Bioaugmentasi tanah sawah tercemar heptaklor oleh bakteri tempatan dan biochar tempurung kelapa = Bioaugmentation of heptachlor in paddy field by indigenous bacteria and biochar coconut shell

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Abstrak

ABSTRAK

Undang-undang RI No. 19 tahun 2009, pengesahan konvensi Stockholm tentang bahan pencemar organik yang persisten, dan telah melarang penggunaan kategori insektisida yaitu aldrin, klordan, dieldrin, endrin, heptaklor, heksaklorobenzena, mirex, toxaphene dan poliklorinatbifenil (PCB), serta membatasi penggunaan insektisida diklorodifenildikloroetana (DDT). Faktanya, keberadaan insektisida organoklorin tersebut masih ditemukan di tanah sawah Kabupaten Karawang yaitu aldrin, DDT, endosulfan, endrin, heptaklor dan lindan dengan konsentrasi berkisar antara 1,5 ng/g sampai dengan 5,37 ng/g. Teknologi pengendalian residu pestisida dapat dilakukan melalui ameliorasi secara biologi dengan bioremediasi, secara fisika dengan adsorpsi arang aktif, sedangkan, secara kimia melalui penambahan alum dan lain-lain. Bioaugmentasi adalah introduksi mikroba tertentu pada daerah yang akan diremediasi. Bakteri tempatan potensial pendegradasi heptaklor hasil isolasi adalah Citrobacter sp. Setelah diidentifikasi dengan 16S rRNA, bakteri tersebut adalah Raoultella ornithinolytica B4, bakteri ini golongan Enterobacteriaceae, Gram negatif, dan menghasilkan enzim katalase. Biochar tempurung kelapa (BTK) memiliki sifat adsorben berdasarkan nilai daya serap iod sebesar 570,22 mg/g, luas permukaannya 371,943 m2/g, dan diameter pori 0,4-7,0 mm karena proses karbonasi 300 oC menghasilkan ukuran makropori. Hasil uji adsorpsi BTK 5% (b/b) terhadap heptaklor 2 mg/L secara adsorpsi fisik, terlihat dari persamaan Langmuir memiliki linearitas y=1,704x ? 0,002, kapasitas adsorpsinya 1,704 mg/g, dengan efisiensi adsorpsinya sebesar 75,01%. Proses bioaugmentasi tanah sawah tercemar heptaklor oleh bakteri tempatan Raoultella ornithinolytica B4 dengan bantuan BTK 5%, menghasilkan degradasi heptaklor (Rt 11,31 menit) menjadi 1-hidroksiklordene (Rt 12,38 menit), dengan nilai efisiensi remediasi sebesar 75,38%.
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ABSTRACT

The regulation of Republic of Indonesia No. 19 in 2009, about the ratification of the Stockholm Convention on Persistent Organic Pollutans (POPs), that bann the use of insecticides category, namely aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene and polychlorinated biphenyls (PCB), and as well as the restriction use of insecticide dichlorodiphenyldichloroethane (DDT). In fact, the presence of insecticides organochlorine are still found on paddy filed, from nine villages and sub-districts in Karawang contained seven types, they are aldrin, DDT, endosulfan, endrin, heptachlor and lindane concentrations in the district ranges from 0.3 ng/g in up to 5.37 ng/g. Bioaugmentation is the applications of indigenous or allochthonous wide type or genetically modified microorganisms to hazardous waste polluted sites in order to accelerate the removal of undesired compounds. Indigenous Bacteria that is potential to degrade heptachlor is obtained from the isolation of Citrobacter sp and finally identified by 16S rRNA

identification technique, that this bacteria is Raoultella ornithinolytica B4 which is classified as a group of bacteria of Enterobacteriaceae, as a Gram-negative, and produce the enzyme catalase. Biochar coconut shell (BCS) as adsorbent was tested for its quality by SNI-06-3730-1995 method. It has a water content of 11.88% (w/w), ash content of 3.32%, an easily evaporated substance content of 13.61%, bounded carbon to 71.20%, and iod number of 570.22 mg/g. The adsorption result of BCS 5% (w/w) to heptachlor was 2 mg/L which was fit with physical adsorption of Langmuir equation with adsorption linearity $y = 1,704x - 0,002$, adsorption capacity of 1.704 mg / g, so BCS can adsorb heptachlor well. Bioaugmentation using single strain of R. ornithinolytica B4 successful for removal of heptachlor with efficiency was observed in 35 days incubation was 75.38%, and heptachlor (11,31 minute) degraded to 1-hydroxychlordene (12,38 minute).