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REMOVAL OF HEAVY METALS FROM SYNTHESIS INDUSTRIAL WASTEWATER USING LOCAL ISOLATED *CANDIDA UTILIS AND ASPERGILLUS NIGER* AS BIO-FILTER

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ABSTRACT

In this study biomass filter of Candida Utilis which isolated from food sample in Baghdad local market and Aspergillus Niger which isolated from Baghdad soil used to biosorption heavy metals from synthesis industrial wastewater. two bio-filters were designed as cylindrical Perspex with height 10cm, diameter 3cm as a shell and inside their are layers of Sponge were prepare as the size of diameter of the cylindrical filter with thickness of 2cm arrange inside it, biomass production were 6 g of Aspergillus Niger and 5.6 g of Candida Utilis spreads between Sponges. pH, residence time, flow rate were tested as parameters, Optimum removal efficiency of Chromium, Lead, and Nickel were 89%, 90%, and 91% for Aspergillus Niger bio-filter, while it was 81%, 83%, 80% for Candida Utilis bio-filter at pH 6, residence time 10 min, flow rate 9 ml/min.

Keywords: Candida Utilis, Aspergillus Niger, Biosorption, Heavy metals, Synthesis industrial wastewater.

INTRODUCTION

The interaction of heavy metals with microorganisms has become an increasing global interest because of its potential as a biotechnological method in removing heavy metals from polluted aqueous systems. The possibility of removing heavy metals saturated from its environment by using biomass may provide an economic method for removing heavy metals from wastewater. The removal of heavy metals from industrial waste water or recovery of heavy metals from their solutions as part of their mining by leaching can be accomplished by biotechnological methods that make use of microorganisms as sorbent (Babel and Kurniawan, 2003).

biomass derived from, moulds and yeasts (Salinas *et al*., 2000) especially Candida Utilis (Baldrain, 2003) has the ability to biosorption heavy metal from the environment (Fencl *et al*., 1974). Fungi and yeast accumulates micronutrients such as Cu, Zn, Mn and non nutrient metals, like U, Ni, Cd, Sn and Hg in amount higher than nutritional requirement (Babel and Kurniawan, 2003). The potential of fungal biomass as biosorbent has been recognized for removal of heavy metals from polluted wasters (Sudha and Abraham, 1998), (Merrin *et al.*, 1998). This study compares the biosorption ability of two types of sorbents derived from the yeast as Candida Utilis and fungi as Aspergillus Niger for heavy metals at various pH, residence time and flow rate.

MATERIAL AND METHODS

Prepare Synthetic industrial Wastewater

Synthetic industrial wastewater was prepared by adding 1g of Lead nitrate, Potassium dichromate, Nickel nitrate in one liter distilled water (Suntud and Thadchai, 2006).

Isolation and Identification Candida Utilis and Aspergillus Niger

Candida Utilis isolated from food samples in Baghdad local market, Aspergillus Niger isolated from local soil samples. The isolates identified according to morphological and biochemical test by Vitek technology (biomerieux) in IBN-ALBALADY Hospital.

Candida Utilis Biomass Media

Strain was cultivated in media containing (g/L): glucose 100, yeast extract 7.5, pepton 7.5, $MgCl_2.2H_2o$ 2, K_2HPO_4 5.3, KH_2PO_4 2.7, NH_4CL 9, $FeSO_4.7H_2O$ 0.007. batch aerobic cultivation took place at pH 5.4 at temperature 30 0C for 3 days (Rajoka *et al.*, 2006).

Aspergillus Niger Biomass Media

The culture media contained (g/L): 100g lactose, 8g yeast extract, 1.51g KH_2PO_4,0.52 g $MgSO_4•7H_2O$, 0.40g NaCl, 1mg $ZnSO_4•H_2O$, 2 mg $Fe(NO_3)_3•9H_2O$, 0.04 mg biotin pH 5.4 at temperature 30 0C for 5 days (Casas López *et al.*, 2003).

Analysis of Heavy Metals

The biosorption of lead, Nickel and chromium in the wastewater was determined by Atomic spectrophotometer (shimadzu)

Biomass Preparing

Biomass was harvested by filtration at the end of the fermentation process it was killed by autoclaving at 121°C for 20 min, washed thoroughly with distill water and dried in an oven at 45°C for 10 hr. Then it was powdered to particles of uniform size of about 100 µm. This powdered biomass was used in further biosorption experiments (Akthar *et al.*, 2003).

