CHAPTER I
INTRODUCTION

1.1 Background and Rationale

Assessing rock properties and steel durability are important for determining the lifespan of cutting tools in construction and excavation industries. Abrasivity testing evaluates tool durability against wear from rock surfaces. CERCHAR abrasivity index (CAI) is one of the methods that have been widely used. Several researchers have identified various factors affecting the CAI, such as stylus hardness, scratching rate, scratching distance, surface condition, moisture content, temperature, and rock properties. Bedding planes, which are inherent stratifications within sedimentary rocks, may also considerably affect their abrasivity. Numerous tests on anisotropic rock properties have demonstrated that anisotropic characteristics significantly affecting rock strength results, with maximum rock strengths typically observed at bedding plane orientations of 0° and 90°, and minimum values between 45° and 60°. The effect of bedding planes and their orientations on the abrasiveness of cutting tools has rarely been investigated.

1.2 Research Objective

The objective of this study is to laboratory investigate the effect of bedding planes and their orientation on CERCHAR abrasivity index. Khao Khad argillaceous limestone, Khao Khad bedded limestone, Phu Kadueng sandstone, Phu Phan sandstone, and Tak Fa gypsum are used as test specimens. The nominal angles (α) between the test surface and bedding plane vary from 0°, 45°, 90° to 135°. The scratching directions of the stylus pin with respect to the bedding trends vary from 0° to 90°. Scratching forces and ploughing volumes are measured and compared between

different rock types, scratching directions, and mineral compositions. CERCHAR specific energy for all test conditions will be evaluated.

1.3 Scope and Limitations

The research scope and limitations are outlined as follows.

1) Five types of rock specimens are prepared and tested including Khao Khad argillaceous limestone, Khao Khad bedded limestone, Phu Kadueng sandstone, Phu Phan sandstone, and Tak Fa gypsum.

2) CERCHAR abrasivity tests are performed on saw-cut surfaces.

3) Different angles of bedding planes at 0, 45, 90 and 135 degrees and scratching directions at 0, 45 and 90 degrees are performed.

4) CERCHAR abrasivity test procedure follows ASTM D7625-22 standard practice.

5) Mineral compositions are analyzed by XRD.

6) Ploughing forces and groove volumes on specimens are measured.

1.4 Research Methodology

The research methodology shown in Figure 1.1 consists of eight steps: literature review, sample collection and preparation, CERCHAR abrasivity testing, X-ray diffractometer analysis, result interpretation, mathematical correlations, discussions and conclusions, and thesis composition.

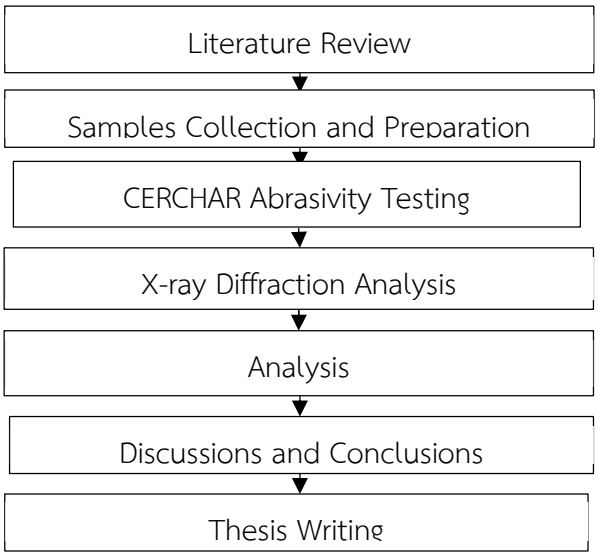

Figure 1.1 Research methodology.

1.4.1 Literature Reviews

Previous research investigation on rock abrasion, CERCHAR abrasivity test, factors influencing CERCHAR abrasivity index will be reviewed.

1.4.2 Samples Collection and Preparation

Preparation takes place at the Geomechanics Research Unit (GMR), Suranaree University of Technology. A total of five types of rock are drilled to obtain core specimens with a diameter of 63.5 mm at various bedding plane angles and scratching directions as shown in Figure 1.2.

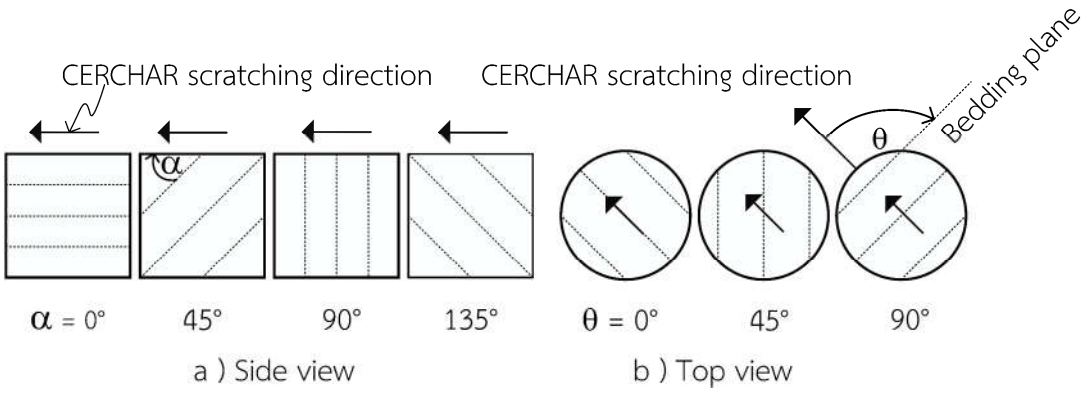

Figure 1.2 Scratching direction as compound to bedding plane angles (a), and as compared to trends of bedding planes (b).

1.4.3 CERCHAR abrasivity testing

The CERCHAR abrasivity testing is conducted on saw-cut surfaces using the west apparatus, as depicted in Figure 1.3. This test objective is to determine the CERCHAR abrasivity index (CAI) of rock specimens. The testing procedure follows ASTM D7625-22 standard practice. There will be additional measurements beyond standard method, including crank rotation torque throughout the entire scratching process.

1.4.4 X-ray Diffraction analysis

The XRD analysis is conducted on finely ground rock powder. The results can be utilized to determine the influence of mineral compositions on the CAI value.

1.4.5 Analysis

Mathematical relations are established based on the correlation between scratching force (F) and scratching distance (ds) to determine the energy utilized by the drilling head at various angles of the bedding planes and scratching directions. They are used to estimate the drill bit's wear and its operational lifespan.

1.4.6 Discussions and Conclusion

All research activities, methodologies, and results are documented and compiled in thesis. The contents and findings will be published in a conference.

1.4.7 Thesis Writing

All research activities, methods, and results are documented and complied in the thesis.

1.5 Thesis Contents

Chapter I describes the background of problems and significance of the study. The research objectives, methodology, scope and limitations are identified. Chapter II summarizes the results of the literature review. Chapter III describes the sample preparations. Chapter IV describes the testing. Chapter V gives the test results. Chapter

VI calculates CERCHAR specific energy. Chapter VII discusses and concludes the research results and provides recommendations for future research studies.