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Editor
Frank Roberts
Technical Adviser
Brian Attwood

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The woodyard

William Fuller
Weyerhaeuser Technology Centre

Quality control begins not in the pulp mill but in the forest. Total quality management should treat woodyard operations as part of an integrated control programme.

Total quality management is a key strategy for almost every major corporation worldwide. The needs of the customer are given the highest priority in manufacturing, delivering and servicing products. It has been proven in the marketplace that when companies are committed to a total quality emphasis, they enjoy the benefits of satisfied customers, good profit margins and highly motivated employees. However, to achieve these kind of results, every part of the organisation must be involved and there must be strong leadership that believes in the total quality emphasis.

It is logical, then, that the concepts of total quality should be fully practiced in the pulp mill woodyard, too. The woodyard product is clean, uniform and fresh chip of the right species blend and delivered according to mill specifications, on time and in the right quantity. This is a demanding task, but fibre raw material technology is improving to meet the increasing needs for chip quality and uniformity.[1] With the use of some total quality concepts and tools, this article will highlight some of the recent developments in chip production and processing that allow the woodyard to satisfy the pulp mill, its customers.

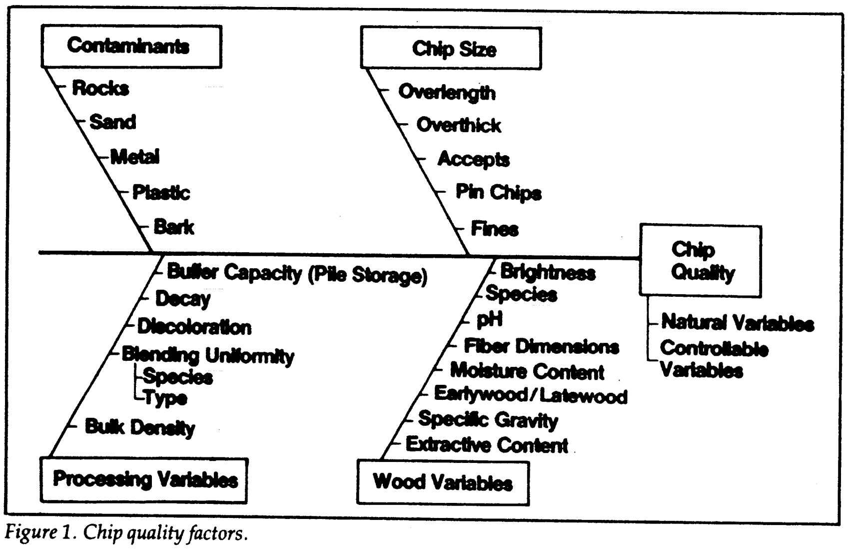


Figure 1. Chip quality factors.

Before entering the woodyard to look at the developments in chip production and processing, we must mention the changes that are occuring in the forests that supply pulpwood. Wood supply is now a global process. Chips and logs are transported between continents to not only meet the volume demands, but more important, to meet fibre quality needs. Hardwood plantations of eucalyptus, aspen, birch and and *Gmelina arborea* are growing worldwide. These species are chosen for their ability to supply fibres that produce good sheet surface properties for printing papers.[2] Similarly, selection and allocation of softwood is being done to achieve specific product requirements. Softwood specific gravity is a relative measure of the percent earlywood fibre content and can be used to allocate these thin-walled fibres to products requiring highly conformable, good bonding, smooth surface properties.[3] Thinnings are a source of low specific gravity wood and are an important product of plantation management. The thicker-walled fibres from older trees and from wood product residuals are then used for products where stiffness, bulk and high tear resistance are needed.

