CHAPTER - II

REVIEW OF LITERATURE AND METHODOLOGY

2.1 Charkha Spinning

Since India lives in its villages, the economic development of the country should be started from the rural areas. We should aim at “Production by masses instead of mass production”. If the earnings of the villagers will improve, standards of living, health and family planning will automatically follow.

The Khadi and village Industries Commission (KVIC) was thus started in the year 1957. The objectives KVIC are social objective of providing employment, economic objective of producing the saleable goods and a wider objective of creating self-reliance among the rural people.

KVIC implements its programmes through 30 state KVIB (One in each State). There are about 5500 registered khadi institutions and 30,000 cooperatives implementing khadi programmes. There has been continuous effort by the KVIC for improving the production of khadi yarn. The KVIC has been encouraging research in this area also over the years. There has been continuous development in the spinning charkha since the 1900 AD. The box charkha has emerged in to multi spindle charkha starting from 2 spindle wooden charkha, 4 spindle wooden charkha, 6 spindle wooden charkha and ultimately to 8 spindle all metal charkha which is the new model Rajkot charkha.
This charkha is used commercially and gives a production of 30 hanks in 8 hours of work by the spinner. But the wage rate earned at this production is not sufficient to maintain a family and hence the charkha spinner migrates to other areas of work as cited by many researchers. A spinner migrates to the cities in search of employment and thus adds to the problems of infrastructure in the already crowded cities. With a view to increase the wage earnings, improve the yarn quality and ultimately to improve the sale rate of the yarn, the researcher has proposed to develop a narrow width and improved high speed spinning charkha machine that could spin most counts of yarn in Khadi sector.

2.2. Review Of Literature

Review of literature is an exercise of what has been already done by expert Committee & Research in the sphere of Khadi spinning and cotton Khadi.

The review is collected from published reports, books, published and unpublished theories and the articles on the cotton, silk, Wool & Muslin on Khadi spinning Industry. The review also enables the researcher to identify certain lacuna in the Literature and select appropriate tools of analysis for the present study. The following is the account of the review work on the existing literature related to the topic of study.

2.2.1 Books

Kriplani J.B. - in his edited book "Gandhian Thought", Gandhi
samarak nidhi, Rajghat, published by Orient long man, New Delhi, has discussed issues and strategies on rural Industries, Human Resources Employed in Village Industries, Social aspects of Rural Industries & Economic policy in Rural India and the role of Village Industries.

“Pattern of Assistance for Khadi & Village Industries” - published by KVIC, 3 Irla Road, Vile Parle, Mumbai - 56, mention the types of assistance to khadi and village industries. The various grants distributed by KVIC over the years and the Subsidies provided to mose engaged in khadi spinning.

Dr Meenakshi Sundram N. and ~ Dr. SeeRangarajan .R - In their book "Developmental strategies for Small Enterprises - GRI, " have discussed selected Khadi & Village Industries and suggested strategies for growth of cottage Industries. They have clearly illustrated the Flow Process Chart from cotton fibers to yarn spinning and how khadi yarns can be efficiently spun in the cottage Industry.

Mr.Soundrapandiyan.M in his book "Rural Industries In India " has selected all the papers, which basically deal with issues and strategies of Rural Industries, Human resources management in Rural Industries, social problems in Rural Industries and Economic Policy in India, and role of KVIC in Rural Industrialization.

Grosberg P. & lype C. in their Book “Yarn Production" published by Textile Institute, Manchester 2000 have dealt at great length on the theoretical affects of yarn spinning, general principles of yarn
manufacture and the forecasting on the Fibers and Yarns. The magnitude of Electro Static forces acting on the fibers and friction on the Fibers & Yarns. The Balloon theory has been discussed in great detail and the tension changes occurring due to Ballooning has been established.

Yovesh Chandra Sharma in his Book “Cotton Khadi in Indian Economy” published by Navajivan publishing House, Ahmedabad - 380 014 in 1970 has explained the Gandhian Khadi and the Khadi independent India, that is, the promotion of KVIC & KVIB. How cotton is purchased for the Khadi Commission, the ginning, opening and cleaning of the cottons and the machines used to process cotton up to central sliver plants. Charkha spinning and powerization of Charkha has been discussed.

Compendium of Textile Statistics 2002 - Office of the Textile Commissioner, Government of India mentions the statistics of number of spindles and looms installed in the 3 sectors respectively mill sector, power loom sector and hand loom sector.

