

LABORATORY SIMULATION OF EROSION PROCESS  
FOR THREE THAI SANDSTONES



A Thesis Submitted in Partial Fulfillment of the Requirements for the  
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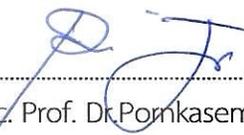


วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต  
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LABORATORY SIMULATION OF EROSION PROCESS  
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Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for a Master's Degree.

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ศรุตษา พัฒนพงศ์สันติ : การจำลองการกร่อนในห้องปฏิบัติการสำหรับหินทรายสามชนิดในประเทศไทย (LABORATORY SIMULATION OF EROSION PROCESS FOR THREE THAI SANDSTONES).

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คำสำคัญ : ความคงทนต่อการผุกร่อน/ความกลมมน/ภาวะทรงกลม/พลังงาน/พันธะระหว่างเม็ดแร่

การศึกษานี้มุ่งเน้นเพื่อจำลองการกร่อนของหินโดยใช้การทดสอบความคงทนต่อการผุกร่อนภายใต้สภาวะแห้งและเปียก หินทรายชุดพระวิหาร หินทรายกรวดมน และหินทรายที่แสดงลักษณะของแนวระนาบชั้นหินจากชุดหินภูพานถูกนำมาใช้เป็นตัวอย่างหินในการทดสอบ ตัวแปรในการทดสอบถูกปรับเปลี่ยนจากวิธีการทดสอบมาตรฐานเพื่อเร่งกระบวนการกร่อนของหิน โดยเพิ่มรอบการหมุนของตะกร้อเป็น 2,000 รอบต่อ 1 วัฏจักรการทดสอบ และใช้ 80 วัฏจักร ผลที่ได้ระบุว่าหินทรายชุดภูพานมีขนาดลดลงอย่างรวดเร็วเมื่อเทียบกับตัวอย่างหินชนิดอื่น ความกลมมนและภาวะทรงกลมของตัวอย่างหินเพิ่มขึ้นตามวัฏจักรการทดสอบ เมื่อถึงวัฏจักรการทดสอบที่ 40 พบว่าหินทรายชุดภูพานภายใต้สภาวะแบบเปียกแสดงภาวะทรงกลมน้อยลง โดยแสดงให้เห็นในลักษณะของรูปทรงที่แบนมากขึ้นตามแนวระนาบของชั้นหิน ซึ่งหินทรายชุดดังกล่าวจะแสดงภาวะทรงกลมมากขึ้นหลังจากผ่านช่วงการทดสอบไปแล้ว 80 วัฏจักร ส่วนหินทรายชุดพระวิหารแสดงลักษณะทางกายภาพที่ไม่มีผลกระทบจากน้ำ กระบวนการขัดถูและการชนกันเป็นปัจจัยหลักในการลดลงของขนาดตัวอย่างหินภายใต้สภาวะแห้ง โดยตัวอย่างหินที่มีขนาดใหญ่จะใช้พลังงานในการลดขนาดที่มีประสิทธิภาพมากกว่าตัวอย่างหินที่มีขนาดเล็ก การใช้พลังงานเพื่อลดขนาดจะเกิดขึ้นสูงสุดในหินทรายกรวดมนภายใต้สภาวะเปียก พันธะระหว่างเม็ดแร่ภายในตัวอย่างหินอ่อนแอเนื่องจากการซึมผ่านของน้ำ ส่งผลทำให้ตะกอนที่ผ่านตะกร้อมีปริมาณมากขึ้นและทำให้ใช้พลังงานในการลดขนาดน้อยลง หินทรายชุดพระวิหารที่ไม่มีผลกระทบจากน้ำจะกร่อนไวขึ้นเมื่ออยู่ภายใต้สภาวะแบบแห้ง ถึงแม้จะใช้เวลามากขึ้นในการกร่อนภายใต้สภาวะเปียก พลังงานที่ใช้ในการลดขนาดนั้นจะมีขนาดน้อยกว่าตัวอย่างหินภายใต้สภาวะแห้งเนื่องจากแรงลอยตัว

สาขาวิชา เทคโนโลยีธรณี

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ลายมือชื่อนักศึกษา ศรุตษา

ลายมือชื่ออาจารย์ที่ปรึกษา ก. ส. ข.

SARUSA PATANAPONGSONTI : LABORATORY SIMULATION OF EROSION PROCESS FOR THREE THAI SANDSTONES. THESIS ADVISOR : EMERITUS PROFESSOR KITTITEP FUENKAJORN, Ph.D., 114 PP.

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This study aims at simulating rock erosion by slake durability index testing under dry and wet conditions. Phra Wihan sandstone, conglomeratic sandstone and bedded sandstone from Phu Phan formation are used as rock specimens. The test parameters are modified from the standard to accelerate erosion process, where 2,000 drum revolutions are used for up to 80 test cycles. Results indicate that Phu Phan sandstone fragments reduce their sizes significantly quicker than other specimens. Fragments roundness and sphericity increase with test cycles. At test cycle 40 to 80, bedding planes reduce the sphericity of Phu Phan sandstone under wet condition, as it becomes flattened. Phra Wihan sandstone is physically insensitive to water. Scrubbing and colliding processes mainly reduce fragment sizes under dry condition. Larger fragments use energy more efficiently to reduce their size than the smaller ones. The highest energy are consumed by conglomeratic sandstone under wet condition. The intergranular bonding of the specimens is weakened by water penetration, leading to higher percentage of passing materials and lower energy required to disintegrate. Water insensitive Phra Wihan sandstone erodes more quickly under dry condition. Even though it requires longer time to erode under water submersion, due to buoyancy force, it consumes less energy than those under dry condition.

