

**SPATIAL PATTERNS OF THE HEAVY METALS IN THE SEDIMENTS AT THE  
CHA-AM MUNICIPALITY WASTEWATER TREATMENT PONDS SYSTEM**

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IRVINE, Ph.D., ROMANEE THONGDARA, D.Tech.Sc.**ABSTRACT**

Cha-Am beach uses an aerated lagoon system with four ponds in series to treat its municipal wastewater. This study investigated the spatial pattern of heavy metals concentrations in the deposited bottom sediment of the four ponds; i) aeration pond; ii) settling pond; iii) extended aeration pond; and iv) evaporation pond. Based on a randomized grid sampling scheme, 11-14 surface grab samples were collected from each of the four ponds on two different dates, for a total of 94 samples. Loss on ignition (LOI) and particle size measurement were analyzed and Bruker S1 Titan 600 X-ray Fluorescence (XRF) analyzer was used to determine the concentrations of heavy metals in the air-dried sediment samples. The lowest and highest values of LOI from both samples were 9.16% and 37.38 %, respectively. The lowest and highest values of particle size ( $D_{50}$ ) from both samples were 105  $\mu\text{m}$  and 521  $\mu\text{m}$ , respectively. The t-tests ( $\alpha=0.05$ ) result showed that As, Cl, Cu, Fe and Zn decreased significantly from the first pond to the third pond and increased significantly in the fourth pond, Cr did not change significantly in the ponds. Mn decreased insignificantly from the first to the second pond, but increased significantly from the second pond to the third pond, and then decreased significantly to the fourth pond. From the first to the second pond, Pb decreased significantly and decreased insignificantly to the fourth pond. V decreased then increased insignificantly from the first to the third pond; and increased significantly in the fourth pond.  $\text{Al}_2\text{O}_3$  increased significantly, insignificantly then significantly from the first to the fourth pond. Ordinary kriging in ArcGIS10.1 indicated that there was a fairly uniform spatial deposition/treat with no obvious dead spots or short-circuiting for metals in the sediment in the settling pond and extended aeration pond. The spatial patterns changed somewhat for some metals between sample one and sample two. Almost all of the mean of the heavy metal concentrations were higher than the lowest effect levels (LEL) of the Ontario Ministry of Environment, Canada. The characteristics of sediment, including heavy metal concentrations, could be affected by other factors such as the movement of the wastewater, the sedimentation process of wastewater and some human activities in the ponds.

**KEY WORDS: HEAVY METALS / SEDIMENT / X-RAY FLUORESCENCE / GIS /  
ORDINARY KRIGING / WASTEWATER TREATMENT PONDS**

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