GAINING MARKET SHARE WITH SHORT LEAD TIMES, HIGH QUALITY AND LOWEST TOTAL COST STRATEGIES

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ABSTRACT

Short lead time for high quality products allows for minimum inventories, maximum flexibility and minimum cost. Configuring manufacturing process to achieve highest throughput with minimum process time while maintaining quality is the goal. Process control is paramount when promising customers delivery of product from moldable powder to shipping dock in three days. The need for many unique products for every application can be hindrance to throughput and process time. Developing only a few needed "multiple purpose" products that meet or exceed customer expectations in numerous applications eliminates the need for many unique application specific products.

BACKGROUND

Ferrite International Company started as a division of Tempel Steel Company. A pilot line to develop a low loss soft ferrite material for high frequency transformers operating in the 15 KHz to 300 KHz range was established in 1985. One year later a full modern production facility was built in Wadsworth, IL. Because it was started as a new company from scratch, the founders had the unique opportunity to choose state of the art processes and equipment and configure them to achieve the highest quality possible.

In 1990 Tempel Smith purchased full ownership of Ferrite International Company from Tempel Steel and has since concentrated his efforts in leading the company. He instituted a company policy stating that Ferrite International is dedicated to the principle of achieving significant market position utilizing: Quality, Service and Lowest Total Cost Strategies to create continuing partnerships with major users of Soft Ferrites world wide with the following objectives.

QUALITY OBJECTIVES

1. Total quality management from order placement to end product utilization.
2. Exceed conformance to all customer requirements and expectations.
3. Meeting or exceeding all industry standards by emphasizing capabilities rather than specifications.
4. Communicating all conformance requirements to all members of the Ferrite International organization.

DELIVERY OBJECTIVES

1. Recognize that speed to market will enable our customers a significant market edge in the world market.
2. Configure our manufacturing process to achieve highest throughput with minimum process time.
3. Communicate effectively all information relating to customer support and services.
4. Create an environment to ease communication with our valued customers.

LOWEST COST SUPPLIER OBJECTIVES

1. Utilizing speed to market and domestic sourcing to limit inventory carrying and transportation costs for valued customers.
2. Achieve critical volume mass to lower cost position.
3. Minimize inventory to achieve profit targets. Quick delivery is to be done thru fast throughput.
4. Maintain technological innovation allowing our valued customers value added contributions to design and development of world-class technologies and topologies.
5. Minimize bureaucracy allowing technical interactions which; will lead to innovation and lower total costs.

MANUFATURING PROCESS

The process of manufacturing soft ferrites is made up of four basic steps: powder preparation, forming, sintering and finishing. Proprietary powder preparation processes are involved in preparing MnO, ZnO and Fe_2O_3 into a dry moldable powder. The forming operation transforms the powder into soft "clay like" material in the desired configuration. The forming is done using presses and powder compacting tools. To create the desired physical and magnetic characteristics the pressed cores are sintered in large kilns. The sintering is divided into three stages. In the first stage the binders are driven off. At Ferrite International we use separate ovens that were designed specifically for removing the binders. Not only does this free up our more expensive high temperature elevator kilns and therefore net over double the through-put of each kiln but it also keeps the binders that could plug up airflow passages out of the sophisticated elevator kilns. The second stage is high temperature (approximately 1 400ºC) soak. In this stage the ceramic structure forms, the part shrinks and the magnetic characteristics are realized. In the final stage the atmosphere is closely controlled during the cool-down. An atmosphere containing too much oxygen at a given temperature causes the part to absorb oxygen (oxidize), to little oxygen in the atmosphere causes the part to give up oxygen to the atmosphere (reduce). Cores that will be assembled require machining on their mated surfaces to remove the fine surface layer of reactive ferrite which result from sintering and to minimize any air gaps by insuring smooth flat and parallel surfaces. Some core sets require gaps with tight tolerances in their flux path. These gaps are accomplished by grinding a core's center leg.