School of Geotechnology

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Student's Signature สรุสา

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มหาวิทยาลัยเทคโนโลยีสุรนารี

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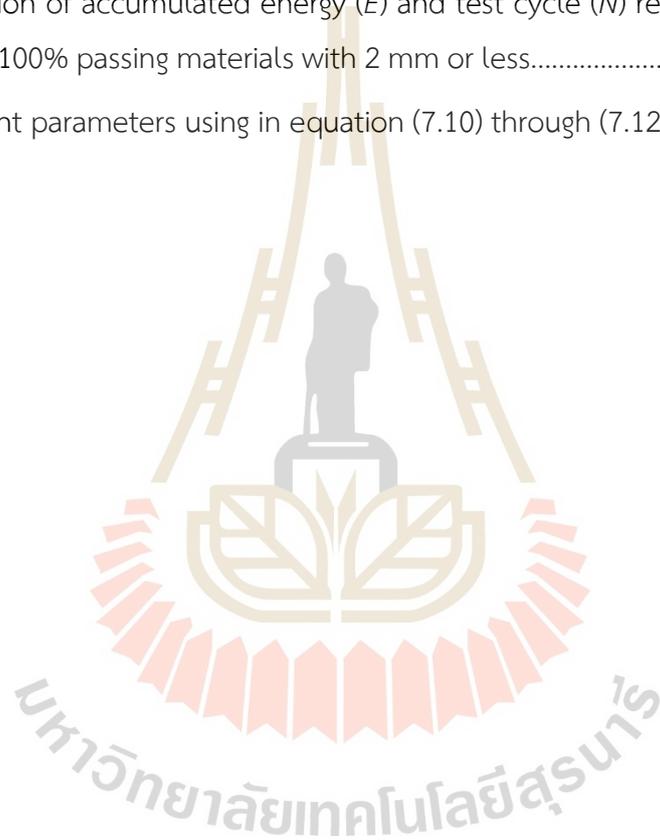
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## SYMBOLS AND ABBREVIATIONS

$A_C$	=	Ratio of area under particle size distribution curves
$A_T$	=	Total area of all particle size distribution curves
$C_p$	=	Specific heat capacity
$d_1$	=	Widest diameters of fragment
$d_2$	=	Narrowest diameters of fragment
$D_R$	=	Disintegration ratio
$E_a$	=	Estimated annual erosion
$E_i$	=	Energy used by a fragment for one drum revolution
$E_p$	=	Estimated period erosion
$m_0$	=	Mass of fragment before testing
$m_i$	=	Mass of retained fragment from test cycle i
$m_{i-1}$	=	Mass of retained fragment before test cycle i
$n_c$	=	Calculated porosity
$P_A$	=	Accumulative passing materials
$P_i$	=	Mass of passing materials from test cycle i
$r$	=	Radius of circles filled to corners of fragment
$r_d$	=	Inner drum radius
$R_i$	=	Number of fragment revolutions
$r_i$	=	fragment radius
$r_{ins}$	=	Largest radius of circle fitted to fragment
$V_d$	=	Drum velocity
$V_i$	=	Equivalent volume
$V_i$	=	Volumatic percent of each mineral

## SYMBOLS AND ABBREVIATIONS (continued)

$W_i$	=	Weight percent of each mineral
$A$	=	Surface area of fragment
$C$	=	Climatic erosivity
$D$	=	Degradation rates
$E$	=	Accumulated energy
$E_i$	=	Energy in test cycle $i$
$E_s$	=	Specific energy
$EWE$	=	Erosive wind energy
$g$	=	Gravity
$h_s$	=	Hop height
$I$	=	Fragment erodibility
$I_i$	=	Moment of inertia
$Id$	=	Durability index
$K$	=	Surface roughness
$K$	=	Fluid flow rate
$L$	=	Unsheltered distance
$l_s$	=	Hop displacement
$m$	=	Mass
$n$	=	Porosity
$N$	=	Test cycle
$n$	=	Number of corner
$Q$	=	Absorbed energy
$R_b$	=	Buoyant density

## SYMBOLS AND ABBREVIATIONS (continued)

$S$	=	Sphericity
$T$	=	Temperature
$t$	=	Time
$U$	=	Windspeeds
$V$	=	Vegetation cover
$v$	=	Velocity
$\varepsilon$	=	Rate of erode mass
$\varepsilon_{kr}^*$	=	Kinetic impact energy
$\vartheta$	=	Bedding slope angle
$\rho$	=	Density of fragments
$\rho_i$	=	Density of each mineral
$\rho_w$	=	Density of water
$\varphi$	=	Bedding surface angle
$\omega$	=	Angular velocity