Effects of Moisture and Storage Duration on Coal Quality and Ash Mineral Composition of Coal From Mae Moh Mine, Lampang Province

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Abstract

This study examines the effects of moisture content and storage time on the quality and mineral stability of coal from the Mae Moh Mine. Five coal seams (K1, K2, K3, Q1+Q2, and Q3+Q4) were stored for 30 days under watered and dry conditions. Proximate analysis and X-ray diffraction (XRD) were used to evaluate changes. Results show that longer storage causes chemical weathering and mineral loss, especially in watered samples. **Ash and moisture increased**, while **fixed carbon and volatile matter decreased due to oxidation.** XRD results indicate that minerals such as **kaolinite, montmorillonite, calcite, and dolomite gradually disappeared.** This is mainly related to pyrite oxidation, which produces acidic conditions that accelerate mineral dissolution and leaching. Although watering helps reduce spontaneous combustion, it accelerates chemical weathering and mineral loss compared to dry storage. The optimal storage period is 7–14 days, because storage longer than 15 days leads to significant coal quality deterioration and mineralogical changes that may affect combustion efficiency and ash management in power plants.

Introduction

Mae Moh coal mine in Lampang Province is the largest Cenozoic coal deposit in Thailand (Fig. 1) and serves as a major source of energy supply for the country. Currently, the mine is facing an increase in ash content in coal stockpiles, which leads to a reduction in calorific value. Therefore, this study aims to investigate the factors affecting changes in coal quality, with particular emphasis on the effects of moisture content and stockpile duration.

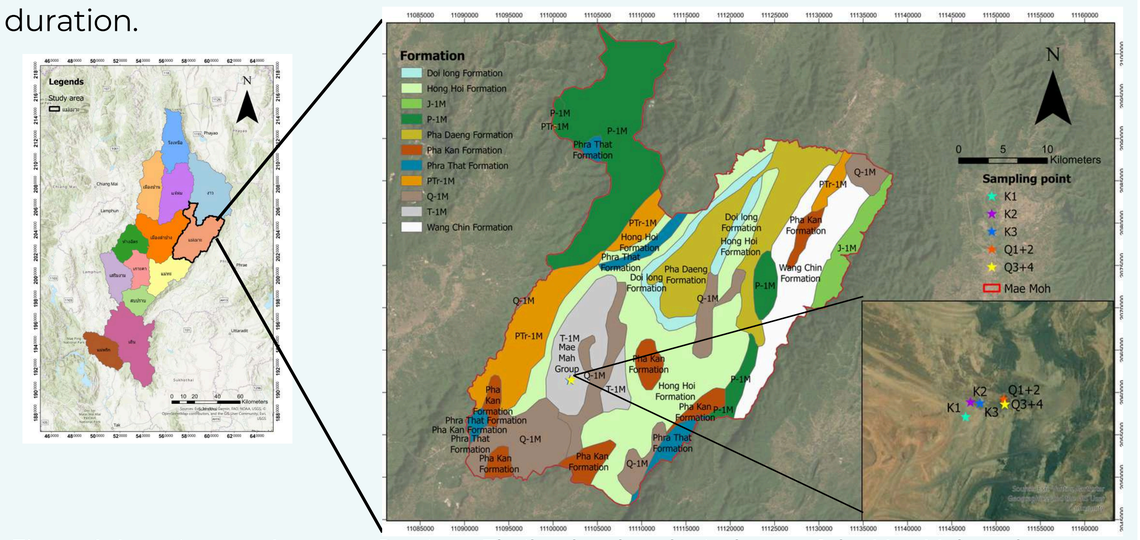


Figure 1. Location map Lampang Province, Thailand and geological map of the Mae Moh coal mine.

Objectives

1. To investigate the effects of moisture content and storage duration on the changes in coal quality from Mae Moh Mine.
2. To analyze the changes in the mineral composition of coal ash resulting from moisture content and storage duration.

Methodology

1. Coal sampling: 5 samples with different physical characteristics collected from the Mae Moh mine face (5 – 10 kg each).
2. Stockpile simulation: Each sample divided into dry and watered piles; stored for 30 days (watered pile: 1000 mL daily). Sampling times: Day 2, 8, 16, and 31.
3. Coal quality: Determined using Proximate Analysis.
4. Mineralogy: Coal ash before and after the watering experiment analyzed by X-ray Diffraction (XRD) using K1 (seam K) and Q1+Q2 (seam Q) as representatives.

