

Simulation of Rotary Kiln for Lead Free Pellet Process
(Development of Lead Free Pellet Process: Second Report)

Prof. Dr. B. Drakaliyski*1, Dr. I. Tcherkezov*1, Dr. J. Bratkov*1
Odr. M. Ichidate*2, K. Katou*2, Y. Yamada*3

- *1 Iron & Steel Research Institute, P. R. of Bulgaria
- *2 Central Research Laboratories, Sumitomo Metal Industries, Ltd.
- *3 Engineering Sales and Consulting Dept., Sumitomo Metal Industries, Ltd.

1. Introduction

Basic operating conditions for lead free pellet process were confirmed by the pilot plant test that has been reported previously.1)

Utilizing those data, computer simulation of a rotary kiln has been performed for the basic design of an industrial plant.

2. Reaction Rate

Reaction of lead elimination, iron reduction, etc. that occur in the rotary kiln can be deemed as the first-order reaction, basing on the pilot test results, and the reaction rate is expressed as following formula applying Arrheniu's relation $(dx/dt)/(x - a_0) = \exp(A/T + B)$

- where, a_0 ; initial concentration of the element (mol/mol-iron)
- x ; concentration of the element (mol/mol-iron)
- t ; time (min.)
- T ; temperature (K)
- A, B ; constants

3. Concept of Simulation Model

The simulation of the rotary kiln bases on the logic flow shown in Fig. 1. Basically, this simulation model gives the conclusion after several trials regarding to productivity, appropriate temperature pattern, energy consumption, etc.

The simulation results are evaluated by the comparison of gas temperature and measured softening point of material so as to avoid sticking troubles.

4. Calculation Results

Fig. 2 shows the relation between lead content in product pellets and productivity. Increase of charging rate of dried pellets shortens the retention time in the kiln, and lead content in the product pellets increases. From this result, upper limit of productivity of the

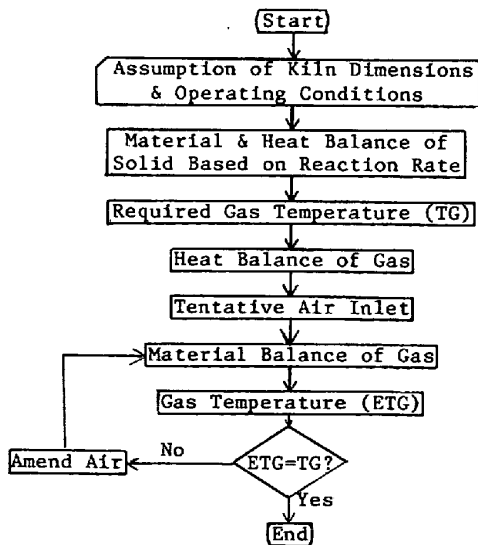


Fig. 1. Logic Flow of Simulation Model

kiln can be presumed.

Calculated distribution of temperature and composition are illustrated in Fig. 3 and 4. Gas temperature does not exceed softening point. This temperature pattern is desirable to avoid the accretion trouble in the kiln.

Preliminary design parameters have been determined after many trials of simulation calculation.

5. Conclusions

Rotary kiln simulation for a lead free pellet plant has been carried out based on the test data obtained in the pilot kiln. Consequently, an industrial rotary kiln for Lead Free Pellet Process has been estimated.

Reference

- 1) B. Drakaliyski et al., presented at 104th ISIJ Conference

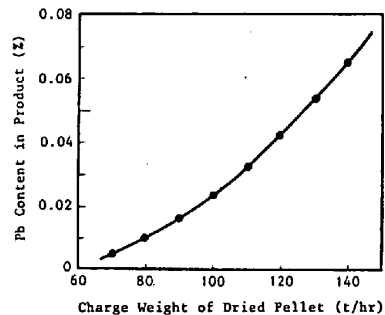


Fig. 2 Lead Content in Product vs. Productivity

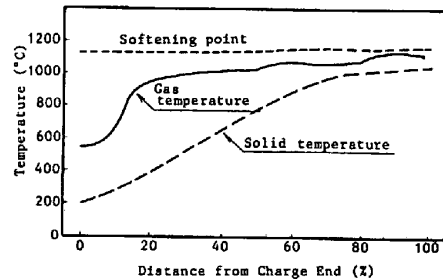


Fig. 3 Calculated Temperature Distribution in the Rotary Kiln

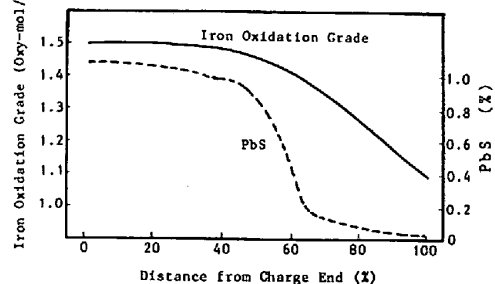


Fig. 4 Calculated Composition Transition in the Rotary Kiln