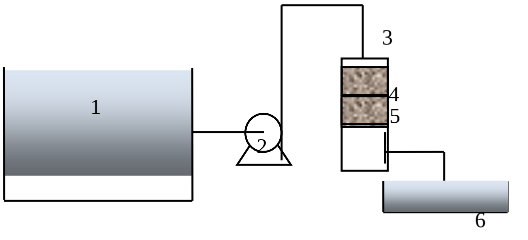
Preparing of Bio-filter

In this system two cylindrical Perspex with height 10cm, diameter 3cm as a shell and inside their is layers of sponge was prepare as the size of diameter of the cylindrical filter with thickness of 2 cm and plated in the filter, the first used 5.6 g Candida Utilis biomass spread on the surface sponge and recover with sponge, the second filter layer was used 6g Aspergillus Niger.

Each filter was tested separately in the system, after prepping filter it connected to dozing pump and system stared figure 1.

Figure1. Shown schematic diagram of the system and bio-filter used

1	Feed tank
2	Dozing Pump
3	Biofilter
4	Sponge layers
5	Biomass
6	Storage tank



Effect of pH

Figures (2, 3) shown the effect of pH in removal efficiency of *Candida Utilis* and *Aspergillus Niger*, pH was taken from 1-10 for both bio-filter, Cr, Pb, Ni removal efficiency by using *Candida Utilis* bio-filter increase with increased of pH till it reached to optimum value of Cr 81%, Pb 83%, Ni 80% at pH equal to 6 (figure 2).

Removal efficiency for *Aspergillus Niger* biomass filter increased from 15 % to 88% for Cr, Pb, 90%, Ni 91% (figure 3).

Figure-2. shown the effect of pH in removal efficiency of heavy metals for *Candida Utilis* bio-filter

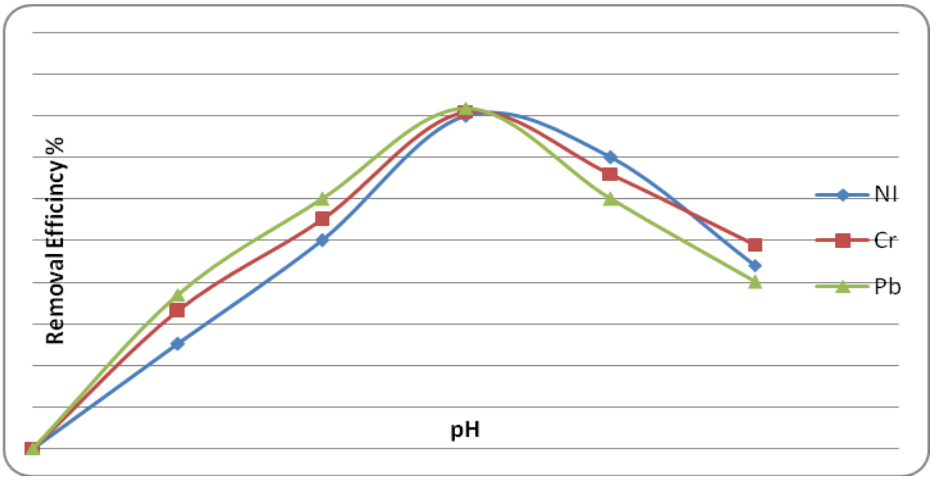
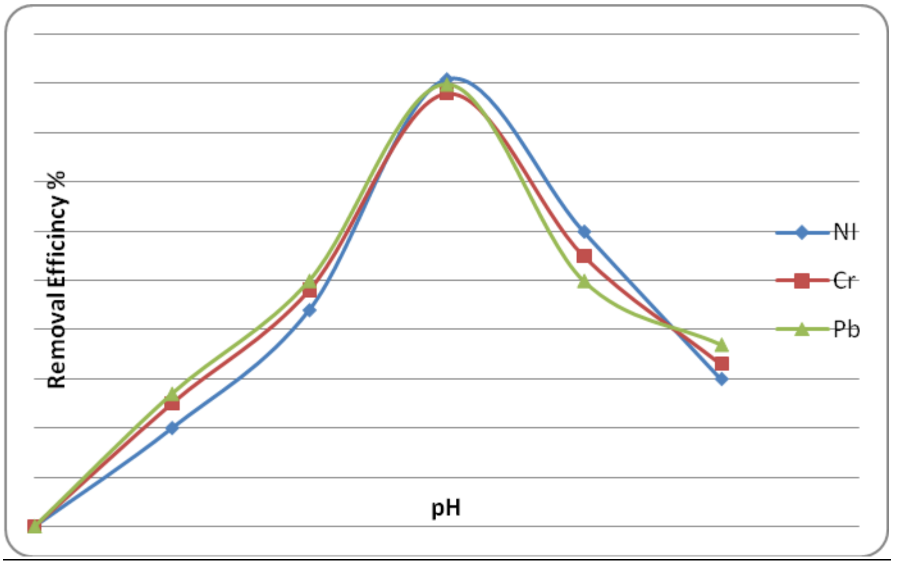


