Determination of Some Flow Properties of a Clinker Grinding Mill through Radiotracing and Residence Time Distribution (RTD) Modeling

H. A. Affum[1] , I.I. Mumuni[1] , G.K. Appiah[1]
[1]Nuclear Applications Centre, National Nuclear Research Institute, Ghana Atomic Energy Commission, P. O. Box LG 80, Legon- Accra, Ghana

Introduction

Cement manufacturing requires the use of mills that operate with large power consumption. Therefore, their capacity and operation must be optimized in order to obtain efficient performance. The performance optimization of such mills will be possible if the flow parameters of the milling process are known.

Residence Time Distribution (RTD) analysis has been identified as the best experimental and classical tool to study the performance of process plants. The approach is cost-effective and provides reliable and detailed hydrodynamic information relating to the efficiency of process systems.

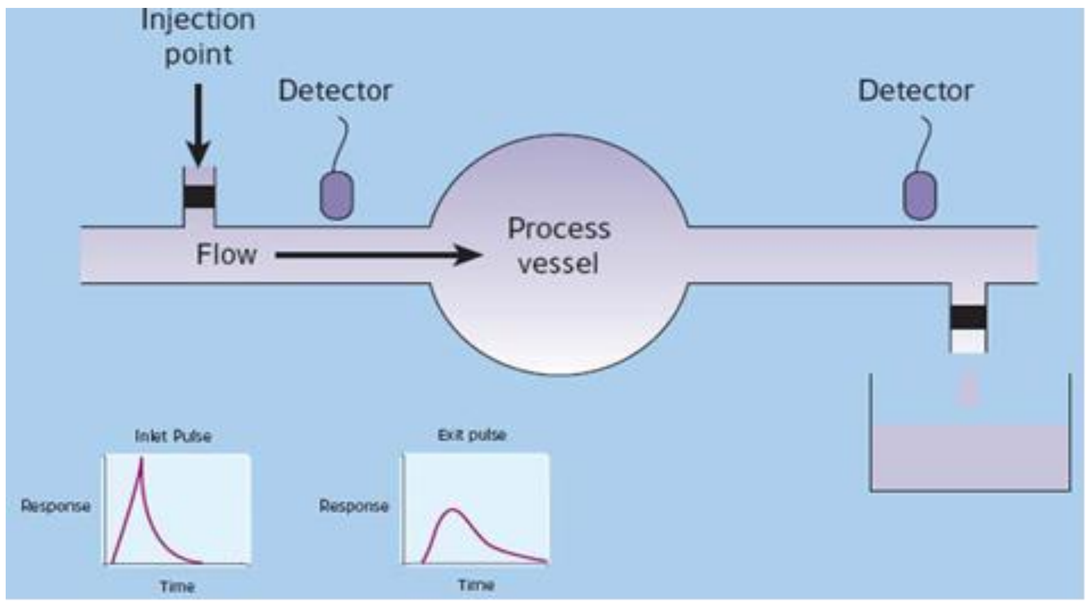

Figure 1. Principle of RTD.

Study Objective

The main objective of this experiment was to employ the radiotracer methodology to determine some flow properties (mean residence time, Peclet number and the dispersion coefficient) of the grinding mill of the Ghana Cement (GHACEM) Plant in Tema, Ghana.

Methods and Materials

- Liquid $^{198}AuCl_4$ was mixed and agglomerated with cement powder from GHACEM and a little water in order to obtain a tracer material with mechanical resistance similar to the cement clinker.
- The radiotracer was introduced at the mill inlet together with the raw material being conveyed by the clinker belt feed transporter.
- The passage of the radiotracer was monitored by a Sodium Iodide (NaI) detector.
- A Data Acquisition System (DAS) connected to the detector displayed the count rates.
- The acquired data was then pre-treated and plotted against time to represent the RTD.
- Modeling with RTD software and data analysis using method of moments.

Figure 2. External View of the GHACEM Mill

.