“100% Swadeshi”- Gandhi M.K. describes how we should be self-reliant for our needs of yarn and cloth. He propagated hand spun and hand woven cloth to oppose the British.

Pattabiram.T.K has edited “Essentials of Practical Cotton Spinning”. The Book gives the formulas for calculating the speeds and production rates for different counts on spinning machines.
2.2.2 Articles

Gandhi **M.K.** In the article “Khadi, Why & How”, Indian National Congress Convention, Bombay 1947, has explained the need to produce the khadi yarns and khadi cloth in rural houses, provide employment to rural masses and fight the evils of poverty and unemployment.

**KVIC Act, KVSC Publication, (1956) (amended up to 24.07.89) and KVIC Publication, KVIC, Acts & Rules (amended up to 28.07.89).**

These publications of KVIC mention the tables of khadi yarn count, rate for wage payment, raw material to be used etc., for different regions in the country. All the centres producing khadi yarn refer to these tables and make payment of wages accordingly. This system is followed throughout the country.

**Cost Chart, KVIC Publication (1979); describes the C (New Model Charkha Act), Production rates in hanks and wage rates to be paid for different counts are given in a tabular column.**

**Rural industrialization; why and How, KVIC Publication (1987)** the report states that India lives in its villages. If the villages start rural industries it not only promotes employment and wage earnings but also prevents migration of the skilled workforce to cities. It ensures peace and harmony in the country besides eco-friendly industries are promoted. K&VI provide employment to nearly 60-lakh people directly.
A New loom”, KVIC Publication (1988); discusses about the sevagrsrn loom. This loom is made up of wooden parts. It is a frame loom, but the weaver can sit on the bench provided and weave comfortably. This loom was introduced from Gujarat state and gave high productivity. The loom was also versatile in that it could weave cotton and silk fabrics.

Ratilal Mehta (1950) in his book “The story of khadi” published by Navajeevan publishing house Ahamedabad-14 has stated that khadi should be encouraged and that it; provodes employment to larger masses of people. He stated that swaraj means ability to regard every innibatitant of India as our own brother or sister. He said Boycott foreign goods not foreign ability.

Bhartiya L.K. in his KVIC publications, (1990); “Towards rural Industrialization has described progress in rural Industrialization. He has made a mention to the development of 12-spindle foot operated charkha. The production rates and speeds achieved.

“WARDHA LOOM”, KVIC publication (1991) describes the Wardha Loom in some details. The flexibility of the loom in producing fabrics from cotton, silk and linen yarns. These looms made of wood are popular even today and used in large numbers in the districts of Dhule, Paitain , Aurangabhad, Nanded, Wardha, Nagpur and Sholapur in Maharastra state.

Planning Commission. GOVERNMENT OF INDIA Report of the working group on Khadi &Viillage Industry (1980) has discussed
strategies for improving the working of the khadi and village industries. The different products that are produced area wise and the people engaged in these trades are discussed at length. Targets are fixed for the plan periods.

Ministry of Industry, Government of India Report of the Khadi and Village Industries. Review committee (1980), has submitted in a report on the working of khadi and village industry. It states the progress made so far by the khadi commission and the reason for the gaps in performance are analysed. The review committee has made some suggestions to increase the employment and wage earnings in the khadi sector. These are to provide more subsidy, central sliver plants, better and cheaper raw material and opening more Khadi Bhandars at selected places throughout the country.

Planning Commission, Government of India Report of the working group on KVS for Ninth Plan (1996-2001). The working group has suggested that the employment and wage earnings of the people employed in khadi spinning had reduced and the trend for the next five years was also not good. So they have suggested to khadi commission to distribute the new model Rajkot charkha on a priority basis to spinners so that both the employment and wage earnings could be improved. Prior to this, the spinners used to operate only the 4 or 6 soindle machines.

Planning Commission. Government of India Report of the working group on KVI for Ninth Plan (1996-2001). It has framed the following terms and references; Evolving strategies for improving
the quality of khadi and village industries products and reduction in manufacturing cost. System market intelligence for contractual products development and layer consumer acceptance. Developing effective marketing systems for KVI products. Establishing the requirements for working capital and term loans and suggesting measures to improve working efficiency.

Raoot in his article “A low Cost Management Strategy”, for continuous improvement and Growth of KVIC has opined that any organization can improve itself by adopting suitable Models, methods strategies and management techniques. It is not the tool which matters but the Ways and Methods in which the tools are being adopted by the organization. Further the study suggests that any organization cannot avoid decay and hence it keeps on improving its performance and efficiency.

