Process Control and Quality Control

7.1. THE INTERACTION OF PROCESS CONTROL AND QUALITY CONTROL

Quality control has traditionally been concerned with the setting of standards which must be maintained at each stage of manufacture, followed by the manual monitoring of process supplies, operations, and products, to check if the specified standards are being maintained. In contrast, process control has been almost entirely concerned with the design and performance of systems for maintaining machine conditions and controlling machine operations. However, both quality control and process control have the common objective of enabling products which are acceptable to the customer to be produced at a cost which ensures both a competitive price and a viable profit margin.

The dichotomy between process control and quality control arose as a natural consequence of the character of manufacturing technology and equipment available prior to the introduction of the microprocessor. In situations where the opportunities for automatic process monitoring, data analysis, and control are limited and where the major contribution to the success of an operation is made by an operator, quality control is naturally concerned with operator performance and is also influenced by the limitations of manual monitoring methods. Consequently, with automatic systems exerting a relatively small influence on quality in comparison with the operator, except in cases of improper setting of controllers or malfunctions, the whole responsibility for automatic systems has tended to be placed with the engineering and maintenance groups, as a natural extension of their responsibility for the proper functioning of manufacturing equipment. As a result, the monitoring of output quality has generally involved off-line inspection, often after a delay of many hours from the time of manufacture, coupled with a limited amount of on-line sampling inspection. Neither of these inspection methods are conducive to the rapid detection and correction of defective work.
The introduction of microprocessor technology into manufacturing gives the potential for radical improvements in production monitoring and control capabilities but it must be accompanied by an integration of process-control and quality-control objectives and responsibilities for successful exploitation. With progressive improvements in process-control methods and the subsequent automation of operations, the contribution of control systems to product quality increases, while the contribution of the operator diminishes. In many sectors of the rubber industry this trend can be sharply accelerated by the effective application of microprocessor technology, which itself is being rapidly improved and reduced in cost. In addition to leading to greater consistency of operation, computer methods can also be used to replace manual inspection in many cases. They also have the advantage of monitoring current production and can provide a continuously updated analysis of the quality of manufacture, creating a powerful tool for the rapid detection and correction of defective work.

Unlike conventional control systems, which perform fixed tasks and are usually concerned with the regulation of machine conditions, microprocessor systems are programmable and can perform sophisticated analyses of the data read from measuring instruments, thus providing an assessment of product quality which is essential for advanced control and the replacement of manual inspection. This demands an insight into the contribution of manufacturing operation variables to product quality which is beyond the scope of most engineering groups, requiring that the quality-control and technical-support groups be involved in the specification and selection of system hardware. These latter groups should also make a major contribution to the programming of new systems and the reprogramming of existing systems in order to improve their performance.

As reliance on microprocessor monitoring and control systems grows it becomes increasingly important to ensure that they are functioning properly and accurately at all times. Validation and calibration can be identified as an important and growing responsibility of the quality-control group.

7.2. SPECIFICATIONS

7.2.1. The Writing of Specifications

The writing of specifications\(^{1,2}\) generally starts with a product performance specification, which describes in quantitative terms what the product should do, the conditions under which it is required to perform, dimensional