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## LIST OF ABBREVIATIONS AND SYMBOLS

Å	Angstrom, $1 \times 10^{-10}$
°C	Degree celsius
K	Kelvin
h	Hour
min	Minute
g	Gram
cm	Centimeter
µm	Micrometer
mol	Mole
mL	Milliliter
L	Liter
pH	Power of hydrogen ion
%wt	Percent weight
rpm	Round per minute
V	Volume
W	Weight
cmol/kg	Centimole per kilogram
m <sup>2</sup> /g	Square meter per gram
mg/g	Milligram per gram
mg/L	Milligram per liter
L/mg	Liter per milligram
g/cm <sup>3</sup>	Gram per cubic centimeter
g/mol	Gram per mole
ERRSQ	Sum of the squares of the errors
MAPE	Mean absolute percentage error
MPSD	Marquardt's percent standard deviation
RMSE	Root mean square error
χ <sup>2</sup>	Chi-square



## ข้อความแห่งการริเริ่ม

มลพิษทางน้ำที่เกิดจากโลหะหนักเป็นปัญหาที่ร้ายแรงและซับซ้อนที่เกิดขึ้นและยังคงได้รับความสนใจ การปนเปื้อนของน้ำด้วยโลหะหนักเป็นอันตรายต่อมนุษย์ สัตว์และพืช แหล่งกำเนิดหลักของมลพิษโลหะหนักมาจากน้ำทิ้งโรงงานอุตสาหกรรม โลหะหนักเหล่านี้จะถูกปล่อยออกมากับน้ำทิ้งของโรงงานและปนเปื้อนไปยังแหล่งน้ำใกล้เคียงบริเวณโรงงาน

วัตถุประสงค์ของงานวิจัยนี้คือ การกำจัดโลหะหนักจากน้ำโดยใช้วัสดุเหลือทิ้งเป็นตัวดูดซับ ลิโอนาร์ไคต์ซึ่งเป็นวัสดุเหลือทิ้งจากเหมืองถ่านหินแม่เมาะในจังหวัดลำปาง ได้ถูกนำมาใช้เป็นตัวดูดซับไอออนโลหะในน้ำ ลิโอนาร์ไคต์เป็นวัสดุที่มีอยู่เป็นจำนวนมากและมีราคาถูก การกำจัดโลหะหนักจากน้ำด้วยลิโอนาร์ไคต์ให้ประโยชน์ในเชิงเศรษฐศาสตร์และการลดปริมาณวัสดุเหลือทิ้งโดยทั่วไปแล้ว น้ำทิ้งโรงงานอุตสาหกรรมจะประกอบไปด้วยโลหะหนักมากกว่าหนึ่งชนิด ดังนั้นจึงจำเป็นต้องศึกษาความสามารถในการดูดซับโลหะหนักที่สภาวะต่างๆ เพื่อให้ได้กระบวนการกำจัดโลหะหนักที่มีประสิทธิภาพ

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## STATEMENTS OF ORIGINALITY

Water pollution caused by heavy metals is a serious and complex problem that has been, and still is, a focus of attention. Water contamination with heavy metals represents a potential threat to humans, animals and plants. Most of the point sources of heavy metal pollutants are industrial wastewater. These metals are transported by runoff water and contaminate water sources downstream from the industrial site.

Aim of this research is the removal of heavy metals from water using the waste material as adsorbent. Leonardite, which is waste material from Mae Moh lignite mine in Lampang province, is utilized as adsorbent for removal of metal ions from aqueous systems. Leonardite is the abundant and low cost material. The removal of heavy metals from water by leonardite provides the usefulness in terms of economic and the reduction of waste materials. Generally, wastewater contains more than one type of heavy metals. Thus, the study of capability of leonardite in the different conditions is required in order to achieve the effective process for heavy metals removal.

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