Neogi. P.K (1996) in his paper on “Group approach to overcome limitations of Small and Village Industries” has employed the importance on concept of group approach to over come limitations. Group approaches Vs Co- Operative approaches and major feature of group approaches and he suggests resources based well planned strategy may be developed to utilize group management as a critical input to reduce cost of production and to maximize profit of the tiny units in the area of smaller radius (Village Panchayat or Block) is a suitable condition for successful implementation of the approach.

ThillaiNayagam.N. (1999) has published a paper on "Input and out Put Analysis" in Khadi and Village Industries sector. This paper deals
with Input and Output of selected Khadi and Village Industries in Dindigul derived on what is major input (Material cost, Labour cost, Capital employed) and output (Production Value) and gives the formula for calculating the input of raw material, Labour cost, Capital cost on value of production. This paper concludes that the material inputs for KVI may be around 32 percentage to 39 percentage of labour cost on total production, for Khadi and Village industries around 28 percentage for exclusive Khadi production is 44 percentage and the capital cost for both Khadi & Village industries is around 5 percentage only.

2.2.3 Unpublished Reports And Thesis

Radhakrishnan.S (2000) in his studies on KVIC on “Rural Industrialization” analyzed the performance of Khadi & village industries growth of production, sales into current and constant price in Khadi & Village Industries products, analyzing capital cost per employment for capital consumption of Khadi and Village Industries all over India for a period of ten years. Their major findings are low/negative growth rate of production, sales, employment are due to many reasons like utilization of capacity, stiff competition from organized sector, low level technology and accumulation of stocks due to low sales. Increased allocation of funds, use of modern technology, change of consumption pattern of people may in future increase the growth of Khadi and village Industries activities.

Bala Subrarmani. K (2001) Input - Output and cost benefit analysis in selected Khadi and Village Industries, examines rural based labour intensive industry can generate substantial volume of employment opportunities in a capital scarce and labour surplus country like India. The study focuses on cost of raw material (input) for the production (output) of Khadi and Village Industries over a period of 12 years and found that the average cost of raw material was 31.8 percentage at constant price. The cost of labour for production of Khadi and Village industries as per studies is 40.05 percentage. As per study, the average cost of capital on total value of production is only 4.75 percentage. It has also proved that non-measurable social cost benefits from KVI sector such as availability of quality products without affecting the eco system.

2.3 Uncovered Area In The Subject And Research Gaps

Most of the literature available on Khadi Spinning deals with Government policies and philosophy of Khadi, Swadeshi Movement, Economic and Financial aspects of Cotton Khadi Spinning and Handlooms. There is little or no literature available on the technical aspects of Khadi Spinning Tools, even though many authors have
discussed the problems faced by charkha spinners and the poor quality of yarn produced in the industry. The technical improvement with use of appropriate technology tools has remained untouched. Therefore specific study of the technical developments that can be made on the New Model Charkha has been examined at the micro level to enable to understand the improvements that can be made in the existing charkha models available in the industry and the consequent increase in production and wage improvement in quality of the khadi yarn produced. This would in turn contribute to the increased wage earnings of the khadi spinners. This is bound to stop the migration of the skilled khadi spinner to other areas of work such as building construction etc; and avoid over crowding in the cities. By providing a motorized charkha the human drudgery is eliminated besides twist flow is uniform resulting in better quality yarn, which can fetch higher price.

The Khadi spinners are mostly women folks who seek out a living by working on the charkha spinning. These charkhas even though they have evolved over the last 4 decades, very little has been achieved in the machine design and ergonomics. The women folk have to use their hands continuously to rotate the handle of the Charkha (8 Spindle Hand Operated Charkha) or pedal with their legs continuously (12 Spindle Foot Operated Charkha). This result in drudgery and fatigue to the spinner besides low production and low wages earned. It has been reported that the women spinners also do not conceive children due to the body heat produced out of continuous spinning. Khadi spinning has thus become unattractive
and the skilled khadi operators migrate to other type of jobs. With the purpose of halting this migration of Labour to cities and also avoid drudgery in spinning besides helping the spinner to earn a living wage.

With the improvements in 16 spindle charkha there will be enough time and opportunity for the spinner to look after two spinning machines placed opposite to each other with a passage in between to enable the spinner to move about and look after the smooth working of the charkha.

