

LIST OF FIGURES

Figure	Page
1.1 Research methodology.....	3
2.1 Schematic of plunge pool.....	8
2.2 Surface roughness profiles in variation systems, the bars represent intervals of 5, 10, 15, 20, 25 and 30 mm, from left to right.....	15
2.3 Simulation of fragment transports in different points of slope height.....	16
2.4 Rock degradation concept. Samples A, B and C (a) represent uniform texture. Samples D, E and F (b) represent weathered zone outside and fresher matrix inside.....	16
2.5 Regression of durability with expansive clay (a), and the total amount of clay minerals (b) for all rock types.....	18
2.6 Percentage of passing materials with a function of grain sizes.....	19
2.7 Relative of clay contents and chlorite in sandstones with variation of stages.....	19
2.8 Geometrical shape parameters of spherical (a), cubic (b) and triangular prism (c).....	21
2.9 Petrographic images of intergranular fracture (a), and intragranular fracture (b) in sandstone.....	22
2.10 Influence of cycles to matrix content and porosity of sandstones.....	25
2.11 Water content in a function of time duration.....	26
2.12 Percentage of variation properties with a number of wetting and drying cycles.....	26

LIST OF FIGURES (continued)

Figure	Page
2.13	Saltation trajectory diagram.....29
2.14	Eroded mass in a function of total energy dissipation.....30
3.1	Geological map of sample collecting area.....33
3.2	Representative of specimens at initial condition of PWSS (a), PPCS (b), and PPSS (c) with dimensions. Dash lines show alignment of bedding planes.....34
3.3	Examples of PPCS specimens prepared for dry testing.....35
3.4	Sample preparation for XRD analysis of PWSS (a), PPCS (b) and PPSS.....36
3.5	Closed-up images of specimens (right) and petrographic images under cross polarized light (left) of PWSS, PPCS and PPSS. Quartz (Qtz), Calcite (Cal), Calcrete (Calc), Muscovite (Mus) and Biotite (Bio).....37
4.1	Diagram representing one test cycle.....38
4.2	Slake durability index test apparatus.....41
4.3	3D schematic diagram for durability test.....41
4.4	Cross section and side view of drum with rotational direction.....42
4.5	Dimension parameters for roundness (a) and sphericity (b).....43
4.6	Classifications for surface roundness and sphericity.....43
5.1	Initial cubical specimens and representative images of specimens after subjected to 20 (b), 40 (c), 60 (d) and 80 (e) test cycles.....46

LIST OF FIGURES (continued)

Figure	Page
5.2	Fragment roundness as a function of test cycle (N) measured every 20 days, classified in accordance with Hryciw et. al. (2016). Open points represent dry testing and solid points represent wet testing48
5.3	Fragment sphericity as a function of test cycle (N) measured every 20 days, classified in accordance with Hryciw et. al. (2016). Open points represent dry testing and solid points represent wet testing.....49
5.4	Average size of fragments remaining in drum after subjecting under dry and wet tests as a function of test cycle (N). Open points represent dry testing and solid points represent wet testing.....50
5.5	Passing weight (a) and passing weight percent (b), as a function of test cycle (N). Open points represent dry testing and solid points represent wet testing.....53
5.6	Volumatic percent of decreasing minerals for PPSS fragments under wet condition after subjecting to 80 test cycles (Cal=calcite, Fsp=feldspar group, Clays=clay minerals, and Mica=biotite and muscovite).....57
5.7	Volumatic percent of decreasing minerals for PPCS fragments under dry condition after subjecting to 80 test cycles (Cal=calcite, Fsp=feldspar group, Clays=clay minerals, and Mica=biotite and muscovite).....57
5.8	Peak patterns of each mineral intensity with two theta degrees of passing materials for PPSS specimens under dry condition after test cycle 40 and 80.....58

LIST OF FIGURES (continued)

Figure		Page
5.9	Densities of fragments as a function of test cycle (N) for PWSS, PPCS, and PPSS specimens after subjecting to 20, 40, 60, and 80 test cycles. Open points represent dry testing and solid points represent wet testing.....	61
6.1	Normalized fragment sizes for PWSS, PPCS and PPSS specimens before testing and after test cycle 20, 40, 60, and 80.....	63
6.2	Total volumatic percent and calculated porosity (n_c) as a function of test cycle (N) for PWSS, PPCS, and PPSS after test through 80 cycles. Open points represent dry testing and solid points represent wet testing.....	66
6.3	Calculated porosities (n_c) compared to submerging porosities (n) for PWSS, PPCS, and PPSS at initial condition and after 80 test cycles. Open points represent dry testing and solid points represent wet testing. Significant increasing of PPSS porosities are shown with the percentage labels.....	67
6.4	Normalized densities as function of test cycle (N) for PWSS, PPCS, and PPSS after subjecting to 20, 40, 60, and 80 test cycles. Open points represent dry testing and solid points represent wet testing. Significant reduction of PPSS densities are shown with the labels.....	68
6.5	Accumulative passing weight percent (P_A) as a function of test cycle (N). Dry testing (open points) and wet testing (solid points). Lines are fitted by $P_A = \alpha \cdot N + [1 - \exp(-\delta \cdot N)/\beta]$	70
7.1	Scrubbing and colliding processes between fragments (a) and between fragments and inner drum surface (b).....	74

LIST OF FIGURES (continued)

Figure	Page
7.2 Accumulated energy (E) as a function of test cycle (N). Dry and wet testing shown as solid lines and dash lines. They are fitted by $E=A \cdot N^B$	75
7.3 Specific energy for PWSS, PPCS and PPSS specimens as a function of equivalent radius (r_i).....	77
7.4 Accumulated Energy for PWSS, PPCS, and PPSS specimens with cobbles disintegrated to smaller sizes.....	78
7.5 Energy for PPSS specimens under wet condition to disintegrate as a smaller size, The classification is followed the unified soil classification system, USCS.....	79