There is an increasing need for foresters and papermakers to work together to design the forests of the future to produce the fibre types that meet product needs. Certainly, advanced planning of this nature is very difficult and must also include the structural wood products needs, but there are many opportunities to also provide engineered fibre furnishes from managed forests.[4] Forest-to-product communication of customer needs is the key.[5]

Chip quality

It is not useful for a pulp mill to simply raise the issue of "poor chip quality". There is a strong, well-documented relationship between chip properties and pulpmill operations,

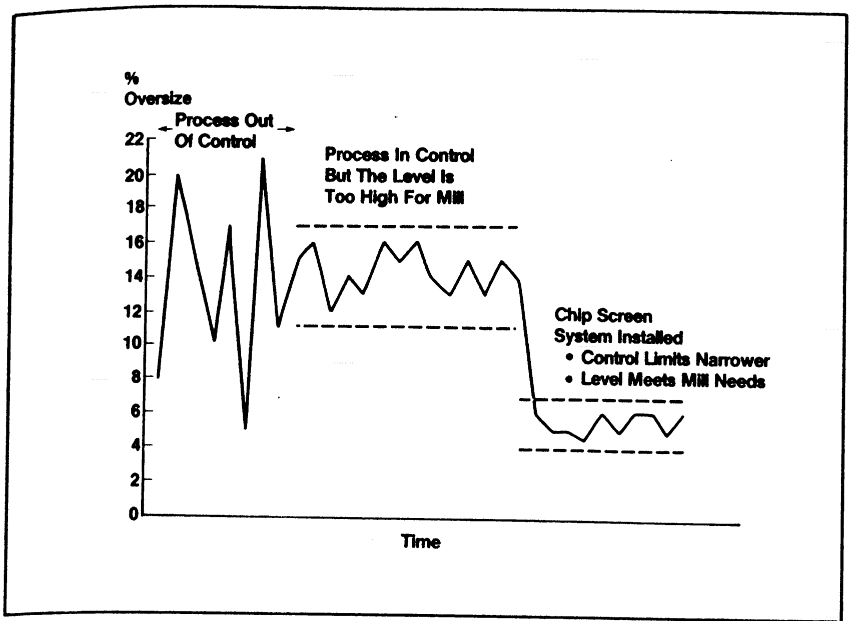


Figure 2. Example control chart for chip quality.

but unlike most pulping raw materials, there are numerous natural and controllable chip quality factors.[6 7]

The benefits of improved chip quality are found in improved and more consistent pulp mill operation and product quality. To achieve this, a mill must collect facts and data to develop cause/effect relationships. This requires good chip sampling and testing technique. Analysis of this data will determine if the process is consistent and under statistical control. Once the process is under control, economically attractive improvements can be made to continuously improve the system performance.[8]

Recent tool developments

There have been numerous recent improvements and developments in tools to provide reliable and accurate chip quality control data. Chip sampling devices are available or can be designed for almost every chip handling situation, but hand sampling can still provide quick, representative samples if technicians are well trained.[9] Chip particle size analysis can be done by a number of manual and automatic systems.[10] Similarly, an optical system is being tested in Scandinavia with good results.[11] Chip moisture sensors are widely used throughout the world to purchase chips on a dry weight basis and more important, to control digester wood and chemical charges.[12] These are only a few examples of the tools that are being used to measure chip variability. Without such facts and data, a chip quality improvement programme is futile.

Another useful tool in quality analysis is the technology spectrum. A mill can track its progress in, for example, a reduction in Kappa number variability. Kappa number is one of the key variables in consistent operation of a pulp mill and chip quality is an important factor.[13] Note that chip quality measurement is one of the first steps. The simple awareness of what chip suppliers are delivering compared to their capability allows the mill to begin immediately to work with these suppliers and obtain improvemens with little or no capial expenditure in such areas as routine debarker and chipper maintenance.

Chip quality improvements

Moving further down the spectrum curve, let's look at other opportunities in the woodyard to reduce Kappa number variability. Once chip quality has been achieved, it must be preserved in storage and handling. The mechanisms of chip pile deterioration are understood. Further, equipment is available that will minimise deterioration from compaction and heat.[14] The most popular equipment utilises automated outstocking conveyors that build linear or round piles without the use of chip dozers and limited to about 50ft in height. An additional benefit to this type of system is the blending that occurs as a transverse conveyor reclaims across the layers of the pile. This blending reduces the impact of variations in chip moisture, chip source and chip species and has been shown to reduce the Kappa variability by as much as 50 per cent.[15]