With the constant rate of rotation of the bottom roller shaft and drafting rollers as well as the spindles, there will be uniform twist flow into the yarn; less jerky motion and hence better quality of yarn with improved strength characteristics.

This improved quality of khadi yarn will fetch a better price in the market resulting in a higher wage earnings to the otherwise neglected khadi worker. The Khadi Industry, which is in recession at the moment, should do well and the subsidy given by the government could be gradually phased out.

2.4 Coverage Of Research Gaps in The Present Study

Very little literature is available on the development of the Charkha Spinning. The 8 spindle metallic spinning charkha that was developed in the year 1986 had remained as such giving low production, poor quality of yarn and therefore sub standard khadi
cloth. Drudgery to the spinner as she has to work the handle of the charkha to spin yarn 8 hours in a day without break.

Besides human drudgery, this has also caused women psychological problems too, as many women do not conceive and some who do conceive have had abortions. This is a practical fact the researcher has gathered during his study at various sarvodaya sangha’s and khadi centers. Hence women work on khadi spinning for 2-3 years, they leave to raise family. There are only 8 Spindle Hand Operated and 12 Spindle Foot Operated Charkha spinning machines commercially available at present. In order to increase the speeds and production rate of these machines, it was necessary to increase the number of spindle per machine and also the speeds. By taking care of machine design aspects, the researcher has tried to undertake the present study.

2.5.1 The Technical improvements Proposed

Based on the review of literature and the research gaps identified it has been proposed to design and develop a narrow width high speed spinning machine with multi spindles that will have the following modifications.

Increasing the number of spindles in existing charkha; More the number of spindles in the machine, greater will be the production of the machine and hence more earnings to the spinners.

Reducing the drudgery of the spinners; As the spinning machine will be motorized, the spindles will be driven by power only
The spinners is not required to turn the wheel, hence drudgery is eliminated. More over the spindle speed does not reduce in the evenings due to monotony of spinners.

Adopting AT tools for improving quality, productivity through the motorization of Charkha; Here due to improved design of spindles, spinning rings, drafting rollers, better top arm pressure and control of short fibers, improved creel design, spinning angle etc. The quality of the yarn obtained will be much improved.

2.5.1 Benefits

To enhance the earnings of the khadi spinners through better prices and evolving methods to popularize charkha spinning in rural houses.

The present exercise seeks to evaluate the performance of the spinning machine under study and draws conclusions there from.

2.6 Statement of the Problem

Khadi activity has been practiced in India for Centuries. It was the major tool in the freedom struggle of India to promote Swadeshi spirit among the Indians. After Independence these activities were promoted to support the livelyhood of millions of rural people who can get a reasonable wage working in their own homes.

The KVIC and other developmental agencies are working currently to improve the productivity of the tools by increasing the
number of spindles in charkha and reduction of drudgery through simple tools. Even these developments could not fetch a reasonable wage to the spinner in the present economic conditions. The 8-Spindle New Model Charkha is the most popular spinning tool used by millions of spinners and other Khadi Institutions, Survey of literature has also indicated that the studies in Khadi and Village Industries were mainly confided to analysis of financial performance of Khadi Institutions, Input and output analysis and marketing of KVIC Products. None of the research studies had ever attempted to work on the Appropriate Technology tools and other improvements in khadi spinning machines. Further Khadi Industry which produces 0.5 percentage of the total clothing needs of India could generate a total employment of 1.4 million persons. These spinners were suffering due to low wage earnings capacity of the tool and the drudgery of hand spinning and also migration from khadi spinning to agriculture and civil construction works is found to be very high. There is a immediate need to improve the production of the existing charkha and reduce drudgery of operations.

If khadi activity is promoted as the major clothing provider to the nation, it could provide additional employment to about 50 million people if khadi meets .35 percentage of the total clothing requirement. This will solve the national problem of large-scale unemployment available in the area m a significant manner. Gandhiji advocated and insisted upon khadi activity to keep the million of rural hands for productive purpose. In the light of the above facts the researcher has attempted to study the production rates in the existing charkha
spinning machines and to devise a charkha that could give sufficient wage earnings to the spinner without any drudgery, that could be operated in rural house holds.

2.7 Objectives of Study

The income of the spinner must be raised from the present Rs 35 per day to optimum earnings of Rs 120 per day, thus solve problem of unemployment & under employment.

1. To design narrow width, high speed spinning machine to suit rural homes.

2. To introduce more number of spindles without enlarging the size of the machine unduly.

3. To design the spinning machine that could run with single-phase power supply.

4. The charkha must be designed in such a way that it can be located in any rural cottage without occupying much space in narrow width 21.5” and height 56” or 4.5 feet.

