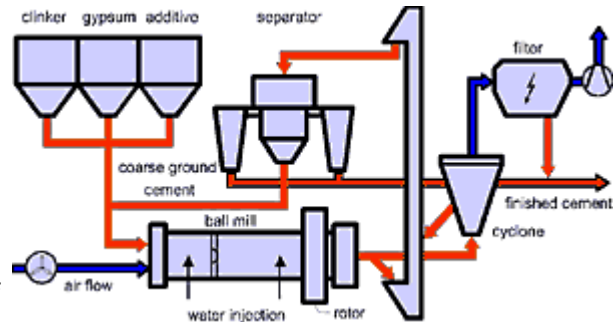


## Process Optimization in Cement Industry

### Task

Near Maastricht at the border between the Netherlands and Germany, ENCI produces more than three million tons of cement per year. In cooperation ENCI and MIT GmbH have inspected the process behavior of a ball mill which is the main component of the manufacturing process. Therefore ball mills are used for grinding of clinker, gypsum and limestone. Ball mills consist of a horizontal cylindrical vessel in which the granular raw compounds are ground by rotation with mixed sized steel balls. Cement grinding is a process performed continuously. Material leaving the mill is carried to a separator there being partially fed back into the mill. Material that meets the required degree of fineness is transported to the storage silo. Air flows through a pulverizing chamber for the dissipation of heat imposed by raw materials and grinding friction. In addition, heat dissipation can be improved by water injection. The properties of the cement, such as its setting time and strength, are adjusted by the addition of gypsum and by grinding to specific degrees of fineness. Influence factors affecting the grinding process are: separator rotation, separator ventilation and water injection in the pulverizing chamber.

During grinding the quantities and composition of the material flows have to be controlled and regulated carefully. It is the goal of process optimization to increase the transparency of process states and thereby the process control by transforming the degree of cement fineness (Blaine-Fineness). This would be as a relevant value of quality of the process and regulation measurements.



### Solution

In the first step, the process model is suitable for quality prediction depending on a given grinding process setting. This model is based on neural networks. In a second step important information can be derived about how manipulated variables have to be set in order to produce cement of a desired degree of fineness. Finally, in step three a genetic algorithm provides the optimal set point with respect to cost minimization for a given degree of fineness.

### Benefits

The neural network supports the operator of the grinding plant in the following aspects:

- Decision support in process control for optimal cost operation of the cement mill and the separator under regular conditions
- Prediction of processing results for verification of human operating decisions
- The process knowledge is repeatably available at any time
- Early process fault detection and safe process operation
- Reduced variation in cement production output

**Reference:**

<http://www.mitgmbh.de/e/solutions/enci/enci.htm#Aufgabe>