ABSTRACT

The present study of the field work entitled “A Study on Application of Statistical Quality Control in Paper Industry with special reference to M/s. SPB Ltd., Erode” was an attempt to introduce statistical techniques to control the quality of paper being produced in a paper industry.

Since quality is the foremost criteria for achieving the sales target, emphasis was made on controlling the quality of paper at the time of manufacturing process itself. This control on quality will help the industry to deduct the small shift in the process parameters and modify the operating characteristics at the time of production itself rather than receiving complaints from customers at a later stage. This study will help the industry to concentrate on quality at the time production.

The study describes how statistical methods through the use of control charts can be applied to control the quality of paper manufactured in a paper machine. The researcher has collected primary data at the time of manufacturing process at M/s. Seshasayee Paper & Boards Ltd., Erode from 2010 to 2013. Also as per the suggestion of the evaluator, data from one more company M/s. Tamil Nadu Newsprint and Papers Ltd., Karur was also collected from the period April 2015. Secondary data has also been collected about company profile, etc. from the books, journals, records of the organization. The study was conducted with the following objectives.

- To assess whether the quality of the product produced at paper mill conforms to specifications.
- To assess whether the manufacturing process is in control.
- To assess the process capability index.
The three major characteristics of paper, viz., substance, caliper and bulk density had been considered for the study. The present study deals with only variable control charts applied on the characteristics of the paper like substance, caliper and bulk density. These characteristics are measured on a metric scale, i.e., substance is measured in g/m², caliper is measured in microns (10⁻⁶ meters) or mils (0.001 inches) and bulk density is measured m³/kg. The researcher deployed various control charts and found the following results.

The X-bar/R Chart for the characteristic substance for the paper variety SPRINT-75 revealed the presence of assignable causes of variation in the manufacturing process. The process average has gone up during stages of production run and this attributed to change of workmen in shifts; it was suggested to carry out some adjustment in operating parameters. The capability index of 1.443 implies that the “natural” tolerance limits in the process (three-sigma above and below the mean) are well inside the lower and upper specification limits which implied that a relatively low number of nonconforming papers will be produced. The capability index (>1) and Performance Index indicated that the process uses 76.3% of tolerance band. The initial analysis through X-bar/R Chart for TNPL variety HMC-80 showed that the process was not in control, however, further analysis was done through Moving Range chart.

The researcher also used Moving Range chart to analyze the variations between the samples and found that the process was still not under statistical control and decided to increase the sample subgroup size and see if there is any improvement in the results of the analysis through X-Bar/S Charts. The Moving Range Chart and S Chart both confirm that the process is in control for both the companies SPB and TNPL.
The data on bulk density was analyzed through X-bar and Moving Range chart. The Cusum chart for Bulk Density of SPB variety of paper reveals that there is a shift in the process. The S Charts for Caliper as well as Substance shows no variability in the process; however, the X-bar charts for these measurements show most of the measurements fall outside the upper control limits and hence it is found that the process is not in control and needs some adjustment in operating parameters. The Cumulative Chart for Bulk Density resulted in detection of small shift (1-sigma) in the manufacturing process. This shift in the process or the presence of assignable causes of variation may be due to the intermittent run of the process. The 1-sigma shift was also observed for TNPL variety, but however, in the subsequent 2-sigma and 3-sigma charts no deviations were found.

To control the shift in production process, it is suggested that while resuming the production on the successive run, the operating parameters need to be checked thoroughly and should be set exactly as per the previous production run standards. The measurements for bulk density were analyzed through cusum charts because X-bar and S charts are incapable of measuring the small shifts in the process. The cusum chart shows that there is a 1σ shift in the process, even though all the points plot within the control limits for 3σ limits. Hence it was found through this study that cusum chart should be deployed to identify a small shift in the production process.

The bulk density of data of SPB was also analyzed through EWMA control chart in addition to the cumulative sum chart. The EWMA chart detects the shifts in the process and at the same time, it indicates the process out of control, thereby giving signal for some modification in the process. The process parameters were slightly modified and again measurements were taken on bulk density after a week time and analyzed. The results revealed that there was no shift in the process.
Multivariate Control Chart is used to monitor simultaneously two quality characteristics Caliper and Substance. When the individual control charts for caliper and substance tell the process is not in control, the chart for Bulk Density shows that the process is in control. Also, when these two quality characteristics Caliper and Substance are plotted through a multivariate control chart, it is seen that the process was in control for the company SPB. However, for TNPL, the multivariate charts confirm that the process was in control and it was suggested to make some modifications in the process parameters.

The nonparametric tests are easy to conduct, though not as much effective as parametric tests, can act as a prelude to the control charts, since the understanding of such tests and using the same is very easy even for a layman. The results of the nonparametric tests, showed that the sample averages are not evenly clustered around the grand mean, but the sign test does not show any indication of variability around grand mean as has been revealed by the R-chart.