5. To optimize the speed and other processing parameters in charkha spinning to get higher production from the present level.

6. To increase the yarn production rate from the present low level to the optimum level.
7. Reduction of drudgery in spinning and to attract more number of people to take up charkha spinning as an avenue of self-employment and thus to reduce the problem of unemployment in villages.

8. Decentralization of power spinning from mill spinning to power driven charkha spinning at homes.

9. To study the economics of course count khadi spinning and weaving with the use of improved charkha.

2.8 Hypotheses

The Present Work is Taken up on The Following Hypotheses:

2.8.1 The design specifications of the selected charkha tools could be modified or improved by increasing the number of spindles per charkha; increasing the height of the spindle blade; increasing the diameter of ring fitting modified drafting rollers and improved top arm and attaching power driving tool (motor) and increase of spindle speed.

The Improved charkha design has resulted in improvement in product on rate, better working performance and better quality and there by higher wage earning capacity to the spinners.

2.8.3 By incorporating the improved design of the charkha, the quality parameters of the output yarn can be improved in terms of
CV% of TPI, U%, Thin places/Km, Thick Places/Km, Total Imperfections, RKM Value, Percentage of Elongation and Hairiness Index.

2.8.4 By Incorporating improved design features in charkha, employment, generation could be enhanced.

2.8.5 The cost economics of the improved charkha output yarn will be feasible for course count spinning and weaving with reasonable rate of returns.

2.9 **Methodology**

Experimental design will be adopted for the proposed work. The methodology includes:

Complete functional analysis of the existing design of the Rajkot / Coimbatore model charkha.

2.9.2 Improving the parts and design to operate the spindles at 1000~rpm higher speeds with out any vibration. This requires modification of spindle - bolster and driving arrangement, change in drafting unit, ring and travellers assembly and tin roller drive.

2.9.3 The foot or hand power for rotating the spindles will be redesigned with electrical power drive and will operate on single-phase power supply that is available in rural homes.

2.9.4 The creel height will be modified not only to accommodate
large bobbins but the height of creel will be reduced to 4 1/2 feet as the lintel level in rural homes is about 5 1/2 feet only. The size of the charkha envisaged will facilitate lifting inside and taking out for repair or any such mobility of charkha in rural cottages.

2.9.5 Trials will be conducted at incremental speeds from the present spindle speed limit of 5000 rpm to 6000 rpm, 7000 rpm and up to 10,000 rpm. Adequate combination of drafting variables twist factor variations will be evolved and the study will optimize speeds at which popular counts can be spun on charkha units.

2.9.6 Quality parameters can be checked at various speeds and for popular counts on the charkha and comparison will be made with existing New Model charkha’s performance.

2.9.7 The spinner in the existing charkha tool is experiencing lot of drudgery and monotony due to continuous manual operation, of his hands or legs for spinning. Some of the spinners have complained about hip pain, miscarriage, and inability to attend work continuously in a month. To eliminate the above drudgery, a fraction HP Motor will be attached to the charkha frame after suitable modifications to the drive and trials will be conducted.

Charkha productivity can be improved through two ways:

1. Increasing the spindle speeds
2. Increasing the number of spindles per charkha
Therefore trials will be conducted at incremental spindle speeds in hand operated charkhas and motorized charkha. Further the existing number of spindles will be increased to 16 spindles by suitably redesigning the charkha components.

2.10 Analytical framework

The above analysis will be conducted in respect of the following tools only which are widely adopted in khadi spinning

1) 8 Spindle Hand Operated Charkha
2) 8 Spindle Motorized Charkha
3) 16 Spindle Improved Charkha.

2.11 Variables to be studied

The present work has identified following variables, which are to be studied for analysis.