Figure-3. Shown the effect of pH in removal efficiency of heavy metals for *Aspergillus Niger* bio-filter



Effect of Contact Time

Residence time was varied from one to 60 min. As can be seen in figures 4 and 5, the percentage removal efficiency of heavy metals increased with the time. A sharp increase was observed at around the time of 10 min. and attained an optimum at the time of 10 min for both types of bio-filters. At this contact time the removal efficiency of heavy metals for *Candida Utilis* were Cr 81%, Pb 83% and Ni 80% (figure 4) and for *Aspergillus Niger* biomass were 88% Cr, Pb, 90%, Ni 91% (figure 5).

Figure-4. Shown the effect of time on removal efficiency of heavy metal for *Candida Utilis* bio-filter

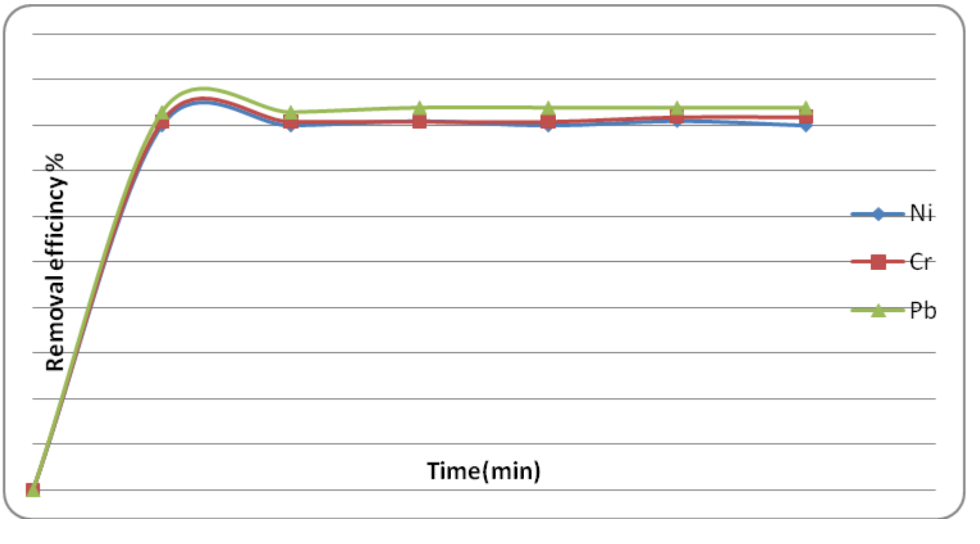
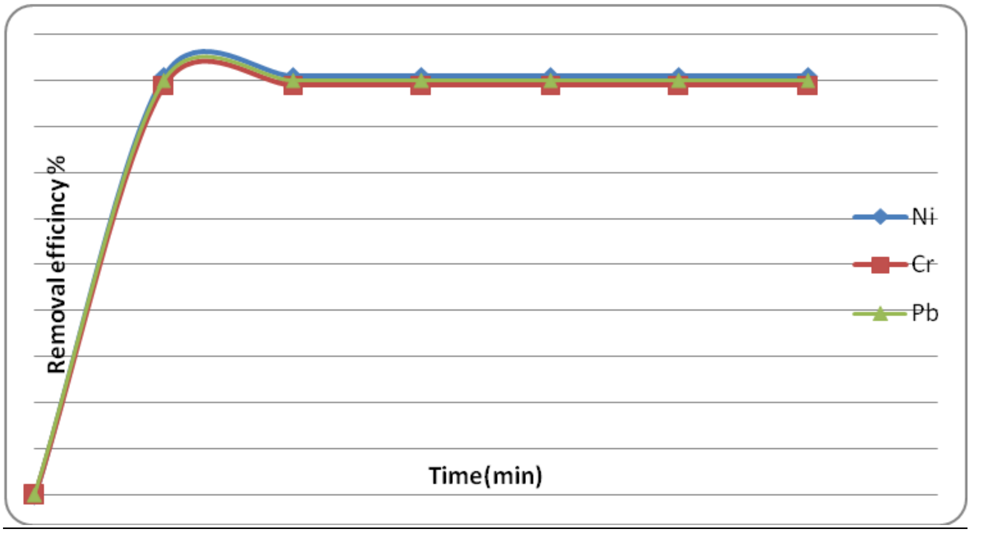


