CHAPTER VI
CONCLUSION

This chapter contains the conclusion of the research that has been done and suggestions for further research.

6.1 Conclusion

Based on the research conducted, the following conclusions have been drawn:

1. Mathematical model that shows the relationship between SEEC (Y_1) and Fineness Level (Y_2) with operational parameters (Airflow (X_1), Separator Speed (X_2), Hydraulic Ratio (X_3), and Differential Pressure (DP) Mill (X_4)) is as follows:

$$Y_1 = -697 + 0.034X_1 + 0.786X_2 + 195X_3 + 8.89X_4 - 0.000214X_1*X_1 - 0.000245X_2*X_2 - 967X_3*X_3 - 0.0467X_4*X_4 + 0.618X_1*X_3 - 0.00381X_2*X_4$$

$$Y_2 = 653 - 0.1487X_1 - 0.687X_2 - 792X_3 - 6.51X_4 + 0.00015X_2*X_2 + 2768X_3*X_3 + 0.00346X_1*X_4 + 0.0045X_2*X_4$$

2. Optimal operating parameter values obtained along with their response variables are as follows:

SEEC (Y_1)	= 15.6 kWh/ton
Fineness Level (Y_2)	= 4 %
Airflow (X_1)	= 340 Nm^3
Separator Speed (X_2)	= 1250.5 rpm
Hydraulic Ratio (X_3)	= 0.127 bar/tph
DP Mill (X_4)	= 39 mBar.

3. Based on the mathematical equation obtained for SEEC (Y_1), the insignificant factor variables include X_2, X_4, X_2*X_2, X_3*X_3, and X_2*X_4. For raw mix fineness level (Y_2), the insignificant variables X_1, X_2, X_4, X_2*X_2, X_1*X_4, and X_2*X_4. However, the range intervals used as predefined levels in this study are still recommended to be applied under real factory conditions. Under normal operations at PT XYZ, air flow (X_1) ranges from 210 to 310 Nm^3, separator speed (X_2) ranges from 1230 to 1290 rpm, hydraulic ratio (X_3) ranges from 0.13 to 0.17 bar/tph, and differential pressure of the mill (X_4) ranges from 40 to 46 mBar.
4. Potential savings in electricity costs by applying the operational parameter values based on the optimization results with the desirability function amount to Rp1,677,503,968.12 or 20% of the total cost of electricity consumed by the Raw Mill.

6.2 Suggestion

The following suggestions are made for future research:

1. Confirmation trials of the optimization results should be conducted to validate the optimal values of the operating parameters.
2. Future research is encouraged to collect data over a shorter time frame to minimize the influence of uncontrolled factors.
3. Grinding wear levels could be included as a variable in the equations, as they also affect the fineness level and power consumption in raw mill operations, resulting in a more accurate mathematical model.
4. Future research can consider additional operating parameters of the Vertical Roller Mill (VRM), such as recirculation load, air-to-material ratio, grinding table speed, and feed material composition, which influence grinding efficiency and energy consumption. Additionally, factors like classifier settings and moisture content of the feed material can also be explored to further optimize VRM performance.

5. Future similar research is also recommended to consider using alternative methods that yield optimization results in the form of intervals, making them more practical and applicable for companies. This is because RSM produces precise point estimates, and since the factor variables interact with one another, even a slight change in one factor may lead to significant deviations in the outcomes of other variables, potentially falling outside the optimal range.