Rates of Production have been measured with grams per spindle and number of hanks per spindle and per machine (charkha). The increase in speed has been done with spindle speed in rpm. The yarn quality parameters are mentioned through RKM strength, TPI, CV% of TPI, U% and Imperfections in terms of Thick places/km, Thin places/km, Neps and percentage of Elongation and Hairiness Index. Each term has been explained in the definition of concepts. The wage rates have been measured in terms of rate per hank and earnings per day and per annum.
2.12 Indicators Of The Study

1. Suitability of extending the existing 8 Spindle Charkha to 16 Spindle Charkha.
2. Suitability of attaching the fraction horse-power motor to 16 Spindle Charkha.
3. Reduction in the drudgery of the spinners.
4. Increased labour productivity.
5. Increased machine (Charkha) productivity.
6. Improvement in yarn quality.
7. Improvement in earnings.
8. Social cost benefit (Without replacing the worker and using local raw materials)

2.13 Tools of Analysis

For carrying out the research work, the following tools were used:

The study needed data to be collected from Institutions associated with charkha spinning, KVIB and KVIC. In TamilNadu KVIB and Sarvaodaya sangams with many branches in all districts are responsible for Khadi & Village Industries activities. Further Gandhi gram Khadi & Village Industries Public Charitable Trust - Gandhigram, Gandhi Ashram -Tiruchengode, Gandhi Niketan at T.Kallupatti.

The doctoral research or any other study need data to meet out the requirement. The Khadi and Village Industries Institutions and
Sarvaodaya sangam institutions in Dindigual District, Coimbatore District, Madurai District, which are functioning continuously for the cause.

The present study will use the following tools of analysis

To testify the hypothesis framed, growth rates, percentages, spindle speeds, productivity index, quality index, are the major tools of analysis.

1. 8 Spindle Motorized Charkha.
2. 16 Spindle Improved Charkha.

As an improved one and optimized model, a 16 Spindle Charkha has been designed on following specifications.

Increasing the number of spindles per charkha, could be possible in multiples of 8 spindles staff length only. The machinery manufactures are supplying top arm only in multiples of 8 spindles. If one attempts to increase the number of spindles to 24, it will be too long and create difficulty in rural households for erection and operation. Thus the design has been limited to 16 spindles per charkha.

The researcher used only cotton roving material for conducting trials in the output yarn. Blended roving could be used for study but, as the khadi Industry is basically cotton oriented, the study is confirmed to cotton khadi.
The counts selected for study are 10\textsuperscript{s} Nm, 33\textsuperscript{s} Nm, 64\textsuperscript{s} Nm and 72\textsuperscript{s} Nm, which are most popular metric counts in khadi spinning in TamilNadu. The above tools of analysis have been applied in the respective analytical chapters.

2.14 Chapter Plan

The study consists of eight chapters

The first chapter deals with the Introduction of Khadi Industry, its importance in freedom struggle, the Growth of the Khadi Industry over Five Year Plan periods in India and Tamil Nadu.

The second chapter is addressed to the Review of Literature and Design of the Work.

Chapter three is concerned with Design of the motorized spinning tools and specification used in the study.

Chapter four deals with Analysis of Production rates of various charkhas including Improved Spinning Tool.

Chapter five deals with Yarn Quality aspects of the improved spinning tool.

Chapter six explains the power consumption in improved charkha.

Chapter seven speaks about the cost economics of coarse count spinning and its adoptability to weaving.
The Chapter eight presents the summary of the findings and the recommendations of the study.

2.15 Definitions Of Concepts

Khadi: Khadi means any cloth woven on hand looms in India from yarns made of cotton, wool or silk or a mixture of these yarns, which are hand spun.

Charkha: It is domestic equipment made of either wood or steel and used to spin yarn. Charkha machine is operated by hand. Hand spun yarn on Charkha is called khadi yarn.

Village Industries: The village industries has been defined as any industry located in a rural area (population less than 20,000) which produces any goods or renders any service with or without the use of power and in which the fixed capital investment in plant and machinery does not exceed 50,000 rupees.

One Rupee: A unit of Indian currency consisting of 100 paisa. One US dollar is equal to 45.520 paisa as on 05.01.2005,

Wages: Payment made to employee of a business for his or her labour by hour, week or month.

Roving: A strand of fibers attenuated to the size of a pencil lead.

Khadi yarn: A thread produced out of roving by spinning on a charkha.
English Count: This is defined as number of hanks of 840 yards present in one pound of the yarn. This is also refereed as “British Count”.

Count Ne = Length of Hank in 840 yards/ Weight in pounds.

Metric Count Mm: This is defined as number of 1000 meters of yarn present in 1 kg of yarn.
Metric Count Nm = Weight units in Kg / Length in units meters.

Twist per Inch: The number of turns given to the thread in one inch during the charkha spinning operation.

Hairiness: The protruding fibers from central axis of the thread.

Hairiness Index: It is a measure of yarn Hairiness. It is calculated as number of the protruding hairs on the fiber axis.

