

EFFECTS OF IMPLEMENTING STATISTICAL PROCESS CONTROL TECHNIQUES ON TOTAL QUALITY MANAGEMENT IN A NITROCELLULOSE FACTORY

Burak BİRGÖREN¹, Nagehan CAGICI², Banu AKIN³

¹Kirikkale University, Engineering Faculty, Department of Industrial Engineering, 71451, Campus, Kirikkale, TURKEY

^{2,3}MKEK Nitrocellulose Factory, Kayseri Highway 7th km, Kirikkale, TURKEY

This study considers the implementation of Statistical Process Control (SPC) techniques at the MKEK (The Machinery and Chemical Industry Institution) Nitrocellulose Factory in Kirikkale, Turkey in 2016, and the effects of this implementation on total quality management studies in the factory. This is the only factory authorised in Turkey for production of nitrocellulose and gun powder for the Turkish defence industry. The factory had been ISO 9000 and AQAP certified for a long time, but had not used SPC charts and any other SPC technique till the beginning of 2016. The revised ISO 9001:2015 quality management system standard puts focus on measuring and properly assessing inputs and outputs of processes. The factory management received suggestions from ISO 9000 auditors in 2015 to initiate a program for implementing SPC charts and other SPC techniques in order to analyse and control the processes in an advanced way. This led to a 5-month SPC implementation study between February and June 2016.

The factory has been measuring and recording several input and output process variables due to defence industry regulations. Therefore the study consisted of two parts. First, the existing data were analysed using different data analysis tools. Mostly graphical data analysis tools were utilized for establishing relationships between inputs and outputs. Also process capability studies were conducted. As a result of these studies, effects of several processes and ingredients on nitrocellulose and gun powder quality were determined.

Second, SPC charts were constructed and applied on nitrocellulose and spherical powder production lines. To this end, specific quality control points and types of charts to implement were determined. In the nitrocellulose line, I and MR charts were constructed for several types of measurements at the blending operation. The charts were constructed separately for different product types. In the spherical powder line, charts were applied to ballistic velocity and pressure measurements at the wet coating operations: due to high correlation between the velocity and pressure, T2 charts were used in addition to I and MR charts. The charts were checked against any out-of-control situation and charts limits were validated. This concluded the Phase I implementation of the control charts. The Phase II implementation, which includes using the charts with new data and making changes to the chart limits if necessary, is currently in progress. By using and analysing control charts, several quality control problems have been identified at several processes.

SPC study in the factory helped the management better control the quality of the processes. More specifically, means and standard deviations for several input and output variables were quantified, process capabilities were studied, several root causes for unexpected changes in the mean and standard deviations were discovered. These achievements enable them to set quality goals that meet customer specifications with higher probabilities.

Keywords: Total Quality Management, ISO 9000, Statistical Process Control, Nitrocellulose production