PAVEMENT **WORK TIPS**

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Asphalt Production Process Control

BACKGROUND

The purpose of the guide is to provide an introduction to the use of statistically based process control charts for control of asphalt production. The paper provides some practical considerations to monitoring asphalt production.

The underlying premise is that quality is maintained and improved, not only by inspection and testing, but also by determining causes. The application of suitable process control procedures and effective use of statistically based measures of quality should assist companies to deliver a consistent quality product meeting client expectations. An additional outcome could be a reduction in the amount and type of traditional tests used to audit the quality of outputs.

PROCESS CONTROL

Process Control is a system that the asphalt producer has in place to demonstrate to itself and to its client, at regular time intervals, that the specification is being continuously met and actions are continuously being applied to ensure a consistent product.

Process Control of asphalt production requires an understanding of all the elements of an asphalt plant, documenting processes and analyzing data to understand relationships between:

- → Raw materials
- → Target recipe
- → Asphalt plant settings
- → Equipment and mix calibration
- → Outgoing production test results
- → Individual product analysis
- → Pooled data analysis

INTRODUCTION TO CONTROL CHARTS

Control charts come in a variety of types but have a number of common features.

The types of charts referred to here can only be used when there is measurable data that is recorded in a time sequence. Data points are plotted on a chart that normally shows, as a minimum, the specification limits(s), the target, the process average and upper and lower control limits. Such charts allow analysis of system changes over time.

Charts are used to minimise making two kinds of mistakes:

- → acting as though something out of the ordinary happened when nothing did (over-controlling); and
- → failing to act when something out of the ordinary did happen (under-controlling)

Variations due to error or process change, detected by statistical methods, are termed assignable causes.

Control limits are upper and lower boundaries established by statistical analysis of the process. They are used to identify assignable causes as an outcome of production going outside the control limits. Action limits are arbitrarily set to initiate some form of investigation and/or corrective action.

It is important to understand the distinction that control limits are not the same as specification limits although specification limits and target values can also be shown on the chart for comparison with specification compliance.

A capable process is generally one where the control limits lie within the specification limits. Where the control limits are outside one or more of the specification limits there is greater risk of falsely reacting to chance or random causes.

Corrective action, when there is no clear evidence of a process problem, is likely to increase, rather than decrease, process variability.

SELECTING CONTROL CHARTS

There are various types of control chart applicable to asphalt work. The following descriptions are somewhat abbreviated and more detailed information can be obtained from the references.

Individual/Moving Range

This is one of the simplest of all control charts. It plots results of individual samples and a moving range that is the simple difference between two consecutive results (See Figure 1).

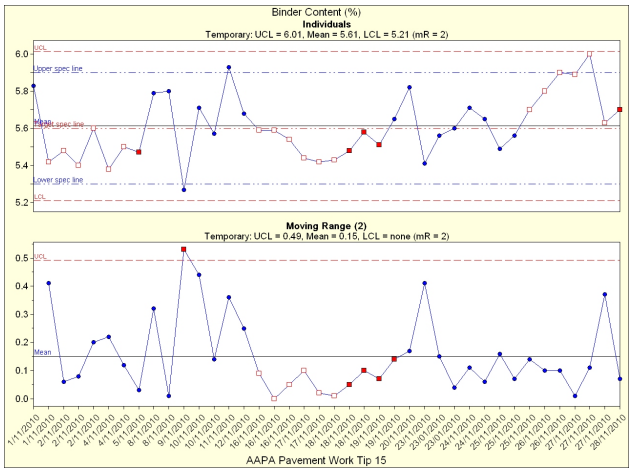

Figure 1 – Individual and Moving Range Chart Example

Moving Average/Moving Range

This is a variation of the individual moving range chart and is used to plot the results of single samples as a rolling average of a number (e.g. 5) of consecutive results and the range of that group of results. By averaging the data, it reduces the risk of reacting to false out of control conditions when the process has not changed and is particularly applicable to monitoring routine production where data is obtained from single samples.

Average/Range or Standard Deviation

This chart plots the average of groups of results and the range or standard deviation of results in those groups. As it uses more data, it is considered a more powerful tool for analyzing whether a process is stable and predictable than the above chart types.

Analysis of insitu compaction testing obtains results in groups and standard deviation of the group is generally calculated and replaces the range data.

USING AND INTERPRETING CONTROL CHARTS

Control Charts can be used for monitoring both test results undertaken for quality assurance purposes and for upstream assurance inspection purposes.

Setting Control Limits

Control limits are commonly set at ±3 times the standard deviation (σ) for single samples or $3\sigma/\sqrt{n}$ where n is the number of samples in a group.

Warning limits are commonly set at $^2/_3$ the control limits.

Decision Rules

Control charts require decision rules. Following are typical examples for action indicated by assignable causes. Determine and correct assignable cause if:

- One point lies outside control limits
- Two out of three points lie outside warning limits.
- Investigate possible assignable cause and need for corrective action if:
- Nine points in a row are on one side of the target
- Six points in a row are steadily increasing or decreasing
- Two out of three points lie outside the warning line.

PROCESS CAPABILITY ANALYSIS

Process capability indices measure how much natural variation a process experiences relative to its specification limits. Cpk estimates capability if the process mean were to be centered between the specification limits.

CONCLUSION

Most of the data required for process control charts is already available in production facilities. Some effort is required to set up, maintain, and interpret systems to improve both efficiency and quality of asphalt production.

REFERENCES

→ AAPA (1997) Implementation Guide IG-3, Asphalt Plant Process Control Guide

→ AS 3942 Quality Control – Variables charts – Guide

→ Butcher & Van Loon (2005) Process Control of Asphalt Production in SA to June 2005.

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