End Breakage rate: The thread breaks on the spindle during spinning operation. Generally the number of thread breakages per spindle per hour is a measure.

Twist Factor: A number obtained by the product of twist level in a yarn (Turns per unit length) and the square root of its count (direct system) or inverse square root of its count (indirect system).

**Uniformity Ratio U%:** A measure of mass variability per unit length of yarn. It is statistically equivalent to the Percentage Mean Deviation (PMD) and is often approximately equal to 0.8 CV% provided the mass variation is normally distributed.
Thin Places: It is a fault of length approximately the fiber staple length having cross section of 50 percentages less than average diameter of Yarn.

Thick Places: It is a fault of length approximately the fiber staple length having cross section of 50 percentage increase over the average diameter of Yarn.

Neps Km: It is a fault of length 1 mm having a cross section of 200 percentage of average diameter of yarn.

Total Imperfections: It is regularly occurring yarn faults. It is the sum total of Thin places, Thick places and Nep fault in yarn per Km.

Note 1: The twist factor is directly related to the angle of twist helix. The surface fibers have in a yarn for the same packing density. The higher the twist level, the greater is the helix angle and larger the twist factor.

Note 2: The purpose of twist factor is to calculate the level of twist to use in spinning in order to maintain the same angle of helix and similar yarn characteristics when yarn count is changed.

RKM: “RKM” stands for “Reiss Kilometer in German and “resistance Kilometers” in French. RKM means the Kilometer of yarn for breaks that length of which the yarn can support at breaking point.

RKM Value= Single yarn strength (G) / Tex number of yarn.

SITRA Norms: The South Indian Textile Research Association
(SITRA) has conducted extensive surveys of several textile spinning mills and analysed yarn defects such as TPI, U% Thin places, Thick places, Neps, Total Imperfections, RKM Values and Elongation percentage.

Yarn Number: It is a number expressing the mass per unit length or the length per unit mass of a yarn.

Yarn: A product of substantial length and relatively small cross section consisting of fibers and or filament with or without twist.

Twist level: The amount of twist given per unit length of yarn.

Spinning machine: The narrow width, high-speed machine with 16 spindles arranged in a row and driven by a motor. It does the operation of drafting, twisting and winding of the threads into the bobbins.

Rings: It is a double-flanged steel ring, looks like a bangle with very smooth surface. The traveller rotates on the crown of the ring flange to insert twist.

Spindles: An aluminium blade of 6”, 7” or more with three special buttons on top to hold the bobbin to fix ring cop having a taper of 1:64.

Traveller: A ‘C’ shaped steel bit fixed on to the ring flange. It goes round and round the ring and guides the yarn in to the bobbin. It helps in twisting and winding the yarn on the bobbin.
Drafting systems: A set of top rollers, rubber covered and spring loaded with top apron that help to draft the strand of sliver or roving into much finer material. In the Khadi spinning, three sets of rollers are used to draft roving into yarn.

Creel: The stand to keep the supply material like roving bobbins. It is fixed on top of the spinning machine.

Fraction Horse power motor: Motor having less than 1 Horse Power is called as fraction horsepower. The 16 spindle-spinning machine require 0.25 HP single-phase motor.

**R.P.M:** The revolutions per minute of the motor or rotating spindles.

Watts: The unit of measurement of power consumed by the motor

\[ 740 \text{ watts} = 1 \text{H.P} \]

Power consumption: The number of watts of power consumed in one hour to run the 16 spindle machines.

Spindle speed: The rpm of the rotating spindles. Higher the spindle speed greater is the machine productivity.

Lappet: A hook fixed above the spindle center to control the yarn tension.

Cots: Rubber covered roller mounted on steel arbours. They form the three sets of rollers in the drafting system mounted.
Aprons: There are endless synthetic aprons fitted over steel cradles. The aprons control the drafting of the short fibres. There are top and bottom cradles.

Draft wheel and twist wheel: These wheels are helical cut steel wheels that form the train of wheels to drive the spindles. The number of teeth in the draft change wheel and Twist change wheel will influence the draft and twist given to the threads.

Doffing time: Doffing is the physical art of removing the full bobbins from the spindles. Doffing time determines the machine efficiency.

Production rate: It is the rate at which the yarn is wound on the spindles. It is generally measured in grams per spindle per shift.

Sales value: The income realized on sale of any item.

Sliver: A strand of fibres all parallel to each other about the size of the rope.

Drafting: Attenuation or thinning down of any material. Normally cotton sliver is drafted into yarn.

