

**SEASONAL VARIATIONS OF TRACE METALS
IN SURFACE WATERS OF THE SETIU
WETLAND, TERENGGANU**

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**MASTER OF SCIENCE
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**Thesis Submitted in Fulfillment of the Requirement
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Alhamdulillah....
To My Beloved Father and Mother,
To My Beloved Family and Friends
Thank You for all the supports

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Spatial and temporal distribution of dissolved and particulate trace metals (Cd, Cu, Pb, Zn, and Fe) and dissolved organic carbon (DOC) in Setiu Wetland, Terengganu was studied. Surface water samples were collected monthly at 10 sampling stations from October 2010 until September 2011. The concentrations of DOC ranged from 153- 8688 µg/L whilst the concentration of dissolved trace metals were in the range of 0.0013-0.1611 µg/L for Cd, 0.12-2.81 µg/L for Cu, 0.01-1.84 µg/L for Pb, 3 – 172 µg/L for Fe and 1 – 34 µg/L for Zn. The concentration of particulate trace metals ranged from below detection limit (BDL) – 96 µg/g for Cd, BDL – 581 µg/g for Cu, BDL- 763 µg/g for Pb, 256 – 203862 µg/g for Fe and BDL – 467974 µg/g for Zn. Concentration of dissolved and particulate trace metals were highest at station B1, B2, B5 and B9. The spatial pattern suggested that riverine input and major activities within the wetland such as agriculture, aquaculture and boating activities were the most important factors influencing the distribution of trace metals. The

concentrations of dissolved and particulate metals were also correlated with rainfall. Dissolved trace metals concentration were highest during wet seasons for all trace metals whilst particulate trace also highest during wet season except for Fe and Zn and showed significant difference ($P < 0.05$) based on Anova two factor test. Trace metals size fractionation were high distributed in large molecular weight range (MWR) ($>100\text{kDa}$) fraction for all dissolved trace metals except for Cd. The concentration of large MWR Cu, Pb, Fe and Zn were made up to $46 \pm 5\%$, $48 \pm 3\%$, $48 \pm 2\%$ and $47 \pm 4\%$ respectively from the total dissolved trace metals. This is can be predicted that bulk of trace metals were consist of colloidal organic or inorganic. The positive correlation between Cu, Pb, Zn and Fe with large MWR DOC further support the finding that the present of colloids fractions influencing the distribution of trace metals.

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**PERBEZAAN BERMUSIM LOGAM SURIH DI AIR
PERMUKAAN TANAH BENCAH SETIU, TERENGGANU**

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Kajian logam surih (Cd, Cu, Pb, Zn dan Fe) dan karbon organik terlarut (DOC) telah dikaji berdasarkan taburan ruang dan masa. Sampel permukaan air telah diambil setiap bulan bagi 10 stesen persampelan bermula dari Oktober 2010 sehingga November 2011. Kepekatan DOC adalah dari julat 153 - 8688 $\mu\text{g/L}$ manakala kepekatan logam surih terlarut adalah di dalam julat lingkungan 0.0013-0.1611 $\mu\text{g/L}$ untuk Cd, 0.12-2.81 $\mu\text{g/L}$ untuk Cu, 0.01-1.84 $\mu\text{g/L}$ untuk Pb, 3-172 $\mu\text{g/L}$ Fe dan 1-34 $\mu\text{g/L}$ untuk Zn. Sementara itu, kepekatan logam partikulat adalah di dalam julat dibawah had pengesanan (BDL) - 96 $\mu\text{g / g}$ bagi Cd, BDL - 581 $\mu\text{g / g}$ bagi Cu, BDL - 763 $\mu\text{g / g}$ untuk Pb, 256-203862 $\mu\text{g / g}$ untuk Fe dan BDL - 467974 $\mu\text{g / g}$ bagi Zn. Kepekatan tertinggi logam surih terlarut dan partikulat telah dicatatkan di stesen B1, B2, B5 dan B9. Situasi ini mencadangkan bahawa input dari sungai dan aktiviti utama di sekeliling tanah bencah seperti aktiviti pertanian, akuakultur dan perkapalan adalah faktor utama yang mempengaruhi taburam logam surih.

Kepekatan logam terlarut dan partikulat juga berkait rapat dengan perubahan taburan hujan. Logam surih terlarut mencatatkan kepekatan tertinggi pada musim basah bagi kesemua jenis logam surih terpilih manakala logam partikulat juga mencatatkan kepekatan tertinggi pada musim basah kecuali Fe dan Zn. Kesemua logam menunjukkan perbezaan yang signifikan ($p < 0.05$) berdasarkan ujian Anova dua faktor. Taburan pembahagian logam surih terlarut adalah banyak pada julat jisim molekul tinggi ($>100\text{kDa}$) untuk kesemua logam terlarut kecuali Cd. Kepekatan julat jisim molekul tinggi masing-masing bagi Cu, Pb, Fe dan Zn adalah terdiri daripada $46 \pm 5\%$, $48 \pm 3\%$, $48 \pm 2\%$ and $47 \pm 4\%$ dari jumlah keseluruhan logam surih terlarut. Ini boleh meramalkan bahawa sebahagian besar logam surih terlarut terdiri daripada koloid organik atau bukan organik. Hubungan positif antara Cu, Pb, Zn dan Fe julat jisim molekul tertinggi DOC menyokong dapatan bahawa kehadiran koloid mempengaruhi taburan logam berat.