Chapter VII

Column Experiments

Expansion of Batch studies as quantitative estimation of TBVSP were ensured through column schemes, since, both the divalent species exhibited better sorption on the former. This was carried out via continuous column running, employing aqueous Pb(II) and Ni(II) solutions. Further, column operations were extended to effluent samples collected from specified areas (Chapter III: 3.12-3.15).

7.1 Packing and Continuous Running of Columns

Glass columns with 6 cm inner diameter, 30 cm height as dimensions were packed with 40 grams TBVSP, between two supporting layers of glass wool, spreaded with glass beads. Heights of glass wool layer, glass beads sorbents', finally glass wool layer in the packing process were fixed as 3 cm, 2 cm, 10cm and 1cm respectively. 100 mg/L of Pb(II) and Ni(II) aqueous solutions as initial concentrations 100 mL / 10 mins and 100 mL / 20 mins as the flow rates for Pb(II) and Ni(II) were fixed as optimum conditions (figures 7.1&7.2).

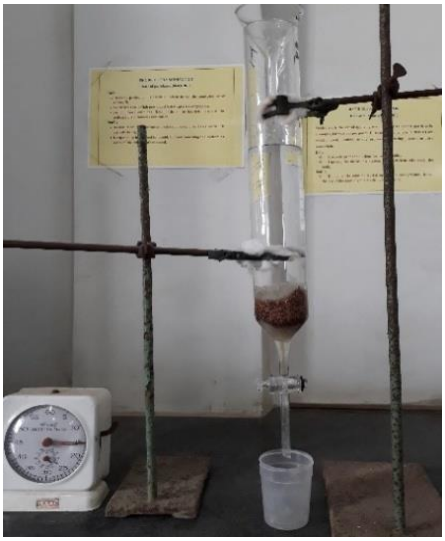

Figure 7.1 Column- Pb(II)-TBVSP

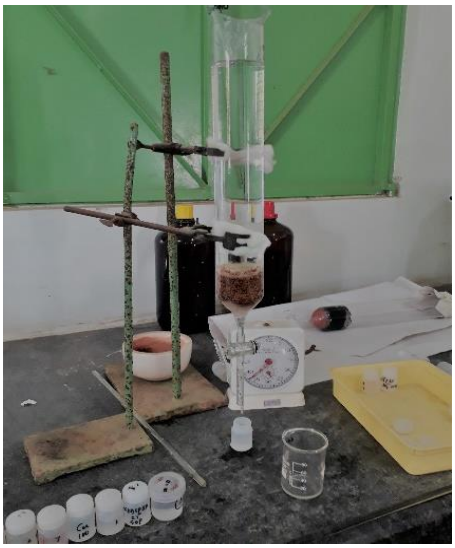

Figure 7.2 Column- Ni(II)-TBVSP

The collected samples were analyzed for their residual concentrations and the resulting data pertaining to percentage removal is calculated and is shown in table 7.1. Excellent sorption capacities were exhibited by TBVSP in trapping Pb(II) and Ni(II) (approximately 99 %) .

Table 7.1 Column Analysis

Aqueous Solution	Adsorbent	Sorbent Dose (g)	Flow Rate (mL /min)	Initial Conc. (mg/L)	Percentage Removal (%)
Pb(II) & Ni(II)	TBVSP	40	100 /10	100	98.5
			100 /20		99.2

The column operations got exhausted after the collection of 6 litres/ 8 litres for Pb(II) / Ni(II) at the end of first cycle. The exhausted material was desorbed using 0.1N HCl as eluent [2,3] at the rate of 100 mL/10mins, with pre and post washings using doubly distilled water. The recorded AAS data for the eluent registered, least traces of the divalent ions leach out, emphasizing the rate of desorption. The regenerated TBVSP was subjected to columns' packing and further running, where the columns' exhibited exhaustion after 7 and 8 litres, correspondingly. Successive desorption and regeneration cycles resulted in a total collection of 22 litres and 20 litres for Pb(II) and Ni(II) aqueous solutions respectively.

7.2 Effluent Treatment- Continuous column operations

The virtuous observations recorded for column studies in the laboratory using aqueous media were for effluent samples. Two samples, one each from Lakshmi Electro Plating finishers and SIDCO industrial estate (Lead- Acid battery unit) were collected on the basis of the reason that cluster of residence, being affected by these leachates without adequate treatment methodologies. The values showed the presence of Pb(II) and Ni(II) species, to exceed the permissible limit as per APHA standards for the industrial discharges[0.1 mg/L for Pb(II)/ 3.0 mg/L for Ni(II)]

Table 7.2 TBVSP vs Effluent

S.No.	Metal	Source	Concentration (mg/ L)		pH	Conductivity (mv)
			Initial concentration	Residual concentration		
1.	Pb(II)	SIDCO Industrial Estate-(Lead Acid battery unit)	600	6.2	4.9	11.2
2.	Ni(II)	Lakshmi Electroplating Finishers	800	8.3	3.2	14.4

The samples with their barren properties (pH and conductivity) were treated as per the conditions designed for the column performances pertaining to aqueous solutions. The analyzed effluent samples after the column process revealed similar results (99%) obtained for laboratory solutions, confirming the applicability of TBVSP as a potential material to chelate Pb(II) and Ni(II) under field conditions. The results are listed in table 7.2.

7.3 References

1. S. Sugashini & K. M. Meera Sheriffa Begum, ―Column Adsorption Studies for the Removal of Cr(VI) Ions by Ethylamine Modified Chitosan Carbonized Rice Husk Composite Beads with Modelling and Optimization, *Journal of Chemistry,* **(2013)**

2. S. P. Mishra, Adsorption–desorption of heavy metal ions, *Current Sciences*., 107, (**2014**) 4-25.

3. Anurag Pandey, Studies on Cr*(*VI*)*,Pb*(*II*)* *and* Cu*(*II*)* adsorption–desorption using calcium alginate *as* biopolymer , *Chemical Speciation and Bioavailability,* 19(1) **(2015**).