DEVELOPMENT OF SUSTAINABLE PROCESSING AND WASHING TECHNIQUES IN YARN PROCESSING

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ABSTRACT

Textile wet processing sector forms the basis of end of pipe treatment like bleaching, dyeing, printing and finishing. Direct end user takes up or feed to garment manufacturing are preceded by textile processing. Unlike yarn and fabric manufacture, this segment of the industry is suffering from environmental issues like water energy (heat and steam), power, labor and effluent generation including air pollution emissions. The current environmental regulations also call for a Zero Liquid Discharge system. The fabric wet processing industries employ batch (jigger, winch, jet dyeing and beam dyeing machines) and continuous process machines (CBR, J-box). Compared to batch machines the continuous wet processing machine system often saves in process time, water, effluent, energy and power apart from added productivity. Whereas the yarn wet processing sector employs mainly open tank cabinet and cheese dyeing, manual hank, bobbins cheese package machinery as per specific needs like atmospheric or HTHP etc. As a result of this higher water effluent @ 1:3 to 1:15 M: l ratio energy power and time. Specific technology development by way of yarn package development, process machines, process method and washing to achieve sustainable textile wet processing results in yarn wet processing and washing.

Keywords: - *Zero Liquid Discharge System, CBR, Cheese Package, Process Machines*

1 INTRODUCTION

The term ‘textiles’ is derived from the Latin word “textilis” and the French word “texere” both of which means “to weave”. After food and shelter clothing is also regarded as one of the basic human necessities. Nowadays textiles have grown in such a way that other being a basic necessity they also represent the thought processes and economic status of any human. The role of pre-processing and post-processing of textile products has been very significant to the value addition of various textile goods. These treatment processes do not only generate a lot of waste but also consume a lot of power and water. Therefore the textile industry is a threat to the environment.

The raw material used in abundance in almost every process of textile wet processing is water. To add value the industry uses dyes and chemicals in huge quantities and most of these end up being the pollutants in water released as waste. The continued use of such huge quantities of water and chemicals is only compounding the problem by every

minute. This review discusses in detail how the alternative methods that have been used can help conserve water and energy. The fabrication of alternate package systems of yarn like warp frames and the use of dry heat technology will lead to sustainable processing techniques.

2 OBJECTIVES

- To develop a suitable package system of yarn like wrap frames in place of collapsible spring and perforated cheese bobbins.
- To develop a suitable vessel system with a frame holder for material and fluid medium with circulation.
- To develop dry heat approach process technology towards speedy reaction compared to heated water medium.
- To develop water substitution washing by air and vacuum application.
- To develop a suitable experimental set up to conduct a process trial of objectives 1,2,3,4 and compare with traditional methods for evaluation of various factors.

2.1. PROCESS OF YARN DYEING

In yarn dyeing, the yarns are dyed first before the fabric manufacturing stage. The yarn dyeing happens in hanks or in package dyeing. Package dyeing is a method where yarns are wound on perforated cones placed in a dye vessel. The dye solution is then alternatively passed inside out and vice versa.

