Lasers application for processing of waste products of textile and clothing industry

E S Ershova, Yu V Martynenko
Moscow Region State University, 24 Vera Voloshina St., Mytishi, 141014, Russia
e-mail erschova.t2012@yandex.ru

Abstract. This article identifies the need for active implementation and application of waste-free and low-cost industries and substantiates the need for active implementation of the latest technologies for processing light industry waste. The article discusses the possibilities of using laser machines in the process of processing textile materials from synthetic and artificial fibers and the artistic processing of waste products from the textile and clothing industry.

1. Introduction
A problem of environment pollution is an urgent task worldwide including Russia. The polluting activities of large industrial enterprises including light industry enterprises (textile and clothing) are becoming the main negative factor affecting the alarming environmental situation. We propose a laser technology for recycling the sewing production waste.

2. Description of the research
More than 7 billion tons of textile waste is accumulated in the Russian Federation annually, about 80 million tons of solid textile waste, including more than 1.7 million tons of toxic industrial waste (toxic waste from the textile industry), is generated in landfills, dumps. Every year this amount grows by about 120 million tons [1]. As a result of the small use of technology for processing textile waste, which results in recycling products that can be used as secondary raw materials huge losses take place in the industry. Besides good yield, low cost out technology has a social impact. The lack of necessary equipment that is needed for the processing of textile waste, as well as special capacities, makes it impossible to return useful fractions of textile waste into circulation. Currently, only 22% of industrial textile waste is recycled, and only 3.5% totally. Comparing the world experience (countries of the Western Europe, USA, Japan) in the processing of textile and clothing industry wastes, we can conclude that Russia needs for sampling and recycling of these wastes [6].

The purpose of the study: to develop non-traditional technologies for the processing of garment waste, which can be used in the process of training future teachers of technological education and for solving environmental and socially significant problems.

That is why in accordance with the purpose, object, subject and hypothesis, the following research tasks are defined:

1. To study the problem of recycling and recycling of textile industry waste world-wide and in the Moscow Region;
2. To develop (propose) non-traditional technologies for the processing of industrial waste (waste from sewing enterprises) a methodology for teaching technology to future technology teachers.

It is very important to actively develop and use non-waste and low-cost industries that can reduce the amount of industrial textile waste (yarn fibers, threads, flaps, scraps of textile materials and various
associated waste products). The active use of these technologies will significantly reduce the harmful effects on the environment as a whole. Currently, the utilization of textile and clothing industry industrial waste in the Moscow Region is of particular relevance. At many points in the Moscow Region, forced closure of landfills took place, to which textile waste was actively collected, which led to a “garbage collapse” in the region. The construction of new modern landfills in the suburbs does not compensate for the retirement of once available capacities. An active solution to these acute problems for the region allows us to think about adopting new, cost-effective non-standard solutions [8]. Currently, with the support of the Government of the Moscow Region, various projects are being implemented, including projects related to volunteer movements to solve the environmental problems of our region. The development of various volunteer movements was made possible thanks to the active consecration in the media and popularization among the population of this sphere of activity in all areas of life in our country. Thanks to the support of the Government of the Moscow Region, volunteer movements related to solving environmental problems have turned from a rare phenomenon into a dynamic social trend that covers not only the region, but also is penetrating to clear regions and countries. Volunteer disinterested voluntary activity has become an important tool for solving significant environmental, social and economic problems of the Moscow region.

Most of the participants in the volunteer movements of the Moscow region for various types of activities are student communities. Students and pedagogical universities who are preparing for further pedagogical activity are more actively involved in various volunteer movements. Future technology teachers have ample opportunity to apply their professional competencies to implement interesting and useful environmental, social projects [2]. Students and teachers of the Faculty of Technology and Entrepreneurship of the MRSU are currently actively involved in volunteer activities for the implementation of social projects in the Moscow region [7]. Volunteering can be expanded through participation in projects (volunteer movements) related to environmental issues. So, for example, in the framework of the social project “We Together”, students of the Faculty of Technology and Entrepreneurship became the organizers of charity fairs at which they sold products made from waste products from sewing enterprises in the Moscow Region. This project started in 2017 and achieved positive results - real financial assistance needed for the treatment and rehabilitation of one of the former students of our university [4]. During the preparation of garment waste products for charity fairs, students studied the problems of textile and clothing industry waste management, which generally focused on the social, environmental and economic importance of issues related to the study and widespread adoption of textile waste processing technologies in the Moscow Region. A lot of work has been done to study the various types of products for the excretion of textile waste - regenerated fibers, which can be used for the manufacture of products for fairs [3]. Students proposed a technology for creating toys based on regenerated fibers. At the same time, students developed artistic images of toys that they represented in sketches [5]. Positive experience in the development of new technologies for creating products from textile waste, gave prerequisites for further research - the search for new ways in the use of new non-traditional technologies for processing waste from the textile and clothing industry. At the junction of the above two urgent problems, we identified the following scientific research problem: “Development of non-traditional technologies for processing industrial waste (artistic processing of waste products from textile and clothing industry) to solve the environmental and social problems of the Moscow Region”.