The single most important development in the woodyard in recent years is the development of high capacity, high efficiency chips screen systems with the capability of removing the extremes in chip size, namely fines, over-length and over-thick chips.[16] The combination of gyratory screens, disc screens and over-size slicers in systems have allowed mills to almost completely eliminate pulp knotter rejects, increase yield, reduce chemical costs and de-

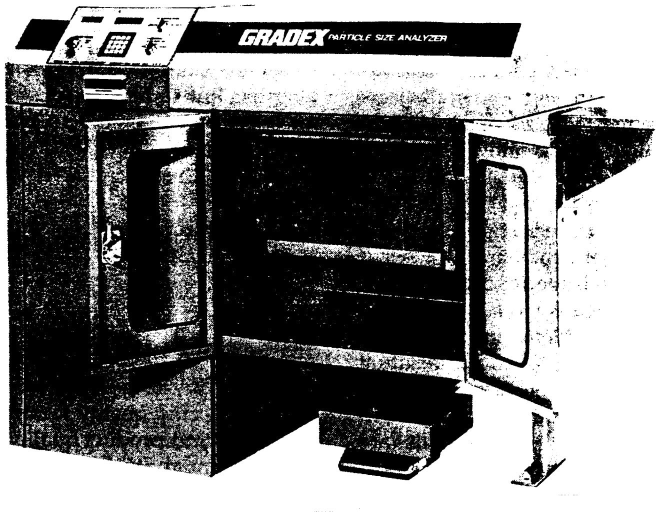
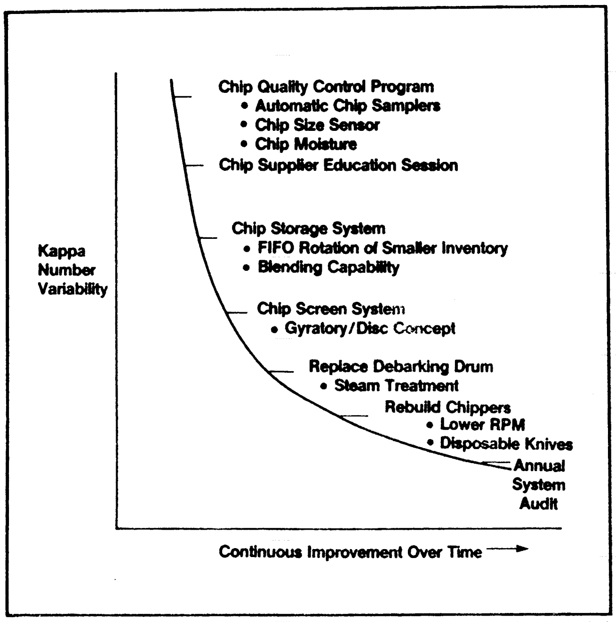
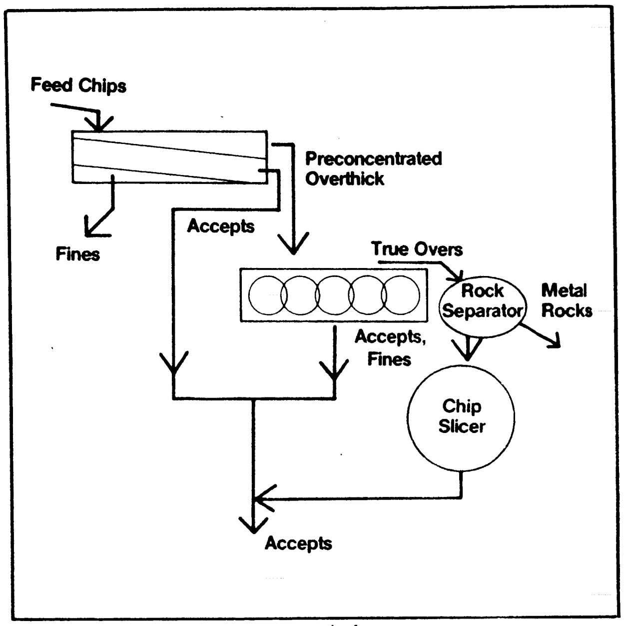


Figure 3. New automatic analyser for wood chips.





