factor	-
EBCT	the empty bed contact time	min
HYBRID	Hybrid fractional error function	-
SE	Standard error	-
χ^2	Chi-square test	-

Greek symbol

τ	The time required for 50% adsorbate breakthrough	min
μ	electrolyte viscosity	$\text{g cm}^{-1} \text{ s}^{-1}$

SUMMARY

Summary

Heavy metal ions are one of the major pollutants to human water resources. Hexavalent chromium is one of these ions and it is known to be toxic to human health and the environment. There are many techniques used to reduce the content of chromium ions in wastewater streams, the most effective and economic way is the use of ion exchange resin for the removal of hexavalent chromium from industrial wastewater.

In the present study, The gel type strong base Diaion SA20A resin have been used for the removal of Cr(VI) from aqueous solutions. Various physicochemical parameters such as pH, adsorbent dosage, rpm, initial metal ion concentration, temperature, and equilibrium contact time were studied. The equilibrium data were tested using three isotherm models—Langmuir, Freundlich and Temkin , among which Langmuir isotherm model was found to be suitable for the monolayer adsorption process with a high correlation coefficient and the maximum adsorption capacity of the resin was found to be 166.6 mg/g.

The Pseudo-first-order, pseudo-second-order, Elovich and intraparticle diffusion models were tested for their applicability of the present kinetic data, results showed that the adsorption followed a pseudo second- order reaction to a great extent.

The results revealed that both film diffusion and intraparticle diffusion contribute to the rate-determining steps.

Continuous adsorption experiments are conducted using fixed-bed adsorption column to evaluate the performance of the adsorbent (Diaion SA20A) for the removal of Cr(VI) from aqueous solutions and the results obtained are validated with a model developed in this study. The effects of significant parameters such as flow rate and bed height were studied and breakthrough curves were obtained. As the flow rate increases the breakthrough time decreases. As the bed height increases, breakthrough time gets delayed. The process parameters for fixed-bed adsorption such as breakthrough time, total percentage removal of Cr(VI), adsorption exhaustion rate and fraction of unused bed length are calculated and the performance of fixed-bed adsorption column is analyzed. Mathematical models such as Adam-Bohart, Thomas, Yoon-Nelson and BDST were applied for fixed-bed adsorption column, among which Thomas Model was suitable for describing the adsorption process.

The references were written according to the American Psychological Association, (APA), and Google Scholar system.