Conclusion

- Coal quality changes during stockpile storage. Ash and moisture contents tend to increase with storage time.
- Clay-rich coal shows greater variation in ash content. XRD results indicate that quartz and clay minerals are the main ash-forming components.
- Moisture exposure may promote coal weathering and reduce fuel quality, highlighting the importance of proper stockpile management.

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Results

Proximate Analysis

Changes in ash content (%) of coal samples exposed to air and those subjected to periodic watering were monitored over 30 days (Fig. 2). In the K-series, K1 increased until D7 and then stabilized, while K1w decreased initially before increasing after D15. K2 and K2w remained relatively stable, whereas K3w showed a continuous increase and reached the highest ash content at D30. In the Q-series, Q1+Q2w increased markedly and peaked at D15, while Q3+Q4 decreased at D7 and then increased toward D30. Overall, watered samples exhibited slightly higher ash contents than air-exposed samples by the end of the experiment.

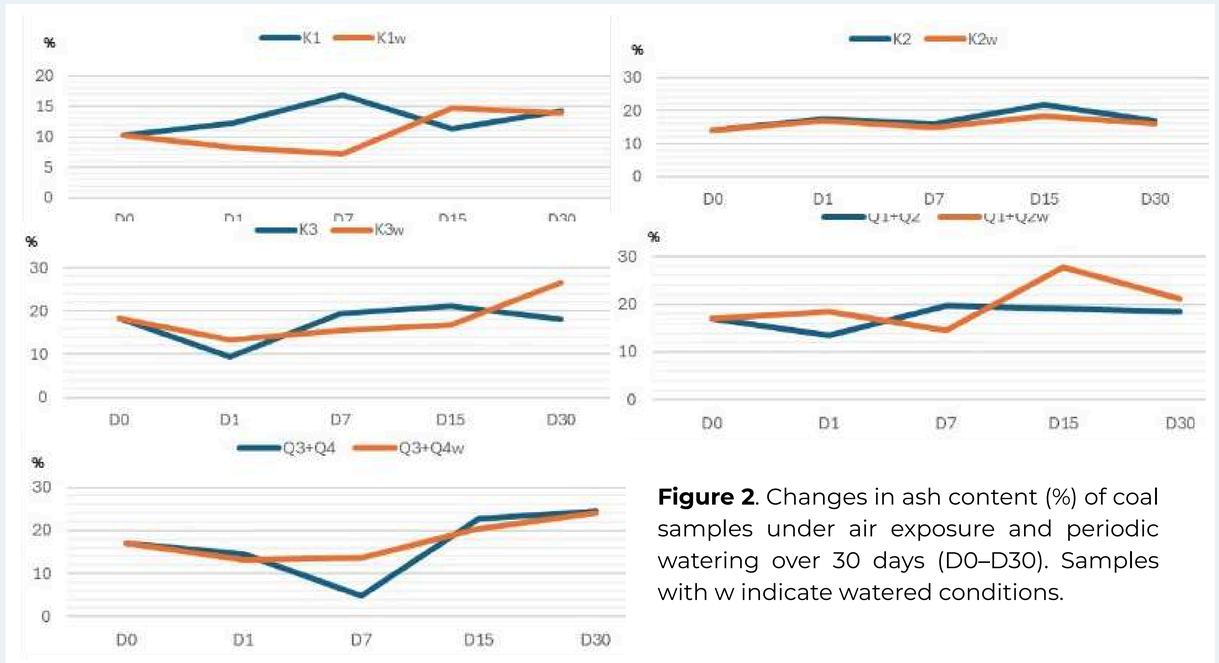


Figure 2. Changes in ash content (%) of coal samples under air exposure and periodic watering over 30 days (D0–D30). Samples with w indicate watered conditions.

Proximate analysis shows that moisture and ash contents increase with storage time, whereas volatile matter and fixed carbon slightly decrease. These trends suggest that moisture exposure during stockpile storage promotes coal weathering and the relative enrichment of mineral matter, which is consistent with the mineral assemblages identified by XRD.