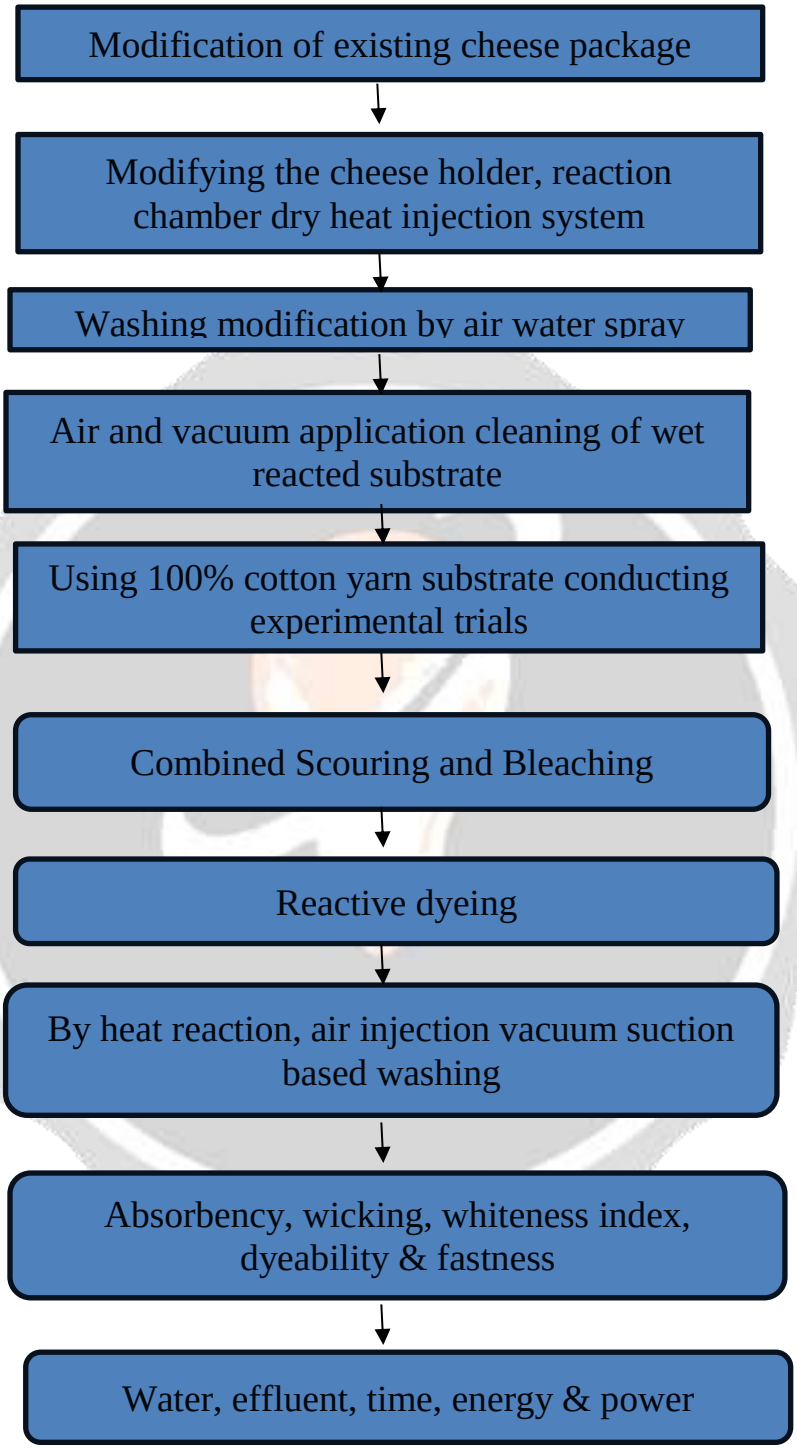
2.2 AIR PAD PRESSURIZATION

RBNV-I, as all Loris Bellini dyeing machines, is Air Padded since the beginning of the 50's. RBNV-I dyeing machine can be pressurized at 5 Bar at low liquor temperature. The relevant advantages to this solution are Lower Consumption. Only pump and carrier volumes are flooded, with reduction of liquor ratio to a minimum water, steam and power consumption. Substantial savings are realized in term of cooling water, steam and electric power. Low Emissions. The air pad operates as a double chamber to reduce heat emissions in the dye-house. NO external Expansion Tank means no emission of chemical vapors. NO external Expansion Tank means no continuous external circulation, thus liquor expansion volume realized directly into the autoclave. Dyestuff exhaustion is perfectly equalized. Air pad pressurization allows to inject dyestuffs and chemicals directly into the main liquor circuit by means of single tank or a multi tank colour-kitchen. Air Pad Pressurization allows the machine to be standard equipped with dynamic hydro-extraction device by compressed air. vat dyeing: during cotton dyeing with vat dyestuffs the dyeing liquor is not subject to a continuous oxidation by external air.

2.3 MULTIKROME DYEING PROCESS

Machine for the polychromatic dyeing of cones and bobbins. It is an innovative technology in substitution of the traditional system by needles. The result is obtained by suction of the colour from outside to inside of the package by mean of vacuum created in the printing head. Thanks to the short dyeing time, it can be used in laboratory or for production. Model for 4 colours (upon request, available up to 6 colours). Structure in stainless steel. N° 2 dyeing heads with contemporaneous utilization with the same colours. Possibility of different patterns on the two heads. It is possible to use a single head. Dyeing on any fiber or type of yarn, polyester included, on cones and bobbins. Total dyeing cycle: 1 min approx.

3 METHODOLOGY



4 MATERIALS

We have used 100% cotton yarn substrate such as $30^{s,}$ 40^{s}, and 60^{s} count for cheese winding. Stainless steel material was used for cheese dyeing vessel. Vacuum cleaner and hot air dryer gun was used for Pretreatment reaction process.

5 EXPERIMENT

Using 100% cotton yarn substrate, medium count range [30s / 40s] Bath reaction for preparation -washing, reactive dyeing - washing. Dry heat reaction study on wet chemical impregnated yarn substrate for preparation, (combined scouring and bleaching) reactive dyeing washing and finishing etc. form the basis of methodology, Further, Development of suitable experimental set up for yarn processing by way of suitable yarn holder frame, reaction chamber, dry heat injection system, washing modification by air- water spray injection, air and vacuum application for cleaning of wet reacted substrate are also part of the project. Conduction of experiments on comparative basis; laboratory bath, cheese package and experimental set up: by heat reaction, air injection, vacuum suction-based washing and finishing trials. Collection of data related to yarn preparation (absorbency, wicking, whiteness index, dye ability, fastness etc.), estimation of comparative data on water/ effluent, time energy, power, effluent characteristics are critical steps. Conclusions and machinery design suggestions for practical applications would be the end scope of this project work.

6 OUTCOMES OF THE PROJECT:

Most of the technology advancements are in the field of knit / fabric process machinery. Due to complexity of yarn form processing, not many advancements could emerge out. Based on the innovative critical thinking and clear-cut approach we are adapting in this project work, the successful outcome can lead to new avenues on major water/effluent, time, energy, and power savings towards sustainable yarn wet processing.

7 CONCLUSION:

Primly as per project objectives design configuration of elliptical based larger area yarn frame instead of cheese was conceived. The M: L ratio of the package process system was reduced by insertion of volume reduction spacer. We had actually constructed a proto model using low cost iron wire and found that such a frame is feasible for fabrication. The overall design of new frame wire package, inner spacer with fluid, air circulation, base outer vessel cover, additional options like air, vacuum, water circulation entries were drafted. Sourcing for suitable SS wire, hot air blower and fabrication support we could study the market availability of product options, price and best effective choice for experimental equipment design required were a bit unclear.

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