Figure-5. Shown the effect of time on removal efficiency of heavy metal for *Aspergillus Niger* bio-filter



Effect of Flow Rate

Flow rate range was taken from 0-60 ml/min for both bio-filters, both bio-filter shown similar behavior As shown in figure 6, 7, the optimum flow rate was 9 ml /min was used to pass the feed in to the bio-filters the curve to get best removal efficiency of heavy metals for *Candida Utilis* were Cr 81%, Pb 83% and Ni 80% (figure 6) and for *Aspergillus Niger* biomass were 88% Cr, Pb, 90%, Ni 91% (figure 7).

Figure-6. Shown the effect of flow rate on removal efficiency of heavy metal *Candida Utilis* bio-filter

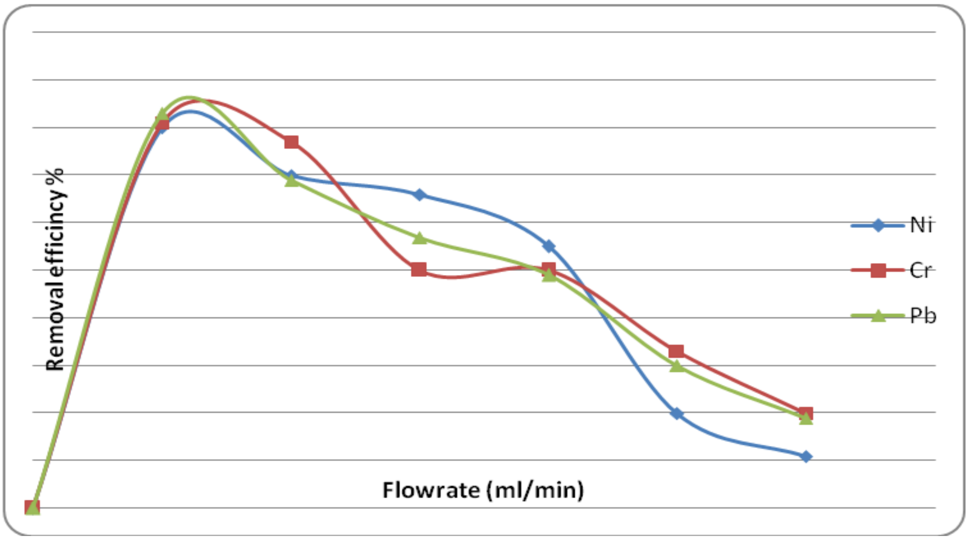
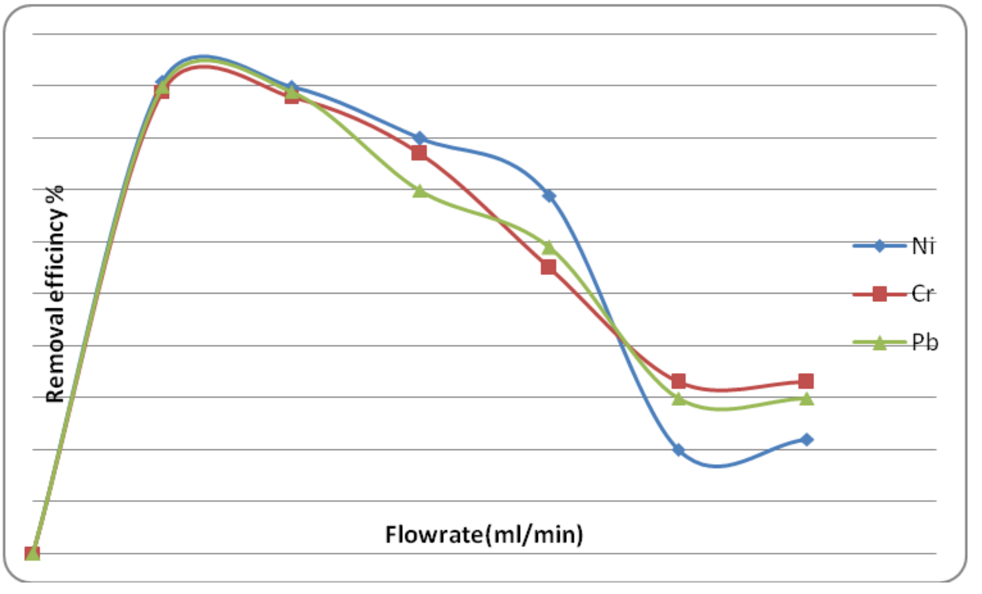


