

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Mecánica

Tesis

**Design of an Ovine Fiber Carding and Spinning
Machine to Enhance Yarn Quality and Production in
High Andean Areas of Peru**

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Design of an Ovine Fiber Carding and Spinning Machine to Enhance Yarn Quality and Production in High Andean Areas of Peru

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Abstract—The objective of this paper was to design a carding and spinning machine for ovine fiber to enhance the quality in the production of yarns according to the demand of the textile market at a family level. For the development of this research work, the analysis of the state of technology of the machine was developed, then the tasks were classified by means of a list of requirements of the families dedicated to the textile industry in the high Andean zones of Peru, in order to determine the functions of the machine and to arrive at a viable solution both technically and economically. The results of the machine design were determined for yarn production at a family level of 6.12 kg/day increasing by 4.2% with respect to the artisanal production, which is 5.87 kg/day. Regarding the carding process a single-phase electric motor of 0.4 hp with 1745 RPM at a transmission ratio of 3.1/1 and for the spinning process a single-phase electric motor of 0.3 hp with 1500 RPM at a transmission ratio of 2.3/1 in order to maintain the properties of the ovine fiber so as to obtain yarn with a tensile strength between 30 to 50 Newton per Kilotex.

Keywords—*design, carding, spinning, ovine fiber*

I. INTRODUCTION

The purpose of this paper was to design a carding and spinning machine for ovine fiber to improve the quality and production of yarn in the high Andean areas of Peru. According to the Ministry of Agrarian Development and Irrigation, the regions of Puno, Junín, Cusco, Pasco and La Libertad are the main producers of ovine wool and it is their principal source of economy producing 7803 tons of ovine yarn annually in Peru. [1]. According to the technical report of the National Institute of Statistics and Informatics, yarn production demand in November 2020 increased by 1.9 % in comparison to the year 2019 [2]. The use of the artisan spinning method and the use of wool carding machines affect the quality and production of yarns, since performing these processes separately requires a longer production time [3]. The production of ovine fiber yarn which is elaborated at a family level presents large shortcomings regarding quality, since spinning it in a conventional way with the spindle that consists of twisting the wool fibers does not meet the necessary parameters for the production of ovine fiber yarns, as a result of which the fiber is sold as raw material at a minimum economic remuneration [3].

The main factor in maintaining yarn quality is mainly the uniformity of fiber distributions as this directly influences the mechanical, aesthetic and functional properties of textile products [4]. Reducing the hairiness of the fiber has significant effects, and those are increasing the abrasion resistance and improving the uniformity of the fabric. To effectively reduce yarn hairiness the thickness of the combing should be around $10 \text{ mm} \pm 1.00$ [5].

II. MATERIALS AND METHODS

The development of the solution of this research work was based on an analysis of the technological status of the machine. The tasks were classified by means of a list of market requirements along with the families engaged in the textile industry in the high Andean areas of Peru. Thus, the functions and structures of the machine were determined and then different possible solutions were obtained, which through an evaluation both technically and economically it was possible to obtain a viable main solution and the key functions for the design were obtained. Those were mathematical analysis, simulations, and the design of the carding and spinning machine for sheep fiber [6].

A. Methodology

1) State of the art

The carding machine especially for the combing of long fibers such as those of sheep, was published in the European Patent Commission where it is stated that the combing of long fibers must be maintained at a homogeneous tension and at a specific length of the fiber strand [7]. To achieve that, such machine has a combing roller mechanism where the fiber tension is controlled and thus the correct combing of the wool fibers is performed taking into account the quality standards for textile production, therefore the objective of the invention of the machine was to maintain a homogeneous tension and an adequate specific length of the fiber, obtaining as a result the tension of the fiber must be greater than 50 Newton per Kilotex (N/ktex) and the length of the wool wick has to be from 6 to 18.5 cm [7].