Our task is to find methods of non-traditional technologies for processing textile materials from synthetic and artificial fibers that are least processed, to find ways to use the resulting processing products for further use in the artistic processing of various materials (including inter-lexical garment industry waste). Materials from synthetic and artificial fibers will serve as the basis for the manufacture of working threads for the technology of "Sewing ribbons." The manufacture of working threads is supposed to be performed on laser machines. The laser beam, touching the surface of the fabric, heats it, causing instant evaporation, and quickly cuts the surface. For experimental work, various types of textile materials made of synthetic and artificial fibers will be selected and the most suitable parameters to be set will be selected [https://gistroy.ru/fabric].

The object of the research is the development of lazer technologies for the artistic processing of the waste products of textile and clothing industry used in economically and socially significant projects of volunteer assistance to needy citizens.
The subject of the study is the development of technologies for processing industrial waste (including artistic processing of waste products from textile and clothing industry).

Research hypothesis: it is assumed that if using of electronic and lazer technologies for processing waste products from the textile and clothing industry are developed, then the processing cost will be reduced the final product quality will be enhanced waste from the textile industry of garment enterprises in the will increase. Besides solution of this problem has the social impact: the training of future teachers of technological education will be activated through the use of recycling products in the manufacture of products sold in student volunteer movements.

The methodological basis of the study was the scientific work of domestic and foreign scientists in the field of developing non-traditional technologies for the processing of industrial waste (waste from sewing enterprises) used in the process of training future teachers of technological education in the implementation of project activities of university students. In the course of the study, the following methods were used: study and theoretical analysis of psychological, pedagogical, technological and methodological literature. As methods, general and particular methods were used, including systemic, problematic and others, systematic analysis of the phenomena and results under study.

The scientific novelty of the work is as follows:

1. On the basis of a comprehensive study of the problems of recycling and reuse of textile and clothing industry wastes across the Region of the Moscow Region, propose the development of non-traditional technologies for the processing of these groups of industrial wastes and a methodology for teaching technology to future technology teachers;

2. Experimentally verify the effectiveness of the proposed unconventional technologies for processing textile and clothing industry wastes in the process of teaching future technology teachers these technologies and in the process of implementing student volunteer movements in the Moscow Region.

The practical significance of the work is determined by the fact that the developed non-traditional technologies for processing waste from the textile and clothing industries will be widely used in the implementation of social projects in the Moscow Region.

The base of the study. Pilot work is carried out on the basis of the Faculty of Technology and Entrepreneurship of Moscow Regional State University (Mytishchi).

On the basis of a comprehensive study of the problems of recycling and recycling industrial waste, non-traditional technologies have been developed for the processing of textile and clothing industry waste - from materials containing synthetic and artificial fibers. Ways were proposed for using the resulting processed products for their further use in the artistic processing of various materials. The process of processing garment waste was the manufacture of the working material necessary for further use for embroidery with ribbons. Production of the working material was carried out on laser machines. The manufacturing technology of the working material was carried out according to the principle of cutting inter-lexical waste from synthetic and artificial fibers into thin strips. When cutting waste, the laser beam of the machine, touching the surface of the fabric, heated it, leading to instant evaporation and rapid cutting of the surface. At the same time, fiber-free edges were formed on the slices of the cut strips, which are important in the further use of the working material in the manufacturing process of embroidered products. When preparing the working material for embroidery, the optimal laser machine power was chosen, which was 60%, while the cutting speed was 40 mm. per second. For the experimental work, we selected the most suitable types of textile materials from synthetic and artificial fibers for the fiber composition, and the most suitable exposed parameters of the laser machine were selected, which made it possible to obtain the best quality edges of the working material.

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