Apron drafting: A method of drafting using two sets of aprons, one on top of each other.

Top arm weighting: A weight given to the drafting system to control the fibre drafting taking place on the spinning machine. Normally spring loaded weighting system is used.
Spinning geometry: The spinning angle formed between the nip of the front rollers and the traveller on the spinning machine is called spinning angle. Lower the spinning angle, lesser is the yarn tension hence lower is the end breakage rate.

Spindle bolster: It is the damper for the spindles. The damper is oil bath type, with high-speed inserts to control the spindle vibration.

Spindle wharves: It is a part of the spindle that receives drives from Tin roller. It is 14 to 18 mm in diameter.

Plug type spindle: It is the top part of the spindle blade 6” to, 8” in height made of aluminum. The spindle rotates in the bolster and holds the bobbin of yarn.

2.16. Scope And Limitations Of Study

Both the 8 spindle as well as the 12 spindle charkhas available now use foot power or hand power for rotating the spindles through a train of gear wheels and ropes. The spinner has to use both his legs (or) hands for operating the machine, which consumes a lot of energy.

For doing the spinning, the spinner has to use his legs or hands for a period of 8 hours in a day, continuous use of foot power causes greater strain to the legs and hence the speed of the spindles get reduced at a diminishing rate. Due to fatigue, monotony, drudgery and low wages, the spinner absents himself from work frequently. This causes shortage of khadi yarn for handlooms.
The production rate of foot operated 12 spindle charkha is around 50 to 60 hanks of yarn per day at maximum and average wage earnings will be Rs.50 per day; because income will not be sufficient to maintain the spinner and her family at the present cost of living.

Moreover the spinning activity of the charkha is highly monotonous and inducts a lot of drudgery. Owing to this the spinners after some time migrate to other occupation such as construction work and agriculture harvesting work during seasons. All the training given to the spinner becomes a waste and investment on training is lost. Charkha spinning centers always face uncertainty of labour availability and risk in investment.

With the view to eliminate the above problems associated with 8 spindle and 12 spindle charkha spinning, it is proposed to modify the design and develop a narrow width, high speed spinning machine with more number of spindles without much change in size of the machine as given below

To eliminate the use of foot and pedaling or rotating the handle in the charkha spinning by addition of % HP single phase motor.

To optimize the speed and other processing parameter in the spinning machine to produce yarn quality comparable with mill yarn.

To increase the production up to 3 times of the existing charkha by making suitable design changes in the machine and by adding
more number of spindles.

    Decreasing the width and height of the machine so that it can be accommodated in rural houses (21.5”x56") WxH.

    The result of the study will enable the policy makers in the KVIC, Textile Ministry to understand the problems faced by the Khadi Industry. By replacing the 8 Spindle Hand Operated Charkha by 16 Spindle Power Operated Charkha, the khadi spinner will earn more wage.

    The productivity increase is also accompanied by better quality yarn due to application of Appropriate Technology Tools.

    The human drudgery will be eliminated and by providing motorized charkha spinning machine the spinner can look after two machines that is 32 spindles, thereby providing more khadi yarn at higher productivity. The Government subsidy can be slowly reduced due to this productivity increase.

    This extra yarn production will boost the handloom sector besides surplus yarn may also be provided to power looms as the yarn quality will be equal to that of mill yarn.

    The findings of this research will also help the KVIC, textile ministry, and Finance Ministry to make necessary policy changes related to khadi industry.
The results of the study will help the individual spinners entrepreneurs and self Help Groups to improve productivity and profitability of their enterprise. Decentralization of spinning mills to power driven charkha spinning at homes will flourish. Large-scale employment generation without polluting the eco system is possible.

Note

As the machinery suppliers of top arm supply in 8 spindle staff length only, the number of spindles in the charkha can be 8,16,24...etc. The 24 spindles machine will be too long and obstruct the movement in rural homes. Hence optimum size of 16 spindles charkha has been selected, as it is easy to take in and take out charkha from homes,

2.17 Limitations Of Study

However the trials indicated that at over 6500 rpm of spindle speed there was excessive thread breakage. This increased spinners work of mending the yarn breaks besides the machine had to be stopped frequently, resulting in uneconomical work after 6500 rpm. There is scope for further study in this area to analysis the performance of both machine and the quality of the raw material supplied to the machine. Broken thread suction device (pneumafil) could be designed and fixed on the spinning machine, but this was not the objective of the study.
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