

EFFECTS OF INDUSTRIAL WASTEWATER ON WATER AND SEDIMENT
QUALITIES AND EFFECTIVENESS OF BIOREMEDIATION METHODS OF
INDUSTRIAL WASTEWATER TREATMENT, GEBENG, PAHANG, MALAYSIA

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ABSTRACT

Gebeng is a very important industrial estate of Pahang, Malaysia. A study was conducted in Gebeng industrial area in order to obtain the current status of industrial wastewater, surface water and sediments. Results of industrial wastewater and surface water were compared to Malaysian and different standards limits. Moreover, the industrial wastewater and surface water classification and contamination intensity were calculated. Sediment quality guidelines were used to compare the results of sediments. Some of water quality parameters such as BOD, COD, TSS, Pb, Cd, Cr and Hg were higher compared to standard limits in studied wastewater. BOD, COD, ammoniacal nitrogen, total nitrogen, total phosphorous, nitrate, phosphate, As, Hg, Co, Pb, Ni, Cr, Cd and Cu were higher in surface water compared to standard threshold. For sediments, Co, Hg, As, Pb and Cu concentrations were higher than those of permissible levels. In addition, wastewater treatments were done by bio-remediation methods. It was performed first by *Pseudomonas aeruginosa* and secondly by Vetiver grass, Cattails and Water hyacinth. From the treatments of *Pseudomonas aeruginosa*, the expected pollutants removal efficiency was found. Because of lower pollutants tolerant features vetiver grass and water hyacinth did not survive in 100 % wastewater while cattails were adapted to 100 % wastewater due higher contaminants tolerant characteristics. The 75 % wastewater with N-P-K mixed fertilizer treatment was found as the best treatments among vetiver grass and water hyacinth treatments. In case of cattails, 100 % wastewater with mixed fertilizer treatment showed the best performance. Statistical software (SPSS) was used to compute data and results. Least significance difference, first order kinetics, correlation analysis, principal component analysis, pollution load index, contamination factors, geo accumulation index and surface water enrichment factors were used to test the significance, validity of data, groupings of parameters and interpretation. In this study, a novel two steps technique was used which proven to give higher efficiency compared to direct treatments with plants. From this study, it could be concluded that the study area is moderately contaminated by industrial wastewater. Furthermore, the surface waters are classified as polluted (DOE-WQI) and sediments are very strongly and strongly polluted by Co and Hg respectively while Pb, Cd and As are found unpolluted to moderately polluted. So, recycling of wastewater, wastewater treatments by bioremediation techniques, close monitoring and supervision in every industry have to be introduced.

ABSTRAK

Gebeng merupakan sebuah kawasan industri penting di Pahang. Satu kajian telah dijalankan di kawasan perindustrian Gebeng untuk mengenal pasti status terkini sisa air, permukaan air dan mendapan industri. Hasil kajian sisa air dan permukaan air industri dibandingkan antara had piawaian Malaysia dan had-had lain. Tambahan klasifikasi dan tahap pencemaran sisa air dan permukaan air industri dikira. Tatacara kualiti mendapan digunakan untuk membandingkan hasil-hasil kajian mendapan. Beberapa parameter kualiti air seperti BOD, COD, TSS, Pb, Cd, Cr dan Hg didapati tinggi dibandingkan dengan had-had piawaian dalam sisa air yang dikaji. BOD, COD, nitrogen daripada ammonia, jumlah nitrogen, jumlah fosforus, nitrat, fosfat, As, Hg, Co, Pb, Ni, Cr, Cd dan Cu adalah tinggi dalam permukaan air dibandingkan dengan piawaian ambang. Untuk mendapan, kepekatan Co, Hg, As, Pb dan Cu adalah lebih tinggi daripada tahap-tahap yang dibenarkan itu. Disamping itu, rawatan-rawatan sisa air dilakukan dengan menggunakan kaedah-kaedah rawatan-bio. Ia pertamanya dilaksanakan dengan menggunakan *Pseudomonas aeruginosa* dan keduanya dengan menggunakan rumput Vetiver, Cattail dan keladi. Daripada rawatan-rawatan menggunakan *Pseudomonas aeruginosa*, kecekapan penyingkiran bahan cemar yang dijangka ditemui. Disebabkan sifat toleransi terhadap bahan cemar yang rendah, rumput vetiver dan keladi tidak boleh hidup dalam 100% sisa air tetapi Cattail boleh hidup dalam medium berkenaan disebabkan sifat toleransinya yang tinggi. Sisa air 75% dengan rawatan baja campuran N-P-K didapati merupakan rawatan terbaik di antara rawatan menggunakan rumput vetiver dan keladi. Dalam kes Cattail, sisa air 100% dengan rawatan baja campuran menunjukkan pencapaian yang terbaik. Perisian statistik (SPSS) digunakan untuk mengira data dan hasil ujikaji. Beza ketara terkecil, kinetik tertib pertama, analisa korelasi, analisa komponen asas, indeks beban pencemaran udara, faktor pencemaran air, indeks penumpukan-geo dan faktor-faktor pengkayaan permukaan air digunakan untuk menguji tahap signifikan (ketermaknaan), penerimaan terhadap data, pengumpulan parameter-parameter dan penterjemahan. Dalam kajian ini, dua teknik baharu digunakan yang terbukti memberi kecekapan yang lebih tinggi dibandingkan dengan rawatan secara langsung dengan menggunakan tumbuh-tumbuhan. Daripada kajian ini, ia boleh dirumuskan bahawa kawasan kajian dicemari secara sederhana oleh sisa air industri. Malahan, permukaan air dikelaskan sebagai tercemar (DOE-WQI) dan mendapan adalah sangat kuat dan sangat dicemari masing-

masing oleh Co dan Hg sedangkan Pb, Cd, dan As ditemui tidak tercemar kepada tercemar sederhana. Oleh itu, kitar semula sisa air, rawatan-rawatan sisa air oleh teknik rawatan-bio, pemantauan dan penyeliaan yang ketat dalam setiap industri patut diperkenalkan.

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