IMPROVING THE QUALITY OF CEMENT MANUFACTURING PROCESS BY USING STATISTICAL TECHNIQUES

A PROJECT REPORT PRESENTED BY

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To the Board of Study in Chemical Sciences of the

POSTGRADUATE INSTITUTE OF SCIENCE

in partial fulfillment of the requirement

for the award of the degree of

MASTER OF SCIENCE IN INDUSTRIAL CHEMISTRY

of the

UNIVERSITY OF PERADENIYA

SRI LANKA

2011

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Cement is a very important raw material to Sri Lanka as a developing country. High demand of cement has pressurized the manufacturing process of cement considerably. Building constructions, road developments, irrigation developments and infrastructure facility developments processes etc have increased the demand of cement in a considerable manner. Therefore, it is absolutely necessary to increase the production of cement while maintaining the quality.

There are two types of cement manufacturing plants in Sri Lanka. One type imports clinker, grind with relevant other materials and produce cement and the other type manufactures clinker by sintering powdered limestone and produce cement by grinding this produced clinker. Putthalm Cement Works (PCW) is the only plant which produces clinker in Sri Lanka.

Number of private companies have involved in the cement industry which supply and distribute cement to the market. Since the cement demand is very high, there is a keen competition between the manufactures to penetrate the cement market. Due to the consumer awareness of the cement quality and other liabilities manufacturers are forced to implement quality improvement programmes in their cement production.

Cement is a finely ground powder which has hydraulic properties when mix with water. Cement is the major element in concrete and motar structure for whole construction processes. Inside of cement consists of clinker gypsum & additives. Clinker provides strength to the cement and setting properties contributed by gypsum. Fly ash, limestone and dolomite act as perform modifiers. Cement clinker is composed by tricalsiumsilicate (C_3S), dicalsiumsilicate (C_2S), tricalsiumaluminate (C_3A) and tetracalsiumaluminoferrite (C_4AF). Free lime, magnesium oxide (MgO), alkali and sulphates are contained as impurities.

Lime Saturation Factor (LSF) is the main quality characteristic of cement manufacturing process which is composed of ingredients of its raw materials CaO, SiO_2, Al_2O_3 and Fe_2O_3 proportion to their weight fraction. LSF is measured to which extent the CaO optimum compounds in clinker composition formed without necessary presence of free lime. The optimum value of LSF in the cement raw mix before burning is 101% with the tolerance level +/-5%. Limestone deposit does not show this optimum value of LSF. Mined High Grade Limestone (HGL) and Low Grade Limestone (LGL) are mixed with correct proportions with additives and obtained this particular value of LSF.

According to the specifications, LSF values of HGL and LGL are (80 +/- 15)% and (120+/-15)% respectively, in the prepared mixed heaps. There are specified LSF values to measure the quality of limestone for each stages of manufacturing process of cement. But in practice, some records show unacceptable variation of LSF values.

This causes to reduce the quality level of cement. Every cement manufacturing plant has failed to use raw material with specified composition. Estimated quality parameters have proved some variation in the LSF value of the limestone as it is mined from earth. In fact the deposits of limestone is not uniformly distributed. Therefore, cement industry, in common, faces this raw material quality variation problem.

There are various statistical techniques of determining whether a process is in statistical control. One such is the use of statistical process control (SPC) technique to test the production process is in statistical control, and if not, to discover the possible causes for it. Then necessary adjustments can be made to bring the process under control.

In this particular study, ten HGL and nine LGL mixed heaps were analyzed using a statistical quality control technique which is known Shewhart control charts for variables. The results were analyzed and find out various factors that affect the outliers which were investigated.

It can be concluded that some random causes such as uneven distribution of material, climatic changes and assignable causes such as operator errors, labor enquiry, machine errors and non-representative sampling etc. Finally, some changes of raw material handling sampling design are proposed to reduce the LSF variation as close as possible to the standard level.

Also, it is to be remembered that eventual goal of SPC is the elimination of variability in the process. It may not be possible to eliminate variability in the process completely, but the control chart is an effective tool in reducing variability to a minimum level.