Figures 4 and 5. Technology spectrum for reduced Kappa variability and chip quality; and disc chip screen system, respectively.

crease pulp dirt.[17] Design of these systems requires more careful attention than given to the woodyard in the past. With the use of statistical analysis of chip variability, pilot plant trials and computer simulation, chip screen systems have been designed with precision and high performance.[18] While these systems may require up to US$6 000 000, the returns on investment are easily justified for almost any mill.

Chipper maintenance

Before investing in a chip screening system, however, a mill should take a look at the design and condition of the chippers. Although chipping technology is almost 100 years old, there are still developments being made to continuously improve chip size distributions at the best time — while chips are being made.[18] As a general observation, chippers in many installations need to be audited periodically. Careful inspection would show that they are not always maintained precisely, wood is not being fed so that the wood/knife interface is stable, the chip cut length is not producing the target thickness for each species of wood, and the chipper speed is too fast.[20] Corrections of these problems in woodyards and at the wood product residual sources will provide more uniform chip size distributions and reduce the need for chip screening. Many mills are taking also taking advantage of disposable chipper knives that not only reduce labour costs, but improve the accuracy of chipping.[21]

Low bark content is another key to producing clean, uniform pulp. The industry attempted to use whole tree chips in the 1970s when wood supply was tight and wood costs very high. However, customer satisfaction and the economics of cleaning the pulp to meet increasing quality specifications, has caused the industry to return to complete debarking. The trend toward smaller diameter trees and tree-length wood handling has forced the improvement in debarking to meet these more stringent bark specifications. Predictive performance equations allow the design and operation of drum debarkers to meet quality and productivity targets.[22] The ability of drum debarkers to overcome the season variations in bark adhesion has now been achieved through the use of steam treatment in almost totally enclosed drums.[23] There is a strong trend toward tree length debarking in which the wood is not slashed to short (2–4m) lengths, but is left in up to full tree lengths. The parallel debarking is achieved at high productivity through redesign of the drum infeed chutes and the exit gates. Bark contents below 0.5 per cent seem to be achievable year-round with almost any type of wood.

Implementing total quality

A mill may only work on a limited number of chip quality factors but the economic and product quality benefits are substantial. We have just looked at several that have been most productive in recent years. A possible tool for setting priorities and quantifying benefits is fibre value analysis.[24] This technique was developed to determine the change in contribution margin for specific mills when a change in fibre raw material type or quality was made. It emphasises the use of mill data backed by fundamental research and the use of teams to gather facts and data upon which a sound decision can be made. Even with the highly variable nature of wood and chips, the quality of the fibre raw material used in pulp mills can be made consistent and controllable. The cost of chips can be 30–50 per cent of the total cost of producing a fibre product. Certainly investments in chip quality control programs and tools can be easily justified. Based on the facts and data such a programme provides, investments in woodyard equipment to continuously improve chip quality can also be justified. The vital role education of all those involved in producing and handling chips cannot be over-emphasised. This education in the fundamentals will gain understanding and commitment from the forest-to-the-product.

Assessment of process capability of woodyard and chip production equipment will result in chip quality targets. Part of the education must include what can be done by each chip supplier to achieve such targets. Some can be achieved through good maintenance practices and adjustment back to original equipment tolerances and settings. Others may require capital spending over time. Supplier ranking and reporting can help a supplier see where his quality is with respect to other suppliers and against the targets that are set. But all of this takes communication; two-way, routine, consistent and co-operative communication from supplier to customer and customer to supplier. □

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William Fuller is a department manager, Weyerhaeuser Paper Company R&D, Tacoma, Washington, USA. He joined Weyerhaeuser in 1967 after obtaining a BSc in Wood Technology and an MSc in Pulp and Paper Technology from the University of Washington College of Forest Resources. Since then, he has been chiefly engaged in R&D and its implemenation in the areas of chip preparation, quality and allocation, forest residual utilisation, relationship of chip quality to mill value, and chip storage. He is an active member of Tappi.