INTISARI

Aktivitas industri baterai nikel kadmium, pigmen, bahan *coating*, bahan *stabilizers* dalam industri plastik dan barang sintetis lain menghasilkan air limbah yang terkontaminasi kadmium. Tercatat bahwa 45% total pencemaran global adalah logam kadmium. Hal ini tentu menurunkan kualitas lingkungan perairan yang akan mempengaruhi kelangsungan makhluk hidup. *Constructed Wetland* (CW) adalah salah satu teknologi pengolahan limbah sederhana dengan memanfaatkan tanaman, media berpori serta bantuan mikroba untuk menghilangkan polutan dalam air limbah. Tujuan dari penelitian ini adalah untuk mengidentifikasi pengaruh adsorpsi oleh media zeolit alam dan fitoremediasi oleh tanaman akar wangi (*Vetivera Zizanoides*) yang dilakukan pada reaktor *Subsurface-CW* dan reaktor *Free Water Surface-CW* dan mempelajari kinetika laju penurunan kadar kadmium dalam limbah cair. Penelitian ini dimulai dengan percobaan adsorpsi batch untuk melihat kemampuan zeolit alam dalam menjerap logam kadmium dengan menentukan kesetimbangan adsorpsi. Hasil percobaan menunjukkan model adsorpsi yang sesuai adalah Freundlich dengan nilai K_F = 3,999 dan n = 0,845. Persentase penghilangan kadmium adalah 99,4% untuk dosis adsorben 70 g/L. Penelitian selanjutnya dilakukan pada dua reaktor *subsurface constructed wetlands* dengan desain dan ukuran yang sama dan satu reaktor free water surface. Reaktor RI berisi zeolit alam, reaktor RII berisi zeolit alam dan tanaman akar wangi, reaktor RIII berisi tanaman akar wangi saja. Limbah cair yang digunakan adalah limbah artifisial yang mengandung 10 mg/L sebanyak 60 L untuk setiap reaktor. Limbah kadmium dituangkan kedalam masing – masing reaktor dan diresirkulasi secara kontinyu selama 24 jam. Sampling dilakukan pada jam ke 1,2, 3, 4, 5, 6, dan 24 pada masing – masing reaktor untuk dianalisis kadar kadmiumnya dengan menggunakan AAS. Tanaman akar wangi diaklimatisasi selama 30 hari sebelum digunakan pada RII dan RIII. Aklimatisasi berlangsung dengan baik ditandai dengan pertumbuhan tanaman dan tumbuhnya tunas baru. Kinetika laju penurunan kadmium ditentukan dengan metode *Sum Square of Error* (SSE) menggunakan persamaan orde 1 dan orde 2. Hasil penelitian menunjukkan rata – rata persentase penyisihan kadmium semakin meningkat seiring bertambahnya waktu pemrosesan yaitu pada RI sebesar 95,488%, RII sebesar 96,235%, dan RIII sebesar 72,674%. Hal ini menunjukkan bahwa kombinasi metode adsorpsi dengan zeolit alam dan fitoremediasi dengan tanaman akar wangi paling efektif menurunkan kadar kadmium dalam limbah cair, Tipe subsurface constructed wetland terbukti lebih baik dalam menurunkan kadar kadmium dibandingkan dengan *free water surface* yang hanya menggunakan tanaman akar wangi saja. Hal ini menunjukkan bahwa media zeolit alam sangat berperan dalam menurunkan kadar kadmium air limbah. Model kinetika laju penurunan kadmium dalam limbah cair pada reaktor RI, RII, dan RIII mengikuti model kinetika orde 1 dengan nilai k sebesar 1,705, 1,9874, dan 12,099.

Kata kunci: Adsorpsi, *Constructed Wetlands*, Fitoremediasi, Kadmium, Zeolit Alam

ABSTRACT

The industrial activies of nickel cadmium batteries, pigments, coating materials, stabilizers in the plastics and other synthetic goods industry produce wastewater contaminated with cadmium. It is listed that 45% of the total global pollution is cadmium. Certainly, this reduces the quality of the aquatic environment which will affect the survival of organisms. Constructed wetlands is a simple waste treatment technology by utilizing plants, porous media, and microbe to remove pollutants in wastewater. The purposes of this study were to identify the effect of adsorption by natural zeolite as media and phytoremediation by vetivera zizanioides as the plant and to study the kinetics of the rate cadmium removal in wastewater. It was carried out in the Subsurface-CW and Free Water Surface-CW reactor. This research started with batch adsorption experiment to observe the ability of the natural zeolite to adsorb cadmium by determining the isotherm adsorption. It was resulted that the appropriate adsorption model is Freundlich with K_F = 3.999 dan n = 0.845. the percentage of cadmium removal was 99,4% for an adsorbent dose 70 g/L. Subsequent research was carried out on two Subsurface-CW reactors with the same design and size while another was Free Water Surface -CW reactor. The waste water used is artificial waste that contain 10 mg/L of cadmium as much as 60 L for each reactor. Cadmium waste is placed into each reactor and continuously recirculated for 24 hours. The Sampling was carried out at per (1, 2, 3, 4, 5, 6, and 24) hour in each reactor to analyze the concentration of cadmium using AAS. Vetivera ziznioides plants were acclimatized for 30 days before being used in RII and RIII. Acclimatization was going well characterized by plant growth and new shoots. The kinetics of the cadmium reduction rate was determined by the Sum Square of Error (SSE) method using the equations of order 1 and order 2. The result showed that the average percentage of cadmium removal increased with processing time, that is in RI was 95.488%, RII was 96.235%, and RIII was 72.674%. This showed that the combination of adsorption methods with natural zeolite and phytoremediation with vetivera zizainoides plants is the most effective in reducing cadmium levels in wastewater. The subsurface constructed wetland type is proven to bebetter in reducing cadmium levels compared to free water surfaces which only use vetivera zizaniodes plants. This shows that natural zeolite media plays a very important role in reducing cadmium levels in wastewater. The kinetic model of the rate of reduction of cadmium in wastewater in reactors RI, RII, and RIII follows the first-orderkinetic model with the k value of 1.7056, 1.9874, and 12.099.

Key Words: Adsorption, Cadmium, Constructed Wetlands, Fitoremediation, Natural Zeolit