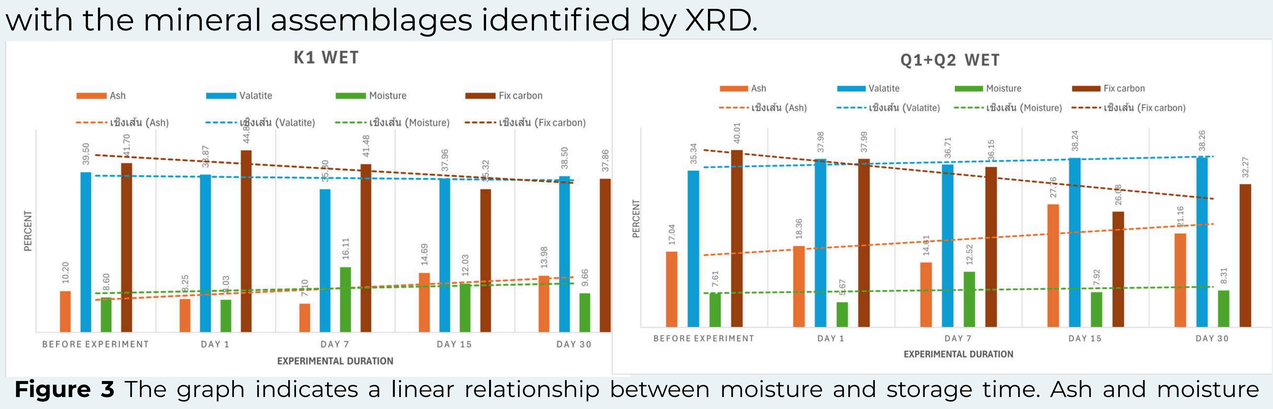


Figure 3 The graph indicates a linear relationship between moisture and storage time. Ash and moisture increase with time, while fixed carbon and volatile matter decrease.

XRD

The figure shows that sample K1 exhibits only minor mineral changes due to its lowest clay content. In contrast, sample Q1+Q2 contains the highest soil contamination. As moisture accumulates over time, the proportion of clay minerals decreases compared to the initial stage.

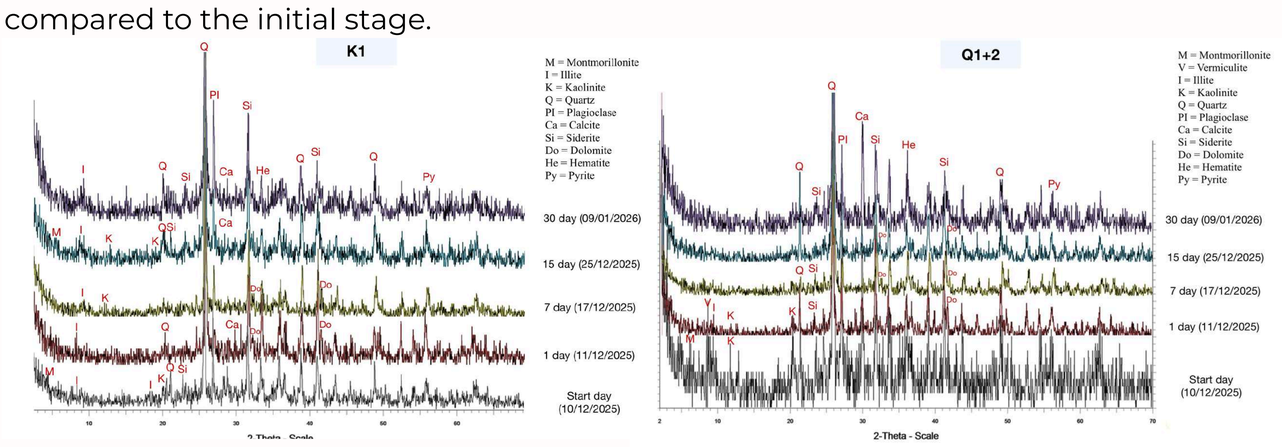


Figure 4. The XRD patterns of the samples K1 and Q1+Q2.

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