CONFIGURING THE PROCESS

Conventional ferrite processes were designed to keep large inventories stored on trays between each process stage. Storing of the piece parts on trays caused double handling because the parts have to be transferred to and from special high temperature ceramic kiln tile before and after sintering process. The tile are too expensive to store large amounts of inventory on them. Double handling of the piece parts adversely affects the quality and yield. The pressed parts are fragile and the sintered parts are brittle. Handling of either the pressed or the sintered parts increase the opportunities for chipping and breakage. Inventories and the double handling of piece parts are costly and not needed if processes are designed, configured, sized and scheduled properly. Inventories at Ferrite International are minimized by keeping every part moving rapidly through our series of batch processes. Over 90% of the parts are shipped within five days from the day they were formed. Handling of parts is minimized by loading parts onto kiln tile right at the presses and then loading the kiln tile directly onto the kiln cars and into the kilns. After sintering, the piece parts are ground right off the tile on the kiln cars. Inspection and packing has been intergraded with the in line grinding process allowing further reductions in handling, process time and work in process inventories. Moving inspection and packing to the end of our through-put grinder has had positive effect on quality because the operators see the problems and consequences immediately and can make adjustments rather than continuing to make defective products. In addition to reducing the work in process inventories and the piece part handling, research and development efforts have successfully reduced the sintering time by more than 50% and increased the amount of product on each kiln load by 10%. The following table shows a comparison of a conventional ferrite process configuration compared to our fast through-put process.

Conventional Ferrite Process Compared to a Fast Through-put Process

	Conventional Process	Fast through-put Process
Moldable Powder Inventory	14 Days 70 000 lbs/kiln	14 Days 70 000 lbs/kiln
Forming	1 day 40 000 pcs/cavity/day piece parts on trays	1 day 40 000 pcs/cavity/day piece parts on tile & tile on kiln car
Inventory Pressed Parts	5 days = 25 000 lbs/kiln	0
Load pcs on tile and tile on kiln car	1 day	0
Binder oven	0	0.5 days 10 to 12 hrs/load
Sintering Kilns	2 days 42 hrs/load	0.5 days 10 to 12 hrs/load
Unload pcs off tile onto trays	1 day	0
Inventory Sintered Parts	5 days = 25 000 lbs/kiln	0
Finish Grinding	1 day 7 500 lbs/grinder/day	1 day 7 500 lbs/grinder/day
Inspect, test, sort & pack	1 day	0
Finished Inventory	30 days	5 days
Ship to Customers		
Number of times piece parts are handled	6 times	3 times
In-Process time from moldable powder not including finished goods inventory	17 days	3 days

QUALITY CONTROL OF THE PROCESS

Process control is paramount when promising customers deliveries of product from moldable powder to shipping dock in three days. There is simply no time to remake or rework. The process must be controlled to insure good quality parts are produced. Quality is controlled by charting critical process points throughout the process producing the products. Critical process are those measurements that affect the outcome of the product. The bulk density and screen analysis are critical process points in the later stages of making moldable powder. The size weight and cosmetic appearance are critical process points forming the piece parts. The core loss, permeability and mechanical dimensions are critical process points measured on samples after every kiln firing. The inductance index (A_L value) and ground dimensions are critical process points measured while grinding. On continuous processes the process point measurements are taken in a time series manor and used to adjust the equipment. If and when a measured value indicates that the process has drifted outside of control limits, adjustments are immediately made to bring process back within its capability. Critical measurements that our customers have interest in such as core loss, inductance index (A_L value) and mechanical dimensions are summarized to show their means, standard deviations and capability indexes (Cp, Cpk or Cpu) with a graphical histogram are included in one of the boxes with every shipment. Company policy is that capability indexes on critical characteristics must exceed 1.50. If any are less than 1.50 our customers must give their acceptance of the deviation before the product is shipped.

MUTIPLE PURPOSE PRODUCTS

A good low loss power material such as Ferrite International’s TSF-7070 can be used in place of other low loss materials like TDK’s PC50 material as well as a substitute for TDK’s PC30 material that has high core losses. Likewise our customers realize no advantage by offering them numerous high permeability materials. A 5000 perm material can be designed into most applications currently using both 4000 perm and 6000 perm materials by adjusting turns or by changing the core dimensions. Materials requiring their own specific material composition and sintering profile may be able to use cheaper raw materials, less expensive compositions or reduced processing time but seldom do the savings offset the increased costs of additional inventories and keeping the material separate through all of the processing steps. Manufacturers are more efficient if they use their capacity to make the best product possible for a fair price and obsolete inferior material grades.

BENCH MARKS

The following table shows the progress our company has made since adopting these philosophies.

Table of Bench-Marks

	1989	1993
North American Market Share	<1%	>8%
Average Lead Time	18 wks	3 wks
Process Time from Moldable Powder	20 days	4 days
Normal Quality Level Excluding Catastrophes in PPM Defective	66 800	3
Total Cost Reduction	Base Year	40% Lower
Flexibility Number of Product Offerings	45	>200

CONCLUSION

Companies who can deliver high quality products at competitive prices with short lead times and maximum flexibility will gain market shares over traditional companies in the 1990s. Configuring flexible manufacturing processes for high through-put while maintaining high quality standards are the keys to success. Critical product characteristics should be specified to the capabilities of the manufacturing process and the process should be controlled to make the best and most consistent products possible.