Figure-7. Shown the effect of flow rate on removal efficiency of heavy metal *Aspergillus Niger* bio-filter



DISCUSSION

The pH considered as one of the most effective parameters in bio-sorption of heavy metals. From figures 2 and 3 we it was found that best pH used for both bio-filters is pH = 6 which gives optimum removal efficiency , this result agree with Sela0.ntina *et al.* (2004)who mentioned that the optimum pH for best removal between 5 and 6. At low pH, the negligible removal of chromium may be due to the competition between hydrogen (H+) and metal ions. At higher pH the increased metal removal may be due to the ionization of functional groups and the increase in the negative charge density on the cell surface. At alkaline pH values, a reduction in the solubility of metals may contribute to lower uptake rates (Srivastava and Thakur, 2007). While Rodríguez *et al.* (2008) found that best removal for Pb^{+2}, Cd^{+2} and Cr^{+3} at pH 3.0–5.0 with the yeast *Saccharomyce scerevisiae*. Some researchers, Liu *et al.* (2007) and Bai and Abraham (2001) found the maximum removal at 100 mg/L Cr (VI) solution using *Mucorracemosus* and *Rhizopusnigricans* with pH optimum of 0.5–1.0 and 2.0, respectively.

The figures 4 and 5 showed that minimum residence time at least 10 minutes for both bio-filters, hence the contact time of 10 minutes was set for all other experiments. Greater availability of various functional groups on the surface of yeast cell, which are required for interaction with anions and cations, significantly improved the binding capacity and the process proceeded rapidly. This result is important, as contact time is one of the important parameters for an economical wastewater treatment system (Baldrain, 2003). While Alpat *et al.* (2010) found that the effect of contact time of Ni (II) on *Circinella sp.* It can be seen that the biosorption process occurred very rapid in 15 min, and Ni (II) uptake capacity value reached equilibrium at 60 min. No further increase in the level of bounded Ni (II) after 60 min. Therefore, 60 min was selected as equilibrium time for biosorption process. The results of the effect of contact time on uptake indicates that the respective test isolates had an optimum residence time for each heavy metal and once this time elapsed, uptake remained either constant or diminished slightly. This agrees with metal uptake models, where the process can be considered as an equilibrium that involves adsorption and desorption due to saturation (Panchanadikar, 1994).

The effect of flow rate on removal efficiency of heavy metal (figures 6, 7). The results revealed gradually increased with flow till it reach to 9 ml/min and it declined at high value, this decrease due to reduce contact time with biomass, this result agree with Chhikara *et al.* (2010) who found that removal efficiency depends on the period of contact between the metal ions and biosorbent surface which is biomass, the flow rate of metal solution through the biosorbent column affects metal removal efficiency as it affects the contact time. At higher flow rates, the contact phase was reduced resulting in early breakthrough and less metal uptake. At lower flow rates large amount of mixing or axial dispersion occurred, thereby, increased the metal uptake. An increase in the height of the column increased metal biosorption because of greater time of contact and more intra particular diffusion.

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