Results and Discussion

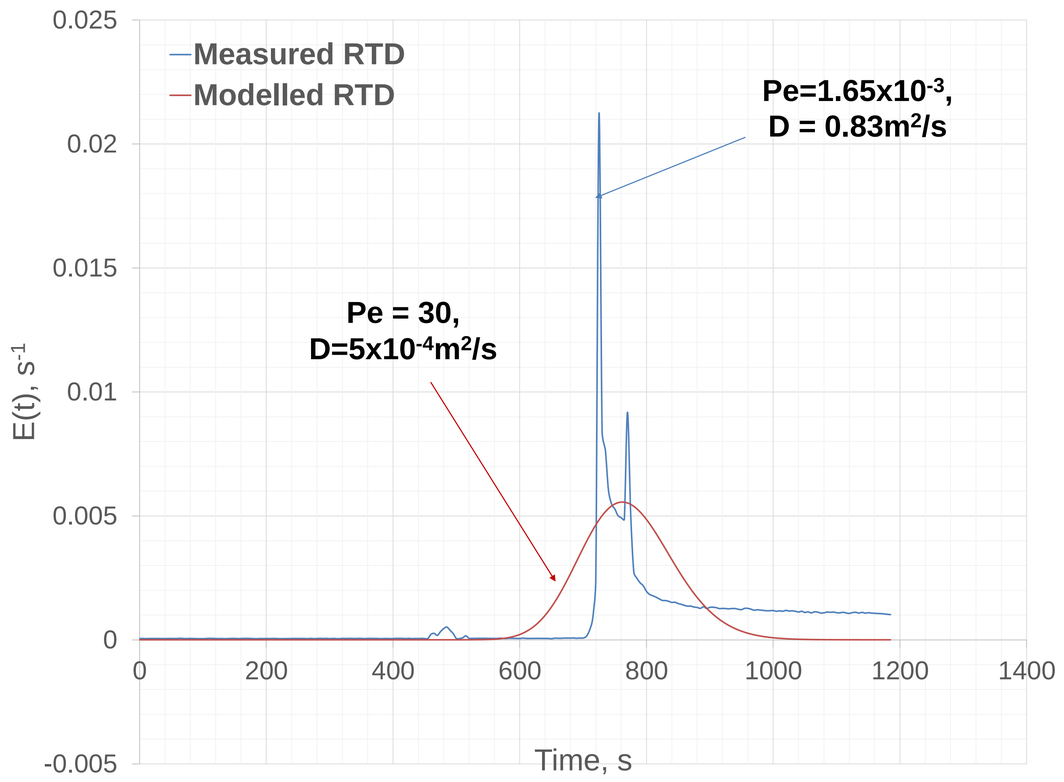

Figure 3: Plot of Measured and Modelled RTD of the mill

- Late appearance of peaks due to poor citing of tracer introduction point.
- Theoretical MRT(58 min) exceeded Experimental MRT(33.6 min) indicating the presence of stagnant zones in the mill.
- Modelling the experimental data with the simple axial dispersion model reveals poor dispersion suggesting a bad choice of model.

Conclusions

- Some flow properties of a cement grinding mill has been successfully determined using the radiotracer methodology.
- The existence of stagnant zones in the mill could have implications for the efficient running of the mill.
- The simple axial dispersion model commonly used for modelling flow in long tubes poorly fitted the experimental data and consequently poorly represents the flow in the mill.

Acknowledgment

The authors wish to thank the International Atomic Energy Agency (IAEA) for providing technical support for this work as well as the Ghana cement, GHACEM for granting our request to carry out this tracer experiment on their plant.

References

1. IAEA, (2008). Radiotracer Residence Time Distribution Method for Industrial and Environmental Applications. Training Course Report Series 31, Vienna, Austria.
2. Levenspiel, O.,(1999) Chemical Reaction Engineering. 3rd edition, John Wiley & Sons, Inc., New York, pp. 257–282.