

Chapter 8

Comparison of Novel Adsorbents, Desorption and Application of Spent Adsorbent

8.1 Comparison of Novel Adsorbents

The comparison of novel adsorbents has been done on the basis of adsorption capacity as shown in Table 8.1.

It is found that all novel adsorbents are capable of removing heavy metals from contaminated water. As shown in Table 8.1, activated carbon is the superior adsorbent among all. After attainment of equilibrium, when all active sites were saturated, >97% of metal ions were adsorbed on the adsorbent's surface and a small fraction remained in the liquid phase. It was found that concentration of each metal ion after an equilibrium time was lower than the permissible limit demarcated by USEPA, USA.

It was concluded that composite was the best adsorbent for Cu^{2+} and Zn^{2+} ions. ATA was the superlative adsorbent for Ni^{2+} ions. For a single adsorbent other than activated carbon, the composite is the ideal choice for removing all metal ions.

The highest adsorption capacity (green colour) for Cu^{2+} , Ni^{2+} and Zn^{2+} ions was identified

Table 8.1: Comparative study of Novel Adsorbents

Adsorbent	Metal ion	Initial Concentration (mg/L)	Volume taken (mL)	Adsorbent dose (g)	Time (min)	Langmuir Adsorption capacity (mg/g)
Composite	Cu ²⁺ (Ternary solution)	100	100	1	300	61.86
	Ni ²⁺ (Ternary solution)				300	37.89
	Zn ²⁺ (Ternary solution)				360	10.48
<i>Azadirachta indica</i> Twig Ash	Cu ²⁺ (Ternary solution)	100	100	1	210	10.10
	Ni ²⁺ (Ternary solution)				210	125
	Zn ²⁺ (Ternary solution)				210	3.12
Mould	Cu ²⁺ (Ternary solution)	100	50	66.86	30	0.045
	Ni ²⁺ (Ternary solution)				30	0.086
	Zn ²⁺ (Ternary solution)				30	0.021
Activated carbon	Cu ²⁺ (Ternary solution)	100	100	1	60	250
	Ni ²⁺ (Ternary solution)				60	500
	Zn ²⁺ (Ternary solution)				60	83.33

in ACTG. The composite material has the second highest adsorption capacity (yellow colour) for Cu^{2+} and Zn^{2+} ions, whereas *Azadirachta indica* twig ash for Ni^{2+} ions.

8.2 Desorption Study

Desorption of heavy metal ions from the adsorbent surface was facilitated by the acidic desorbents, which protonate the surface of the adsorbent. The result has been shown in Figure 8.1. The distinct colors filled in each bar represents the desorption percentage of Cu^{2+} , Ni^{2+} and Zn^{2+} ions for each novel adsorbent in ternary metal solution. Activated

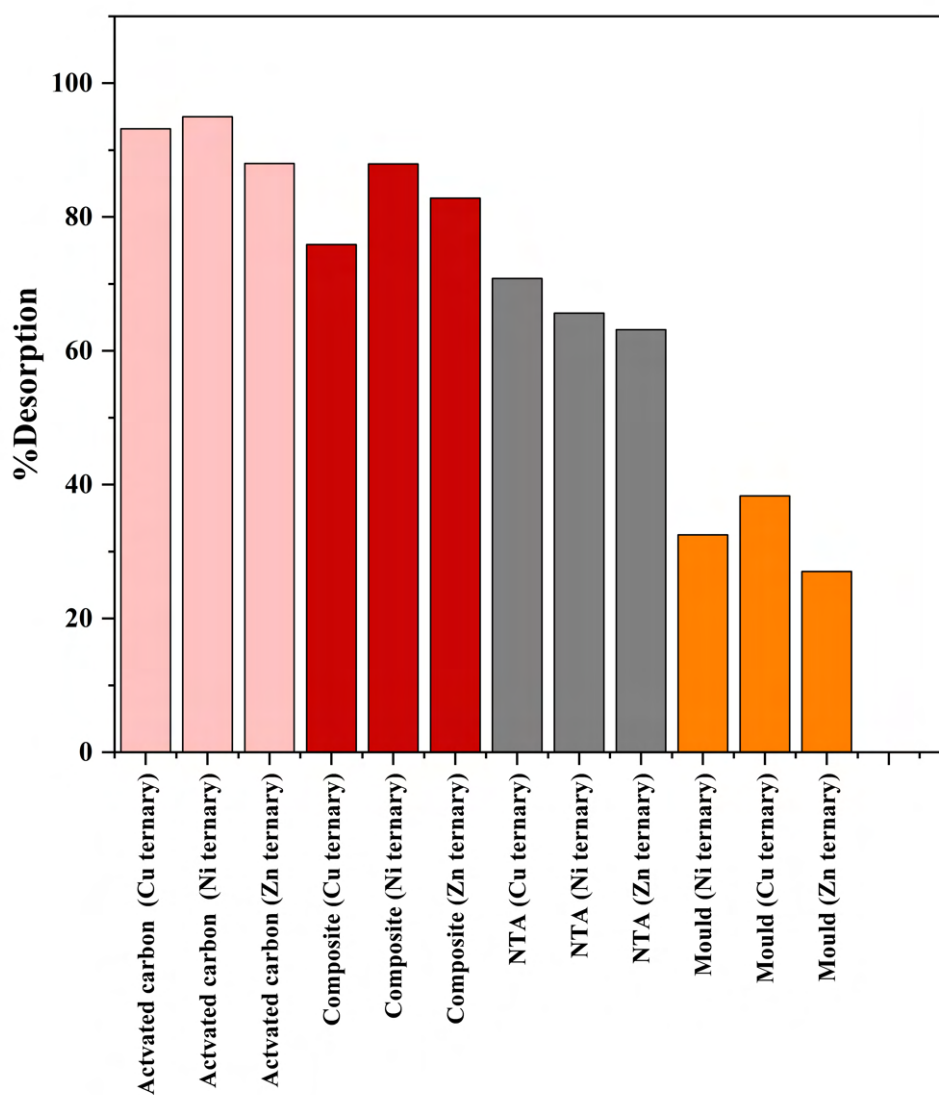


Figure 8.1: Percentage desorption of novel adsorbents

carbon is determined to have the highest percentage of desorption, followed by the composite, NTA and the mould.

8.3 Application of Spent Adsorbent

1. Red ochre can be utilized in cement manufacturing unit.
2. The cement grade mix raw material requires a minimum quantity of iron and alumina.
3. The red ochre mixed with limestone makes a perfect blend of elements in the raw material given to the cement producing facilities.
4. The red ochre can be found in a variety of industries, including the tile and ceramic industry, the plastics and rubber industry, the paint and dyes industry, the ceramics industry, the fertiliser industry, the brake lining industry, the cement industry, and other public and commercial areas.
5. Clay in combination with concrete can be utilized for creating roof tiles.
6. *Azadirachta indica* is well-known for its insecticidal effects against stored products, pests, stem borer, and other pests, but little is known about its insect repellent properties against insects that infest garden plants and other plants in the nature. As a result, spent *Azadirachta indica* twig ash can be used for a wide variety of such applications.
7. Activated carbon is a permitted material that organic farmers may use in the production of livestock. It is utilised as a pesticide, animal feed supplement, processing assistance, non-agricultural substance, and disinfection in livestock production. It is often used as biochar.
8. Activated carbon is widely used in a wide range of industries, including the chemical, pharmaceutical, food and beverage, mining and automotive sectors, for a wide range of purposes, including air cleaning, water purification, decolorization, solvent

removal, and odour removal.